DELHI AVIATION FUEL FACILITY PRIVATE LIMITED
AVIATION FUELLING STATION
SHAHBHAD MOHAMMADPUR
IGI AIRPORT
NEW DELHI-110061

TENDER NO: DAFFPL/MOD/FF/2017-18/21

INVITING BIDS FOR TERMINAL AUTOMATION

BID DUE DATE & TIME: 1500 Hrs. IST on 02nd April 2018

OPENING OF TECHNICAL BIDS: 1100 Hrs. IST on 03rd April 2018

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Sign & Stamp of Bidder

Contents

NOTE: BIDDERS ARE REQUESTED TO SIGN AND STAMP ALL THE PAGES OF THE TENDER DOCUMENT AND SEND THE SAME BACK IN THEIR OFFER AS A TOKEN OF UNCONDITIONAL ACCEPTANCE OF TENDER FIRMS.

THE DEVIATIONS, IF ANY, SHOULD BE MENTIONED SEPARATELY ON BIDDER‟S LETTER HEAD IN TECHNICAL BID. THE DEVIATIONS MENTIONED ANYWHERE ELSE SHALL NOT BE CONSIDERED. IN ABSENCE OF DEVIATION SHEET IT WOULD BE CONCLUDED THAT BIDDER HAS ACCEPTED THE TENDER TERMS WITHOUT ANY DEVIATIONS. CORRECTIONS IN TENDER DOCUMENT WILL NOT BE ACCEPTED.

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DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

TENDER NOTICE
DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

INVITING BIDS FOR TERMINAL AUTOMATION AS PER SPECIFICATIONS

TENDER NO: DAFFPL/MOD/FF/2017-18/21

Delhi Aviation Fuel Facility (P) Ltd (DAFFPL) invites sealed bids under single stage two bid system from eligible bidders for terminal automation as per the specification given in the document.

Brief Scope of work:

We intends to provide terminal automation as per specification as required. Scope includes supply, erection, testing and commissioning shall include design, engineering, manufacture/procurement, assembly, shop testing, inspection at works & at site; Factory acceptance tests, painting; packing; transportation to site, unloading, storage, erection, testing, calibration, pre commissioning, commissioning, training, site / final acceptance test, final handing over of the complete system of instrument / equipment and all associated hardware, as required in all respects for completeness & satisfactory stable operation of the terminal for instrumentation & automation system.

Bid Security (EMD):	As mentioned in the Tender document
Date, Time & Venue for Voluntary Pre-bid Meeting:	20th March 2018 @ 15:00 HRS (IST) at DAFFPL, Aviation Fuelling Station, Shahabad Mohammadpur, New Delhi-110061
Bid Due Date, Time & Place of Submission:	Upto 15:00 HRS (IST) on 02nd April 2018 at the office of the Chief Executive Officer, DAFFPL, Aviation Fuelling Station, Shahabad Mohammadpur, New Delhi

Detailed Invitation for Bids (IFB) along with Pre-qualification Criteria, Bid Document Corrigenda can be viewed and downloaded from DAFFPL's website: **http://www.daffpl.in**

Chief Financial Officer
DAFFPL, New Delhi
9920819995

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CHAPTER 1: INTRODUCTION (COVERING NOTE)

Delhi Aviation Fuel Facility Private Limited (DAFFPL) is a Joint Venture comprising Indian Oil Corporation Ltd. (IOCL), Bharat Petroleum Corporation Ltd. (BPCL), and Delhi International Airport (P.) Ltd. (DIAL). We provides the infrastructure aimed at ensuring an uninterrupted flow of Aviation Turbine Fuel (ATF) to all type of aircrafts at the Indira Gandhi International Airport, New Delhi (IGI Airport) as per international benchmarking.

The bidder/ contractor shall refer to various sections of this tender document for detailed scope of work. It is contractor's responsibility to execute the job in all respects as per detailed drawings, documents / specification furnished by consultant / owner and as per applicable codes, standards & in line of statutory requirements.

The field circumstances shall also be taken into consideration and methods suitable to the site conditions shall be adopted with concurrence of the Engineer-in-charge and in line with manuals, instructions of respective equipment and specified codes and standards. The successful accomplishment of the project is greatly influenced by the team work, workmanship of the workers and supervisors.

The Contractor shall employ only such workers and supervisors who have considerable experience of similar work and who can work, temperamentally in good harmony and co-operation.

Delhi Aviation Fuel Facility Private Limited (DAFFPL) invites sealed tenders in prescribed tender form under two-bid system. For viewing details including EMD, BID QUALIFICATION CRITERIA etc. please visit our web site www.daffpl.in and go to tender section by clicking the link "Tenders". Tender documents are available on our website.

The bid documents can also be collected from our office and the bids are to be submitted in Physical form in the Tender Box kept at the office of the **Delhi Aviation Fuel Facility Private Limited (DAFFPL)** at Shahabad Mohammadpur, New Delhi-110061, India.

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1. The Tender is floated in Two Bid system consisting of Technical Bids (Bid Qualification Criteria - BQC, Technical plus Commercial) and Price Bids.

   Part-I : Bid Security / EMD in accordance with tender document.
   Part-II : BQC (Bid qualification criteria), Technical & commercial Bid, duly filled in & along with all supporting as requested to be submitted in Physical form in the Tender Box.
   Part –III : Price Bid.

2. The bidder should be able to construct the entire size/type/quantity bidded by them. Bidders cannot bid for part items or part quantity.

3. Firstly the Technical bid (BQC & Techno commercial bids) shall be opened. The Bids shall be initially scrutinized by a team as per tender requirements of BQC (Bid qualification criteria). Technical cum commercial bids of only those vendors who qualify the BQC will be processed further. The price bids of only techno-commercially qualified bidders will be opened, evaluated and shortlisted for Placement of Work Order.

4. Each page of bid documents is to be duly signed & stamped by the bidder before submitting the Tender.

5. The bids submitted should be valid for **Four months** from the due date of bid submission for Owners acceptance. Once accepted it will remain firm till completion of contracts/orders.

6. We request the bidder to carefully go through all tender documents before submitting the offer. Please note that any exceptions or deviations to the tender document are necessarily to be recorded in the attached deviation statement only. Any exceptions/deviations brought out elsewhere in the bid shall not be considered.

7. The bidders may be invited for a presentation to DAFFPL during Techno-commercial evaluation before price bid opening.

8. The bidders to provide their bank details/ PAN / Sales Tax /WCT Registration numbers/Goods & Service Tax Registration No. / VAT registration No., as applicable for updating vendor master file. You are also requested to keep us informed of any change in address / status of your business / contact details including email address etc.

9. Party can quote with the deviations as referred in Point No.6 above. Please refer query end date / time in tender calendar after which no query posted by bidder

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shall be considered. However DAFFPL reserves the right to respond the queries after cutoff date / time mentioned in tender calendar.

10. Please note that queries related to scope of job, tender specifications, terms & conditions etc., should be submitted by means of letter/E mail to reach the owner's office not later than one week before the meeting .It may not be practicable to answer queries received late, but queries and responses/clarifications will be posted in the form letter, E-mail within one week from the date of Pre Bid Meeting. Any modification in the bid document that may become necessary as a result of the Pre Bid meeting shall be made by the owner exclusively through the issues of corrigendum/ addendum posted at web site and not through the minutes of the pre bid meeting.

11. UNSOLICITED POST BID MODIFICATION
Bidders are advised to quote strictly as per terms and conditions of the Bidding Document. After tender submission due date & time/ extended due date & time (as the case may be) the bidders shall not make any subsequent price changes, whether resulting or arising out of any technical / commercial clarifications sought/allowed on any deviations or exceptions mentioned in the bid unless discussed and agreed by DAFFPL in writing.

12. EMD & Techno Commercial bid shall be opened on **03rd April 2018 at 11:00 Hrs (IST)** in the presence of authorized representative of bidders (Restricted to one [1] person per bidder only) at the office of DAFFPL. Price Bid of only those bidders whose offer is found meeting both BQC & techno-commercially acceptable, shall be opened on a later date as per convenience of DAFFPL after intimation to the qualified bidders.

13. DAFFPL reserves the right to accept any tender in whole or in part or reject any or all tenders without assigning any reason. DAFFPL reserves right to accept any or more tenders in part. Decision of DAFFPL in this regard shall be final and binding on the bidder.

    QUERIES AND CLARIFICATIONS: Any query or clarification with regard to this tender may please be referred to below address & phone nos. on any working day during office working hours

Mr M Vishnu Vardhan Project Officer Vishnu.vardhan@daffpl.in, manish.kumar@daffpl.in 8826000228, 9810640818	Mr Harshit (Project Consultant) Harshit.Mamtora@mottmac.com +91 (0)79 2657 5550 (Sbd) +91 (0)79 3041 5374

14. GOVERNING LAWS: The laws of Union of India shall govern all matters concerning the tender. Any issue arising related to the tender or the selection process shall be adjudged by the courts in Delhi alone.

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15. A Pre-bid meeting is scheduled for **20th March 2018 at 15:00 Hrs IST** at the office of DAFFPL, New Delhi. All prospective bidders can participate in the same. Any clarification with regard to tender shall be sorted out during the pre-bid meeting.
    a. The purpose of the pre-bid meeting is to clarify any doubts of the BIDDER on the interpretation of the provisions of tender.
    b. Bidder(s) are requested to submit their queries, mentioning form name, clause no. & clause, by a letter / e-mail to our office as per schedule in order to have fruitful discussions during the meeting.
    c. All the Bidder(s) are requested to attend the pre-bid meeting to be held at DAFFPL Office as per schedule.

16. **Tender document can be purchased from our office located at Shahabad Mohammadpur at a cost of Rs 1000/- and also can be downloaded from our website www.daffpl.in.**

    - **A bidder who downloads the document from website has to submit a separate DD for an amount of Rs.1000/- along with the EMD document.**
    - **Bidders who purchase the document from our office have to submit a DD for an amount of Rs.1000/- at the time of purchase.**

17. **Earnest Money Deposit (EMD) (also referred to as Bid Security):** Bidder shall be required to submit the Earnest Money Deposit (EMD), either in the form of Bank guarantee as per format (provided as Annexure) or PAY ORDER or BANK DRAFT (in favour of Delhi Aviation Fuel Facility Private Limited, payable at New Delhi) at our office. The EMD in either form has to be submitted on or before the due date & due time of bid submission of this tender with a covering note mentioning the tender no.

    a. The bidders not submitting EMD by due time & date shall be rejected & their bids shall not be evaluated further.
    b. **The EMD amount shall be 1.0 Lakhs INR**
    c. Firms registered with National Small scale Industries (NSIC)/MSME of India are exempted from submission of bid security. Central Public Sector Enterprises of India and Firms registered with Nation Small Scale Industries Corporation (NSIC) of India are exempted from submission of Bid Security. Central Public Sector Enterprises are requested to give a self-declaration on their letter head to this effect. Bidders registered with NSIC of India are also requested to submit self-declaration on their letter head to this effect along with a copy of their Valid Registration certificate, specifying limit of volume and other details which should be submitted.

18. **Site Restriction:** The job has to be done in licensed area which is inside the premises of DAFFPL Fuel Facility. Successful bidder will have to follow all the security norms and procedures for entry and exit to the facility. The job timings will

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Sign & Stamp of Bidder

have to change as per the permissions obtained from Operation Dept. All the entry procedures for labours / machinery / raw materials as per the rules of the DAFFPL will have to be followed by the vendor. Contractor shall visit the site and ensure familiarity with the working condition / limitation at the site. Also the entire works are to be carried out in an operating Location. The contractor may have to follow the timings of the facility and have to work under restricted conditions. The normal working hours of plants is 0930 Hrs to 1800 Hrs on Monday to Saturday except holidays. Working beyond above normal working hours / holidays/ Sundays are to be with prior permission of Engineer in charge and relevant facility officers. Contractor is required to plan his work within the normal working hours and days and accordingly he has to mobilize the resources to complete the job within the scheduled time. However all efforts will be made by DAFFPL to give extended working time beyond normal working time in order to help the contractor for early completion of the job. No additional payment / charges shall be payable for such works. Not getting permission for working on holidays/ Sundays or beyond normal working hours will not be considered as reason for delay in work. The contractor and his personnel have to obey all rules and regulations of the plant. Trained and experienced supervisor/ engineer are required to be present at the work spot always.

All hot work like welding, cutting, grinding etc. needs to be done in the closed booth of asbestos cloth. No extra claim on account of the same will be considered. Also the shutdown jobs may get delayed due to operational requirement. Any extra claims on account of the same will not be entertained.

The tenderer must visit the site of the tender and familiarize himself with location, operating / working conditions as well as any other local factors which could influence the working before quoting for the job. His quote should take care of any such restrictions; conditions etc and any claim afterwards will not be entertained. **It is suggested that the Tenderer must visit the site in order to have a better idea of site conditions and factors.**

19. **Water: Contactor shall arrange the supply of Water for Construction.**

20. **Power: Power required for this work shall be arranged by CONTRACTOR only.**

21. **Completion Time:** Time is the essence of the contract. The time period of contract is **24 (Twenty Four) months** from the date of Letter of Intent including monsoon period. **The time includes necessary time required for mobilizations and demobilizations after the execution of work and includes monsoon period.** Successful bidder is required to provide a bar chart /schedule showing the activities/events with time along with the Technical bid to be scheduled accordingly.

Sign & Stamp of Bidder

22. The work is required to be done in a working/operating location, the party has to get necessary Hot/cold work permits from the concerned officer in plant as per OISD standards and all workmen should be provided with necessary safety helmet, safety belts, safety shoes and other standard safety equipment's. Any delay on account of non-adherence to safety norms, rules and regulations of plant as well as obtaining work permits from the plant shall not be accounted for the delay in completion of job.

23. **Receipt & storage of material at Site**: Contractor is required to make his own arrangement for unloading and storage of materials at site. Contractor is required to inform us prior to dispatch of materials and his representative required to be available for receipt and unloading of materials at site.

24. The successful vendor has to arrange and submit to fuel facility the proper POLICE VERIFICATION DOCUMENTS of all the labours, site in charges, supervisors, welders, grinders and all associated workmen who will be coming inside the terminal for carrying out related jobs.

25. For carrying out the jobs inside the depot the vendor has to arrange for electricity (sufficient nos. of acoustic DG sets), working water, associated tools, tackles, manpower, machinery of his own and no extra payment will be made to vendor on account of the same.

26. For arranging the electricity vendor to note that only Acoustic Proof, box type DG sets will be allowed inside the depot premises. Vendor to also note that proper GI plate type earthing system as per IS 3042 (LATEST) has to be provided by the vendor for DG set and no extra payment will be done for the same. There should be two nos. earthing system connected in a grid at a location as instructed by DAFFPL site in-charge

27. All the debris, scrap, cut pieces, etc coming out of fabricated plates, excavated earth, area cleaning will have to be shifted by the vendor to a location inside or outside the terminal premises as per the instruction of DAFFPL site in-charge and no extra payment will be done for the same.

THE FORMS /ATTACHMENTS TO THIS TENDER ARE AS UNDER:

1. Covering Note – CHAPTER: 1
2. Instructions To Bidders - CHAPTER: 2

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Sign & Stamp of Bidder

3. Bid-Qualification Criteria - CHAPTER: 3
4. Performance of Work – CHAPTER: 4
5. General Purchase Conditions- CHAPTER: 5
6. Technical Specification Documents - **(Attached separately as Annexure I)**
7. Annexure attached are as follows:
   - Annexure II – DEVIATION SHEET
   - Annexure III – DECLARATION SHEET
   - Annexure IV – FORMAT FOR DRAFT BANK GUARANTEE IN LIEU OF BID SECURITY (EMD)
   - Annexure V - FORMAT DRAFT COMPOSITE BANK GUARANTEE FOR SECURITY DEPOSIT/PERFORMANCE GUARANTEE
   - Annexure VI – FORM OF LETTER OF UNDERTAKING
   - Annexure VII – DECLARATION TO BE SUBMITTED ALONGWITH Technical BID
   - Price Bid

Thanking you,
Yours faithfully,
For DELHI AVIATION FUEL FACILITY (P) LTD.

Chief Financial Officer
DAFFPL, New Delhi

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CHAPTER 2: INSTRUCTIONS TO BIDDERS

1. The bidder shall bear all costs associated with the preparation and submission of the bid and Owner will in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

2. Bidder is requested to submit their bids taking full notice of all the technical specifications, terms and conditions, forms & attachments to this tender. Bids must be submitted in Physical form only.

3. Owner reserves the right to accept / reject any or all bid qualification documents at their sole discretion without assigning any reason whatsoever.

4. Owner is not responsible for any delays from bidder end.

5. Owner reserves the right to make any changes in terms and conditions of purchase before due date of bid submission and to reject any or all bids received incomplete.

6. Undertaking by the bidder:
    a. I/we hereby undertake that the statements made herein/information given in the bids through Physical Tendering system/annexure/forms referred are true in all respects and that in the event of any such statement or information being found to be incorrect in any particular, the same may be construed to be a misrepresentation entitling DAFFPL to avoid any resultant contract.
    b. I/we further undertake as and when called upon by DAFFPL to produce, for its inspection, original(s) of the document(s) of which copies have been annexed hereto.

7. Owner, at its discretion reserves the right to verify information submitted by the bidders.

8. Bidder to submit documents/information to satisfy the bid qualification criteria. Bidders should also be in a position to produce further information as and when required by DAFFPL with in a time limit of 15 days.

9. DAFFPL reserves their right to negotiate the quoted prices with lowest bidder.

10. Bidders would be qualified based on data and documents submitted by them.

11. Owner's decision on any matter regarding short listing of vendors shall be final and no corresponding in this regards will be entertained.

12. The vendors who are on IOCL/BPCL/DIAL holiday list or delisted will not be

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considered.

13. The bidder is expected to examine all instructions, forms, attachments, terms and specifications in the tender document. The entire tender document together with all its attachments thereto, shall be considered to be read, understood and accepted by the bidder, unless deviations are specifically stated seriatim by the bidder. Failure to furnish all information required in the tender document or submission of a bid not substantially responsive to the tender documents in every respect will be at bidder risk and may result in the rejection of his bid. The bidder scope of supplies as specified in the material requisition shall be in strict compliance with the scope detailed therein and in the bid document.

14. Bidders in their own interest shall ensure that they submit their bid, complete in all respects, well within the specified bid due date and time. No relaxation shall be given for delay due to any unforeseen event in submission of bid.

15. At any time prior to the bid due date, we may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the bid document. The amendment will be notified through our portal www.daffpl.in to all prospective bidders and will be binding on them. In order to afford prospective bidder, reasonable time in which to take the amendment into account in preparing their bids, we may, at our discretion, extend the bid due date.

16. The bid prepared by the bidder and all correspondence/ drawings and documents relating to the bid exchanged by bidder and the owner shall be written in ENGLISH language, provided that any printed literature furnished by the bidder may be written in another language so long as accompanied by an ENGLISH translation, in which case, for the purpose of interpretation of the bid, the ENGLISH translation shall govern.

17. Declaration with the bid qualification criteria that bidder has not been banned or delisted by any Government or quasi Government agencies or Public Sector Undertaking (PSU) as per declaration format (provided as annexure) of the tender document should be submitted along with the bid.

18. Bidders are advised to submit bids based strictly on the terms & conditions and specifications contained in the tender document and not to stipulate any deviations. Each Bidder shall submit only one bid. A Bidder who submits more than one bid will be rejected. Alternative bids will not be accepted.

19. The Owner may, at its discretion, extend the bid due date, in which case all rights and obligations of the Owner and the Bidders, previously subject to the bid due date, shall thereafter be subject to the new bid due date as extended. The same will be hosted in the web site.

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20. Bids shall be kept valid for 4 months from the bid due date. A bid valid for a shorter period shall be considered as non-responsive and rejected by the Owner. Notwithstanding above, the Owner may solicit the Bidder consent to an extension of the period of bid validity. The request and the responses thereto shall be made in writing. The EMD (bid security) shall also be accordingly extended.

21. Telex/ Telegraphic/ Telefax / E-mail offers will not be considered and shall be rejected.

22. No bid shall be modified subsequent to the due date & time or extension, if any, for submission of bids. Bidder(s) to note that Price changes after submission of bid shall not be allowed. In case any bidder gives revised prices/price implication, his bid shall be rejected. No bid shall be allowed to be withdrawn in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder. Withdrawal of a bid during this interval shall result in the forfeiture of Bidder s EMD.

23. Bids that do not meet the Bid qualification criteria as specified in the bid document shall be rejected. A bid with incomplete scope of work and/or which does not meet the technical requirements as specified in the bid document, shall be considered as non-responsive and rejected. Conditional bids will be liable for rejection.

24. The Owner will examine the bids to determine whether they are complete, whether any computational errors have been made, whether the documents have been properly signed and whether the bids are generally in order.

25. The bids without requisite EMD and/or not in the prescribed Performa and the time limit will not be considered and bids of such bidder(s) shall be rejected.

26. PRICE EVALUATION CRITERIA: As award is on overall landed lowest basis, part offers will be rejected. Bidder has to quote for all items in a lot for us to consider them.

27. Prior to the expiration of period of bid validity, the owner will notify the successful bidder in writing or by e-mail, that his bid has been accepted. The Notification of Award will constitute the formation of the Contract. Delivery Period shall be counted from the date of notification of award (Letter/Fax/e-mail of Intent).

28. Any efforts by a bidder to influence the owner/ in the owner bid evaluation, bid comparison or contract award decisions may result in the rejection of their bid.

29. ISSUE OF CONTRACT/ PURCHASE ORDER: After the successful bidder has been notified that his bid has been accepted, DAFFPL will send to such bidder a detailed contract/purchase order incorporating all the terms and conditions agreed

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between the parties. Within 15 days of receipt of the detailed purchase order, the bidder shall sign and return to the owner the duplicate copy of the order as a token of their acknowledgement.

30. Vigil Mechanism: DAFFPL has developed the Vigil Mechanism to deal with references/ grievances, if any, that is received from bidders who participated / intends to participate in the tender. The details of the same are available on our website www.daffpl.in

31. VERIFICATION BY OWNER: All statements submitted by bidder regarding experience, manpower availability, equipment and machinery availability etc., are subject to verification by the owner either before placement of order or after placement of order. If any data submitted by the bidder at the bid stage is found to be incorrect, the offer is liable to be rejected or the contract/order is liable to be terminated.

32. SEALING & MARKING OF BIDS

A. Bids shall be submitted separately in THREE SECTIONS in sealed envelopes superscribed with the Bid Document number, bid due date and time, item and nature of bid as under:

- **SECTION - I (Envelope No. 1): Bid Security / EMD:**
  Bid security in accordance with tender document.

- **SECTION - II (Envelope No. 2): Technical Bid:**
  a. Information and documentary evidence establishing bidder's claim for meeting qualification criteria as stipulated in IFB. This section/envelope should necessarily contain all the required back-up documents for Bid Qualification.
  b. Technical bid complete with all technical and commercial details, covering letter and un-priced copy of price Schedule with prices substituted with 'QUOTED' or 'NOT QUOTED' or 'NOT APPLICABLE'. **Deviation sheet duly filled with deviations, if any, shall form part of technical bid.**

- **SECTION - III (Envelope No. 3): Price Bid:**

  a. PRICE BID WITH FULL PRICE DETAILS. The price bid shall contain prices only in the prescribed price schedule formats, without any technical and commercial details. Technical specifications or commercial terms given in unpriced schedule will only be evaluated and the same will be binding on the Bidder. The bids shall be sealed and kept in a single envelope with marking as Section - III (Price Bid) /

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Envelope No. 3 : "Original'

b. The bidder shall quote the final prices (including taxes, Cess, duties and other levies etc) in the 'PRICE SCHEDULE FORMAT' of bid document ONLY. Prices quoted in any other format shall not be considered for evaluation.
c. The Price bid shall be kept in a larger envelope duly sealed and shall bear the name and address of the bidder.

B. The envelopes containing Section -I, Section -II, Section -III of bid shall be enclosed in a larger envelope duly sealed and pasted and shall bear the name and address of the bidder.
C. Bidder to note that if bid security / EMD (in the Proforma attached with these documents) in original and/or bid document fee (if the bid document is downloaded) is kept in any other envelope and not found in envelope no. 1, the offer of the bidder(s) will be REJECTED during opening.
D. Bidder to note that prices are to be quoted in the format provided in the price schedule formats provided along with the tender without any conditions. Price bids submitted in any other format and conditional price bids will be liable to be rejected. Price bids received in open condition (not in sealed envelope) or kept in any other Section of the bid (i. e, Section - I or II) will also be liable for rejection.
E. If the outer envelope is not sealed and not marked as required, then DAFFPL will assume no responsibility for the bid's misplacement or premature opening.
F. Bidders in their own interest shall ensure that they send their bid complete in all respects well in time to reach the specified office within the specified bid due date and time. No relaxation shall be given for delay due to any unforeseen event in submission of bid.
G. Central Public Sector Enterprises and Firms registered with NSIC are exempted from submission of Bid Security. Central Public Sector Enterprises are requested to give a self declaration on their letter head to this effect, which should be submitted in a sealed envelope marked as Bid Security.
H. Bidders registered with NSIC are also requested to submit self declaration on their letter head to this effect along with a copy of their Valid Registration certificate, specifying limit of volume and other details which should be submitted in a separate sealed envelope no. 1 marked as Bid security.
I. Bid Security strictly in the Proforma attached with these documents shall be submitted in Original along with the Bid. Bids received without original bid security, shall not be opened for evaluation.
J. Tender document complete in all respects must be submitted in the tender box provided at the DAFFPL office before due date and time

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33. DOCUMENTS COMPRISING THE BIDS

The bid prepared by the Bidder shall comprise the following components:

I. **ORIGINAL BID SECURITY (Section - I):** Bidders are advised to instruct their banks not to post Bid Security directly to Owner as the same has to accompany with the bid.

II. **TECHNICAL BID (Section -II):**

- Documentary evidence establishing Bidder's claim for meeting qualification criteria as stipulated in the Bid Document.
- Notarized Audited Annual Report of previous three financial years.
- Documentary evidence establishing Bidder's eligibility to bid and that the offered Goods conform to the Bid Document.
- Price Schedule (with Price figures blanked) completed in accordance with the requirements specified in the bid document.
- Agreed Terms & Conditions duly filled-in.
- Deviation Sheet, if any.
- Declaration with the bid qualification criteria that bidder has not been banned or delisted by any Government or quasi Government agencies or PSU's.
- Any other information/details/documents/data required as per Bid Document.
- Parent Company Guarantee, if applicable

III. **PRICE BID (Section -III):** Bid Form and Price Schedule (Both given along with tender) duly filled in.

34. BID FORM & PRICE SCHEDULE

The bidders shall complete the Bid Form and appropriate Price schedule furnished of Bid Document, indicating the required information for all quoted items.

35. FORMAT AND SIGNING OF BID

a. The Bidder shall prepare required number of copies of the bid, clearly marking each 'Original Bid' and 'Copy of Bid' as appropriate. In the event of any discrepancy between them, the 'Original Bid' shall govern.
b. The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to sign on behalf of the bidder on all pages of the bid. Such authorization shall be indicated by written Power of Attorney accompanying the bid. The name and position held by each person signing must be typed or printed below the signature. The person or persons signing the bid shall initial all pages of the bid, except for unamended printed literature.
c. The complete bid shall be without alterations, interlineations or erasures,

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Sign & Stamp of Bidder

except as may be necessary to correct errors made by the Bidder, in which case such corrections shall be rewritten & initialed by the person or persons signing the bid.

d. All the pages of the price bid shall be signed by the authorized signatory. In case all the pages of the price bid are not signed, the bid shall be rejected.

36. OPENING OF BIDS

Bids will be opened by Owner at DAFFPL Office, New Delhi, in the presence of bidders/bidders authorized representatives available on the opening date and time (duly authorized by a competent person and having the letter of authority).

a. **BID SECURITY / EMD (SECTION-I) AND TECHNICAL BID (SECTION-II):**
   I. On the day and time of bid opening, Bid security (Envelope 1) and Technical Bid (Envelope 2) shall be opened in presence of bidders.
   II. The Bidder's representatives, who are present, shall sign a register/attendance sheet evidencing their attendance.
   III. The Bidder(s) names, presence or absence of requisite bid security will be announced at the opening.
   IV. Bidder (s), whose bids are not opened for any reason, including non receipt of original bid security, will not be allowed to be present during bid opening.

b. **PRICE BID OPENING (SECTION -III):**
   I. Only those bidders whose bids meet the qualification criteria and are technically/commercially acceptable shall be called for opening of Price bid (Envelope 3) at a later date, informed in advance.
   II. The Bidder's representatives, who are present, shall sign a register/ attendance sheet evidencing their attendance.
   III. Bidder(s), whose bids are not opened for any reason, will not be allowed to be present during bid opening.

37. EVALUATION OF BIDS

a. Qualification of Bidder: The experience details and financial & technical capabilities of the bidder(s) shall be examined to determine whether the bidder(s) meet the Bid Qualification Criteria mentioned in the INVITATION FOR BIDS (IFB).
b. The Owner will examine the bids to determine whether they are complete, any computational errors have been made, whether the documents have been properly signed and whether the bids are generally in order.
c. The bids without requisite Bid Security and/or not in the prescribed proforma will not be considered and bids of such bidder Bidder(s) shall be rejected.
d. To assist in the examination, evaluation and comparison of technical bids,

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the owner/ may, at its discretion, ask the Bidder clarifications on the bid. The request for such clarifications and the response thereto shall be in writing.

e. Prior to the evaluation and comparison of the bid, the owner will determine the substantial responsiveness of each bid to the bidding documents. For the purpose of this Article, a substantially responsive bid is one, which conforms to all the terms and conditions of the bidding document without material deviations or reservations. A material deviation or reservation is one which affects in any substantial way the scope, quality, or performance of the works or which limits in any substantial way, inconsistent with the bidding document, the DAFFPL's rights or Bidder's obligation under the contract and retention of which deviation or reservation would affect unfairly the competitive position of other bidders presenting substantially responsive bids. The owner's determination of bid responsiveness is to be based on the contents of the bid itself without recourse to the extrinsic evidence.

f. A bid determined as substantially non-responsive will be rejected by the Owner and shall not subsequently be allowed by the Owner to be made responsive by the Bidder by correction of the non-conformity.

Note:

1) **The Bid Shall be submitted in English Language Only**
2) **For any Document submitted in any language other than English, the translation copy in English language shall be submitted.**

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CHAPTER 3: BID-QUALIFICATION CRITERIA:

Bidders need to meet following pre-qualification criteria to qualify for short-listing as a successful vendor, who would be considered for tendering process for the job of "***Terminal Automation at DAFFPL"***

1. **Work Experience** :

   Bidders shall have carried out (i.e. ordered) and completed Terminal Automation jobs at least at 3 locations (Terminals / Depots), including Design, Engineering, Supply of Hardware and software, Erection, Installation, Commissioning and Stabilization of integrated automation system comprising of Tank farm management system in petroleum oil/Gas installation in the last 7 years ending with the last day of the month previous to the month in which applications are invited.

   At least one of such three terminal Automation jobs referred above should have completed minimum one year of successful operation within the last 7 years ending last day of the month previous to the one in which applications are invited. Satisfactory operation certificates from the client for the location shall be enclosed. The Bidder should have his own TAS software.

2. **Previous Order Value**: Bidder shall meet the minimum prescribed bid qualification requirements as follows :

   The bidder should have carried out (i.e. ordered) and completed Design, Engineering, supply of hardware & software, Erection, installation, Commissioning, SAT of Instrumentation / Process Automation in Hydrocarbon industry including Refinery / LPG of total value of minimum **Rs. 03 Crores** in the last 7 years ending with the last day of the month previous to the month in which applications are invited. In case the Order comprises of work for multiple locations, only the value of works of the locations completed shall be considered. In Case the Bidder is unable to provide supporting documents such as Completion Certificates, Work Order copies, etc., notarized Self-declaration letter containing the PO / work order No, Name of job, PO Value & the value of executed Jobs , date of commencement and date of completion as per Tender shall be submitted along with Documentary Evidence.

3. **Average Annual Turnover**: Bidder shall meet the minimum prescribed bid qualification requirement as per the audited financial results during the last three financial years (2016-2017, 2015-2016, 2014-2015) of **Rs. 05 Crores**.

4. **Net Worth** as per the latest audited financial statement shall be **positive** for the financial year 2016-2017.

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5. **Bidder shall qualify if all the prescribed requirements given in clause 1, 2, 3 & 4.**

6. Bidder shall meet the technical as well as commercial qualification criteria as stated above. Bidder shall furnish necessary documentary evidence, along with the Bid, to justify meeting the stipulated Qualification Criteria, such as work orders, completion certificate of relevant previous works reference list of previous supplies, inspection and testing facilities, Annual Report, Auditor's Certificate, etc., In the absence of requisite documents DAFFPL reserves the right to reject the Bid without making any reference to the Bidder.

7. Bidders shall have sufficient experienced specialized man power to ensure work of best quality and workmanship and **bidders shall furnish their organizational man power details to support their claim.**

OTHER INFORMATION OF BQC

1. Parties who are affiliates of one another can decide which affiliate will make a bid. Only one affiliate may submit a bid. Two or more affiliates are not permitted to make separate bids directly or indirectly. If 2 or more affiliates submit a bid, then any one or all of them are liable for disqualification. However up to 3 affiliates may make a joint bid as a consortium, and in which case the conditions applicable to a consortium shall apply to them. "Affiliate" of a Party shall mean any company or legal entity which:
    a. Controls either directly or indirectly a Party, or
    b. Which is controlled directly or indirectly by a Party; or
    c. Is directly or indirectly controlled by a company, legal entity or Partnership which directly or indirectly controls a Party. "Control" means actual control or ownership of at least a 50% voting or other controlling interest that gives the power to direct, or cause the direction of, the management and material business decisions of the controlled entity.
2. Bids may be submitted by:
    a. A single person/ entity (called sole bidder);
    b. A newly formed incorporated joint venture (JV) which has not completed 3 financial years from the date of commencement of business;
    c. A consortium (including an unincorporated JV) having a maximum of 3 (three) members;
    d. An Indian arm of a foreign company.
3. Fulfillment of Eligibility criteria and certain additional conditions in respect of each of the above 4 types of bidders are stated below, respectively:
    a. The sole bidder (including an incorporated JV which has completed 3 financial years after date of commencement of business) shall fulfill each eligibility criteria.

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b. In case the bidder is a newly formed and incorporated joint venture and which has not completed three financial years from the date of commencement of business, then either the said JV shall fulfill each eligibility criteria or any one constituent member/ promoter of such a JV shall fulfill each eligibility criteria. If the bid is received with the proposal that one constituent member/ promoter fulfils each eligibility criteria, then this member/promoter shall be clearly identified and he/it shall assume all obligations under the contract and provide such comfort letter/guarantees as may be required by Owner. The guarantees shall cover inter alia the commitment of the member/ promoter to complete the entire work in all respects and in a timely fashion, being bound by all the obligations under the contract, an undertaking to provide all necessary technical and financial support to the JV to ensure completion of the contract when awarded, an undertaking not to withdraw from the JV till completion of the work, etc.

c. In case the bidder(s) is/are a consortium (including an unincorporated JV), then the following conditions shall apply:

I. Each member in a consortium may only be a legal entity and not an individual person;

II. The Bid shall specifically identify and describe each member of the consortium;

III. the consortium member descriptions shall indicate what type of legal entity the member is and its jurisdiction of incorporation (or of establishment as a legal entity other than as a corporation) and provide evidence by a copy of the articles of incorporation (or equivalent documents);

IV. One participant member of the consortium shall be identified as the "Prime member" and contracting entity for the consortium;

V. This prime member shall be solely responsible for all aspects of the Bid/ Proposal including the execution of all tasks and performance of all consortium obligations;

VI. The prime member shall fulfill each eligibility criteria;

VII. a commitment shall be given from each of the consortium members in the form of a letter signed by a duly authorized officer clearly identifying the role of the member in the Bid and the member's commitment to perform all relevant tasks and obligations in support of the

VIII. Prime/lead member of the Consortium and a commitment not to withdraw from the consortium;

IX. No change shall be permitted in the number, nature or share holding pattern of the Consortium members after pre-qualification, without the prior written permission of the Owner.

X. No change in project plans, timetables or pricing will be permitted as a consequence of any withdrawal or failure to perform by a consortium member;

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XI. No consortium member shall hold less than 25% stake in a consortium;

XII. Entities which are affiliates of one another are allowed to bid either as a sole bidder or as a consortium only;

XIII. Any person or entity can bid either singly or as a member of only one consortium.

d. In case the bidder is an Indian arm (subsidiary, authorized agent, branch office or affiliate) of a foreign bidder, then the foreign bidder shall have to full fill each eligibility criteria. If such foreign company desires that the contract be entered into with the Indian arm, then a proper back to back continuing (parent company) guarantee shall be provided by the foreign company clearly stating that in case of any failure of any supply or performance of the equipment, machinery, material or plant or completion of the work in all respects and as per the warranties/ guarantees that may have been given, then the foreign company shall assume all obligations under the contract. Towards this purpose, it shall provide such comfort letter/guarantees as may be required by Owner. The guarantees shall cover inter alia the commitment of the foreign company to complete the entire work in all respects and in a timely fashion, being bound by all the obligations under the contract, an undertaking to provide all necessary technical and financial support to the Indian arm or to render the same themselves so as to ensure completion of the contract when awarded, an undertaking not to withdraw from the contract till completion of the work, etc.

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CHAPTER 4: PERFORMANCE OF WORK

1. EXECUTION OF WORKS:
    a. All the works shall be executed in strict conformity with the provisions of the contract documents and with such explanatory detailed drawings, specifications, and instructions as may be furnished from time to time to the contractor by the Engineer-in-Charge whether mentioned in the contract or not. The contractor shall be responsible for ensuring that works throughout are executed in the most substantial, proper and workman like manner with the quality of material and workmanship in strict accordance with the specifications following all safety requirements of DAFFPL and as stipulated in work permits as per the directions and to the entire satisfaction of the Engineer-in-Charge.
    b. Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities/materials, it is understood that the contractor shall do, so at his cost unless otherwise specified.
    c. The materials, design and workmanship shall satisfy the relevant Indian Standards, the Job specification contained herein and codes referred to. Where the job specification stipulate requirements in addition to those contained in the standards codes and specifications, these additional requirements shall also be satisfied.

2. COORDINATION AND INSPECTION OF WORK:
    The coordination and inspection of the day-to-day work under the contract shall be the responsibility of the Engineer-in-Charge. The written instructions regarding any particular job will be normally be passed by the Engineer-in-Charge or his authorized representative. A work order book / logbook will be maintained by the Contractor for each job in which the aforesaid written instructions will be entered. These will be signed by the contractor or his authorized representative by way of acknowledgment within 12 hours. The non-maintaining of the order book or non-signing by the contractor shall not preclude the contractor from complying with the instructions.

3. WORK IN MONSOON AND DEWATERING:
    a. The completion of the work may entail working in the monsoon also. The contractor must maintain a minimum labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered for such work in monsoon.
    b. During monsoon and other period, it shall be the responsibility of the contractor to keep the construction work site free from water at his own cost.

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4. WORK ON SUNDAYS AND HOLIDAYS:
   For carrying out work on Sundays and Holidays if needed, the contractor will approach the Engineer-in-Charge or his representative at least two days in advance and obtain permission in writing. No special compensation on this account will be payable.

5. GENERAL CONDITIONS FOR CONSTRUCTION AND ERECTION WORK:
   a. Place of Work: The work has to be executed at specified premises as per the tender. Contractor should apprise himself of all the conditions prevailing in such location and the restrictions placed on movement of personnel and equipment, types of equipment and tools permitted, working methods allowed etc. in the light of security and safety regulations operative in the area. The safety regulations to be complied with, by the contractor will also be provided along with the tender. No idle time wages or compensation for temporary stoppage of work or restrictions would be paid, and the rate quoted for the various items of work should cover the cost of all such contingencies and eventualities. Substantial structures and utilities exist both above ground and underground, adjacent to the work site. (The construction activity gets restrained by the existence of such structures and utilities). Special care is necessary in transportation, storage, working on equipment's and other construction activities to protect the existing features and prevent damage to any facility. Necessary protective structures barricades etc. have to be erected at various places as directed by Engineer-in-Charge. No extra payment of such protective works will be made unless specially provided in the tender.
   b. The working time or the time of work is 48 hours per week normally. Overtime work is permitted in cases of need and the Owner will not compensate the same. Shift working at 2 or 3 shifts per day may become necessary and the contractor should take this aspect into consideration for formulating his rates for quotation. No extra claims will be entertained by the Owner on this account.
   c. The contractor must arrange for the placement of workers in such a way that the delayed completing of the work or any part thereof for any reasons whatsoever will not affect their proper employment. The Owner will not entertain any claim for idle time payment whatsoever.
   d. The contractor shall submit to the Owner reports at regular intervals regarding the state and progress of work. The details and preforma of the report will mutually be agreed after the award of contract.

6. DRAWINGS TO BE SUPPLIED BY THE OWNER:
   a. Where drawings are attached with tender, these shall be for the general guidance of the contractor to enable him to visualize the type of work contemplated and scope of work involved. The contractor will be deemed to have studied the drawings and formed an idea about the work involved.

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b. Detailed working drawings on the basis of which actual execution of the work is to proceed will be furnished from time to time during the progress of the work. The contractor shall be deemed to have gone through the drawings supplied to him thoroughly and carefully and in conjunction with all other connected drawings and bring to the notice of the Engineer-in-Charge, discrepancies, if any, therein before actually carrying out the work.
c. Copies of all detailed working drawings relating to the works shall be kept at the contractor's office of the site and shall be made available to the Engineer-in-Charge at any time during the contract. The drawings and other documents issued by the Owner shall be returned to the Owner on completion of the works.

7. SETTING OUT WORKS:
   a. The Engineer-in-Charge shall furnish the contractor with only the four corners of the work site and a level bench mark and the contractor shall set out the works and shall provide efficient staff for the purpose and shall be solely responsible for the accuracy of such setting out.
   b. The contractor shall provide, fix and be responsible for the maintenance of all stacks, templates, level marks, profiles and other similar things and shall take all necessary precaution to prevent their removal or disturbance and shall be responsible for the consequence of such removal or disturbance should the same take place and for their efficient and timely reinstatement. The contractor shall also be responsible for the maintenance of all existing survey marks, boundary marks, distance marks and centre line marks, either existing or supplied and fixed by the contractor. The, work shall be set out to the satisfaction of the Engineer-in-Charge. The approval thereof or joining in setting out the work shall not relieve the contractor of any of his responsibilities.
   c. Before beginning the works, the contractor shall at his own cost, provide all necessary reference and level posts, pegs, bamboos, flags, ranging rods, strings and other materials for proper layout of the work in accordance with the scheme, for bearing marks acceptable to the Engineer-in-Charge. The centre, longitudinal or face lines and cross lines shall be marked by means of small masonry pillars. Each pillar shall have distinct marks at the centre to enable theodolite to be set over it. No work shall be started until all these points are checked and approved by the Engineer-in-Charge in writing but such approval shall not relieve the contractor of any of his responsibilities. The contractor shall also provide all labour, material and other facilities, as necessary, for the proper checking of layout and inspection of the points during construction.
   d. Pillars bearing geodetic marks located at the site of work under construction should be protected and fenced by the contractor.
   e. On completion of works, the contractor must submit the geodetic documents according to which the work was carried out.

Sign & Stamp of Bidder

8. RESPONSIBILITY FOR LEVEL AND ALIGNMENT:
   The contractor shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the work and shall rectify effectually any errors or imperfections therein. Such rectifications shall be carried out by the contractor, at his own cost, when instructions are issued to that effect by the Engineer-in-Charge.

9. MATERIALS TO BE SUPPLIED BY CONTRACTOR:
   a. The contractor shall procure and provide the whole of the materials required for construction including tools, tackles, construction plant and equipment for the completion and maintenance of the works except the materials which will be issued by Owner and shall make his own arrangement for procuring such materials and for the transport thereof. The materials procured by the contractor shall be DAFFPL approved/specified quality.
   b. All materials procured should meet the specifications given in the tender document. The Engineer-in-Charge may, at his discretion, ask for samples and test certificates for any batch of any material procured. Before procuring, the contractor should get the approval of Engineer-in-Charge for any material to be used for the works.
   c. Manufacturer's certificate shall be submitted for all materials supplied by the contractor. If, however, in the opinion of the Engineer-in-Charge any tests are required to be conducted on the materials supplied by the contractor, these will be arranged by the contractor promptly at his own cost.

10. MATERIALS SUPPLIED BY OWNER:
    a. If the specifications of the work provides for the use of any materials of special description to be supplied from the Owner's stores, price for such material to be charged therefore as herein after mentioned being so far as practicable for the convenience of the contractor but not so as in any way to control the meaning or effect of the contract. The contractor shall be bound to purchase and shall be supplied such materials as are from time to time required to be used by him for the purpose of the contract only. The sums due from the contractor for the value of the actual materials supplied by the Owner will be recovered from the running account bill on the basis of the actual consumption of materials in the work covered and for which the running account bill has been prepared. After the completion of the works, however, the contractor has to account for the full quantity of materials supplied to him as per relevant clauses in this document.
    b. The value of the materials as may be supplied to the contractor by the Owner will be debited to the contractor's account at the rates shown in the schedule of chargeable materials and if they are not entered in the schedule, they will be debited at cost price, which for the purpose of the contract shall include the cost of carriage and all other expenses whatsoever such as normal storage

Sign & Stamp of Bidder

supervision charges which shall have been incurred in obtaining the same at the Owner's stores. All materials so supplied to the contractor shall remain the absolute property of the Owner and shall not be removed on any account from the site of the work, and shall be at all times open for inspection to the Engineer-in-Charge. Any such materials remaining unused at the time of completion or termination of the contract shall be returned to the Owner's stores or at a place as directed by the Engineer-in- Charge in perfectly good condition, at contractor's cost.

11. CONDITIONS FOR ISSUE OF MATERIALS:

a. Materials specified to be issued by the Owner will be supplied to the contractor by the Owner from his stores/location. It shall be the responsibility of the contractor to take delivery of the materials and arrange for its loading, transport and unloading at the site of work at his own cost. The materials shall be issued between the working hours and as per the rules of the Owner framed from time to time.
b. The contractor shall bear all incidental charges for the storage and safe custody of materials at site after these have been issued to him.
c. Materials specified to be issued by the Owner shall be issued in standard sizes as obtained from the manufacturer.
d. The contractor shall construct suitable godown at the site of work for storing the materials safe against damage by rain, dampness, fire, theft etc. He shall also employ necessary watch and ward establishment for the purpose.
e. It shall be duty of the contractor to inspect the material supplied to him at the time of taking delivery and satisfy himself that they are in good condition. After the materials have been delivered by the Owner, it shall be the responsibility of the contractor to keep them in good condition and if the materials are damaged or lost, at any time, they shall be repaired and/ or replaced by him at his own cost, according to the directions of the Engineer-in-Charge.
f. The Owner shall not be liable for delay in supply or non-supply of any materials which the Owner has undertaken to supply where such failure or delay is due to natural calamities, act of enemies, transport and procurement difficulties and any circumstances beyond the control of the Owner. In no case, the contractor shall be entitled to claim any compensation or loss suffered by him on this account.
g. It shall be the responsibility of the contractor to arrange in time all materials required for the works other than those to be supplied by the Owner. If, however, in the opinion of the Engineer-in-Charge the execution of the work is likely to be delayed due to the contractor's inability to make arrangements for supply of materials which normally he has to arrange for, the Engineer-in-Charge shall have the right, at his own discretion, to Issue such materials If available with the Owner or procure the materials from the market or elsewhere and the contractor will be bound to take such materials at the

Sign & Stamp of Bidder

rates decided by the Engineer-in-Charge. This, however, does not in any way absolve the contractor from responsibility of making arrangements for the supply of such materials in part or in full, should such a situation occur, nor shall this, constitute a reason for the delay in the execution of the work.

h. None of the materials supplied to the contractor will be utilized by the contractor for manufacturing item, which can be obtained from standard manufacturer in finished form.
i. The contractor shall, if desired by the Engineer-in-Charge, be required to execute an indemnity bond for safe custody and accounting of all materials issued by the Owner.
j. The contractor shall furnish to the Engineer-in-Charge sufficiently in advance a statement showing his requirements of the quantities of the materials to be supplied by the Owner and the time when the same will be required by him for the works, so as to enable the Engineer-in-Charge to make necessary arrangement for procurement and supply of the material.
k. A daily account of the materials issued by the Owner shall be maintained by the contractor indicating the daily receipt, consumption and balance in hand. This account shall be maintained in a manner prescribed by the Engineer-in-Charge along with all connected papers viz. requisition, issues etc. and shall be always available for inspection in the contractor's office at site.
l. The contractor should see that only the required quantities of materials are got issued. The contractor shall not be entitled to cartage and incidental charges for returning the surplus materials, if any, to the stores/location where from they were issued or to the place as directed by the Engineer-in-Charge.
m. Materials/ Equipment supplied by Owner shall not be utilized for any other purpose(s) than issued for.

12. MATERIALS PROCURED WITH ASSISTANCE OF OWNER:

Notwithstanding anything contained to the contrary in any or all the clause of this document where any materials for the execution of the contract are procured with the assistance of Owner either by issue from Owner's stock or purchase made under orders or permits or licenses issued by Government, the contractor shall hold the said materials as trustee for the Owner and use such materials economically and solely for the purpose of the contract and not dispose them off without the permission of the owner and return, if required by the Engineer-in-Charge, all surplus or unserviceable materials that may be left with him after the completion of the contract or at its termination for any reason, whatsoever on his being paid or credited such prices as the Engineer in-Charge shall determine having due regard to the condition of the materials. The price allowed to the contractor however, shall not exceed the amount charged to him excluding the storage charges if any. The decision of the Engineer-in- Charge shall be final and conclusive in such matters. In the event of breach of the aforesaid condition, the contractor shall in terms of the licenses or permits, and/or for criminal breach of trust, be liable to compensate the Owner a

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double rate or high rate, in the event of those materials at that time having higher rate or not being available in the market, then any other rate to be determined by the Engineer-in-Charge and his decision shall be final and conclusive.

13. MATERIALS OBTAINED FROM DISMANTLING:
    If the contractor in the course of execution of the work is called upon to dismantle any part for reasons other than those stipulated in clauses 64 & 68 hereunder, the materials obtained in the work of dismantling etc. will be considered as the Owner's property and will be disposed off to the best advantage of the Owner.

14. ARTICLES OF VALUE FOUND:
    All gold, silver and other materials, of any description and all precious stones, coins, treasure relies, antiquities and other similar things which shall be found in, under or upon the site, shall be property of the Owner and the contractor shall duly preserve the same to the satisfaction of the Engineer-in-Charge and shall from time to time deliver the same to such person or person indicated by the Owner.

15. DISCREPANCIES BETWEEN INSTRUCTIONS:
    Should any discrepancy occur between the various instructions furnished to the contractor, his agents or staff or any doubt, arise as to the meaning of any such instructions or should there be any misunderstanding between the contractor's staff and the Engineer-in-Charge's staff, the contractor shall refer the matter immediately in writing to the Engineer-in-Charge whose decision thereon shall be final and conclusive and no claim for losses alleged to have been caused by such discrepancies between instructions, or doubts, or misunderstanding shall in any event be admissible.

16. ALTERATIONS IN SPECIFICATIONS AND DESIGNS AND EXTRA WORK:
    a. The Engineer-in-Charge shall have power to make any alterations in, omissions from, additions to of substitutions for, the schedule of rates, the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work and the contractor shall be bound to carry out such altered / extra / new items of work in accordance with any instructions which may be given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions or substitutions shall not invalidate the contract and any altered additional or substituted work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the contractor on the same conditions in all respect on which he agree to do the main work. The time for completion of work may be extended for the part of the particular job at the discretions of the Engineer-in-Charge, for only such alteration, additions or substitutions of the work, as he may consider as just and reasonable. The rates for such additional, altered or substituted work

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under this clause shall be worked out in accordance with the following provisions:

- If the rates for the additional, altered or substituted work are specified in the contract for the work, the contractor is bound to carry out the additional, altered or substituted work at the same rates as are specified in the contract.
- If the rates for the additional, altered or substituted work are not specifically provided in the contract for the work, the rates will be derived from the rates for similar class of works as specified in the contract for the work. The opinion of the Engineer-in-Charge as to whether the rates can be reasonably so derived from items in the contracts will be final and binding on the contractor.
- If the rates for the altered, additional or substituted work cannot be determined in the manner specified in sub-clause (a) and (b) above, then the contractor shall inform the Engineer-in-Charge of the rate which is his intension to charge for such class of work supported by analysis of the rate or rates claimed, and the Engineer-in-Charge shall determine the rates on the basis of the prevailing market rates of materials, labour cost at schedule of labour plus 10% to cover contractor's supervision, overheads and profit and pay the contractor accordingly. The opinion of the Engineer-in-Charge as to the current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the contractor.
- Provisions, contained in sub-clause mentioned above shall not, however, apply: Where the value of alterations / additions / deletions or substitutions exceeds beyond plus or minus 25% of the estimated contract value (i.e. quoted item rates of contractor shall hold good for variations etc. within plus or minus 25% of estimated contract value)

b. In the event and as a result of such alternatives / additions / substitutions / deletion, the scope of contract work exceed the value stipulated in the contract by more than the limits given in clause above, the Contractor shall claim revision of the rates supported by the proper analysis in respect of such items for quantities in excess of the above limits, notwithstanding the fact that the rates for such items exist in the tender for the main work or can be derived in accordance with the provision of sub-clause (b) of Clause 61 A, and the Engineer-in-Charge may revise their rates having regard to the prevailing market rates, and the contractor shall be paid in accordance with the rates so fixed. But, under no circumstances the contractor shall suspend / stop / slowdown the work on the plea of non-settlement of rates of items falling under this clause.

Sign & Stamp of Bidder

17. ACTION WHERE NO SPECIFICATIONS ISSUED:
    In case of any class of work for which there is no such specification given by the Owner in the tender documents, such work shall be carried out in accordance with Indian Standard Specifications and if the Indian Standard Specifications do not cover the same the work should be carried out as per standard Engineering Practice subject to the approval of the Engineer-in-Charge.

18. ABNORMAL RATES:
    The contractor is expected to quote rate for each item after analysis of cost involved for the completion of item/work, considering all specifications and conditions of contract. This will avoid loss of profit or gain, in case of curtailment or change of specification for any item. In case it is noticed that the rates for any item, quoted by the tenderer unusually are high or unusually low it will be sufficient cause for the rejection of the tender unless the Owner is convinced about the reasonableness of the rates on scrutiny of the analysis for such rate to be furnished by the tenderer on demand.

19. INSPECTION OF WORK:
    a. The Engineer-in-Charge will have full power and authority to inspect the works at any time wherever in progress either on the Site or at the contractor's premises / workshop where situated premises /workshops of any person, firm or corporation where work in connect with the contract may be in hand or where materials are being or are to be supplied, and the contractor shall afford or procure for the Engineer-in-Charge every facility and assistance to carry out such Inspection. The contractor shall at all time during the usual working hours and at all other time for which reasonable notice of the intention of the Engineer in-Charge or his representative to visit the works have been given to the contractor, either himself be present to receive order and instructions or post a responsible agent duly accredited in writing for the purpose. Orders given to the contractor's agent shall be considered to have the same force as if they had been given to the contractor himself. The contractor shall give not less than seven days, notice in writing to the Engineer-in-Charge before covering up or placing any work beyond reach of inspection and measurement any work in order that the same may be inspected and measured. In the event of breach of above the same shall be uncovered at contractor's expense carrying out such measurement or inspection.
    b. No materials shall be dispatched by the contractor before obtaining the approval of Engineer-in-Charge in writing. The contractor is to provide at all times during the progress of the work and the maintenance period, proper means of access with ladders, gangways, etc. and the necessary attendance to move and adopt as directed for inspection or measurement of the works by the Engine in-Charge.

Sign & Stamp of Bidder

20. ASSISTANCE TO THE ENGINEERS:

The contractor shall make available to the Engineer-in-Charge, free of cost necessary instruments and assistance in checking of setting out of works and taking measurement of work.

21. TESTS FOR QUALITY OF WORKS:

a. All workmanship shall be of the respective kinds described in the contract documents and in accordance with the instructions of the Engineer-in-Charge and shall be subjected from time to time to such test at contractor's cost as the Engineer-in-Charge may direct at place of manufacture or fabrication or on the site or at all or any such places. The contractor shall provide assistance, instruments, labour and materials as are normally required for examining, measuring and testing any workmanship as may be selected and required the Engineer-in-Charge.
b. All the tests necessary in connection with the execution of the work as decided by Engineer-in-Charge shall be carried out at the field testing laboratory of the Owner by paying the charges as decided by the Owner from time to time. In case of non-availability of test facility with the Owner, the required test shall be carried out at the cost of contractor at government or any other testing laboratory as directed by Engineer-in-Charge.
c. If any tests are required to be carried out in connection with the work or materials workmanship not supplied by the contractor, such tests shall be carried out by the contractor as per the instructions of Engineer-in-Charge and cost of such tests shall be reimbursed by the Owner.

22. SAMPLES:

The contractor shall furnish to the Engineer-in-Charge for approval when requested or if required by the specifications, adequate samples of all materials and finishes to be used in the work. Such samples shall be submitted before the work is commenced and in ample time to permit tests and examinations thereof. All materials furnished and finishing applied in actual work shall be fully identical to the approval samples.

23. ACTION AND COMPENSATION IN CASE OF BAD WORK:

If it shall appear to the Engineer-in-Charge that any work has been executed with unsound, imperfect or unskilled workmanship or with materials of any inferior description, or that any materials or articles provided by the contractor for the execution of the work are unsound or of a quality inferior to that contracted for, or otherwise not in accordance with the contract, the contractor shall on demand in writing from the Engineer-in-Charge or his authorized representative, specifying the work, materials or articles complained of, notwithstanding that the same have been inadvertently passed, certified and paid for forthwith shall rectify or remove and reconstruct the works specified and provide other proper and suitable materials or articles at his own charge and cost, and in the event of failure to do so within a period to be specified by the Engineer-in-Charge in his demand aforesaid, the

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contractor shall be liable to pay compensation at the rate of 0.5% of the estimated cost of the whole work, for every week limited to a maximum of 10% of the estimated cost of the whole work, while his failure to do so shall continue and in the case of any such failure the Engineer-in-Charge may on expiry of notice period rectify or remove and re-execute the work or remove and replace with others, the materials or articles complained of as the case may be at the risk and expenses of the contractors in all respects. The decision of the Engineer-in-Charge as to any question arising under this clause shall be final and conclusive.

24. SUSPENSION OF WORKS:
The contractor shall, if ordered in writing by the Engineer-in-Charge or his representative, temporarily suspend the works or any part thereof for such period and such time as so ordered and shall not, after receiving such written order, proceed with the work therein ordered to be suspended, until he shall have received a written order to proceed therewith. The contractor shall not be entitled to claim/ compensation for any loss or damage sustained by him by reason of temporary suspension of the works aforesaid. An extension of time for completion, corresponding with the delay caused by any such suspension of the works as aforesaid will be granted to the contractor, should he apply for the same, provided that suspension was not consequent to any default or failure on the part of the contractor.

25. OWNER MAY DO PART OF WORK:
Upon failure of the contractor to comply with any instructions given in accordance with the provisions of the contract, the owner has the alternative right, instead of assuming charge for entire work to place additional labour force, tools, equipments and materials on such parts of the work, as the owner may designate or also engage another contractor to carry out the work. In such cases, the owner shall deduct from the amount which otherwise might become due to the contractor, the cost of such work and materials with ten percent added to cover all departmental charges and should the total amount thereof exceed the amount due to the contractor, the contractor shall pay the difference to the owner.

26. POSSESSION PRIOR TO COMPLETION:
The Engineer-in-Charge shall have the right to take possession of or use any completed or partially completed work or part of the work. Such possessions or use shall not be deemed to be an acceptance of any work completed in accordance with the contract agreement. If such prior possession or use by the Engineer-in-Charge delays the progress of work, suitable adjustment in the time of completion will made and contract agreement shall be deemed to be modified accordingly.

27. PERIOD OF LIABILITY FROM THE DATE OF COMPLETION OF WORK:
    a. The contractor shall guarantee the installation/site work for a period of 24 (Twenty Four) Months from the date of completion of all work, unless

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otherwise specified. Any damage that may lie undiscovered at the time of issue of completion certificate, connected in any way with the equipment or materials supplied by him or in the workmanship shall be rectified or replaced by the contractor at his own expense as deemed necessary by the Engineer-in-Charge or in default, the Engineer-in-Charge may cause the same made good by other workmen and deduct expenses (for which the certificate of Engineer-in-Charge shall be final) from any sums that may be then or at any time thereafter, become due to the contractor or from his security deposit.

b. If the contractor feels that any variation in work or in quality of materials or proportions would be beneficial or necessary to fulfill the guarantee called for, he shall bring this to the notice of the Engineer-in-Charge in writing. The work will not be considered as complete and taken over by the Owner until all the temporary works etc., constructed by the contractor is removed and work site cleaned to the satisfaction of Engineer-in-Charge.

c. Care of Works:
From the commencement to completion of works, the contractor shall take full responsibility for the care of all works including all temporary works, and in case any damage, loss or injury happens to the works or to any part thereof or to any temporary work, from any cause whatsoever, he shall at own cost repair and make good the same, so that at completion, the work shall be in good order and in conformity in every respect with the requirements of the contract and the Engineer-in-Charge's instructions.

d. Effects prior to taking over: If at any time, before the work is taken over, the Engineer-in-Charge shall
   - Decide that any work done or materials used by the contractor or any sub-contractor is defective or not in accordance with the contract or that the works or any portion thereof are defective or do not fulfill the requirements of contract (all such matters being herein after called 'Defects' in this clause) and
   - As soon as reasonably practicable, notice given to the contractor in writing of the said decisions specifying particulars of the defects alleged to exist or to have occurred, then the contractor shall at his own expenses and with all speed make good the defects so specified. In the case contractor shall fail to do so, the Owner may take, at the cost of the contractor, such steps as may in all circumstances, be reasonable to make good such defects. The expenditure, so incurred by the Owner shall be recovered from the amount due to the contractor. The decision of the Engineer-in-Charge with regard to the amount be recovered from the contractor will be final and binding on the contractor. As soon as the works have been completed in accordance with the contract and have passed the tests on completion, the Engineer-in-Charge shall issue a certificate (hereinafter called completion certificate) in which he shall certify the date on which the

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work have been so completed and have passed the said tests and the Owner shall be deemed to have taken over the works on the date so certified. If the works have been divided into various groups in the contract, the Owner shall be entitled to take over any group or groups before the other or others and thereupon the Engineer-in-Charge shall issue a completion certificate which will however, be for such group or groups as taken over only.

e. Defects after taking over: In order that the contractor could obtain a completion certificate, he shall make good with all possible speed, any defect arising from the defective materials supplied by the Contractor or workmanship or any act of omission of the contract that may have been noticed or developed after the works or group of the works has been taken over. The period allowed for carrying out such work will be normally one month. If any defect be not remedied within a reasonable time, the Owner may proceed to do the work at the contractor's risk and expense and deduct from the final bill such amount as may be decided by the Owner. If by reason of any default on the part of the contractor a completion certificate has not been issued in respect of every portion of the work within one month after the date fixed by the contract for the completion of the works, the Owner shall be at his liberty to use the works or any portion thereof in respect of which a completion certificate has been issued provided that the works or the portion thereof so used as aforesaid shall be afforded reasonable opportunity for completing these works for the issue of completion certificate.
f. The Security Deposit/retention money deducted / furnished shall be retained for the period of liability as given in clause above. This Retention amount or Bank Guarantee furnished against Security Deposit/retention money shall be released only on expiry of the period of liability and also based on the certification of the Engineer-in-charge that no defect/damage has been reported / observed during the stipulated period of liability for the contract.
g. Performance of contractor shall be evaluated on each job by Engineer-in-Charge and recorded. Review of performance will be carried out at appropriate intervals by DAFFPL.

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CHAPTER 5: GENERAL TERMS & CONDITIONS:

1. General:
   The materials and workmanship shall satisfy the relevant Indian Standards, the job specifications contained herein & codes referred to. Where the job specifications stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

   In the absence of any standard / specification / codes of practice for detailed specifications covering any part of the work covered in this tender document, the instruction / direction of consultant engineer will be binding on the contractor.

   Wherever it is stated in this tender document that a particular supply is to be effected or that a particular work is to be carried out, it shall be understood that the same shall be affected / carried out by the contractor at his cost, unless a different intention is specifically and expressly stated herein or otherwise explicit from the context.

2. Construction Program:
   A detailed bar chart showing various activities shall be prepared by the tenderers. The work shall be executed strictly as per the agreed time schedule. The period of completion shall include, the time required for mobilization and testing as well as rectification, if any, testing & completion in all respects to the entire satisfaction of the consultant.

   A joint programme of execution programme shall be prepared by the contractor.

   Monthly / weekly construction programme shall be made by the contractor. The contractor shall scrupulously adhere to these targets / programme by deploying adequate personal and construction tools and tackles. He shall also supply all materials in his scope of supply in time to achieve the targets set out in the weekly and the monthly programme.

   The contractor shall give every day, a report on labour and equipment deployed along with the progress of the work done on previous day, for each category of work.

3. Construction Water and Power:
   Construction Water and Power will be arranged by the contractor. The rates quoted shall be inclusive of the same.

4. Safety Rules and Regulations:
   All Safety rules and regulations of the terminal operator have to be followed by the contractor without fail. If any damage occurs due to negligence of safety, contractor

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will be held responsible for the same.

5. Tests and Inspection:
   The contractor shall carry out the various tests as enumerated in the technical specifications of this tender document and the technical documents that will be furnished to him during the performance of the work. No separate payment shall be made.

   The contractor shall carry out at his cost, all the tests either on the field or through external institutions / laboratories, concerning the execution of the work and supply of materials by the contractor.

   Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the contractor shall carry out the rectification at this own cost. Results of all inspection & tests shall be recorded in the inspection reports, test reports, etc., which will be approved by the Engineer-in-charge. These reports shall form part of the completion documents.

   Inspection & Acceptance of works shall not relieve the contractor from any of his responsibilities under this contract.

6. Site Cleaning:
   The contractor shall take care to clean the working site from time to time for easy access to work site and for safety. Working site should be always kept cleared to the entire satisfaction of DAFFPL.

   Before handing over any work to the owner, the contractor in addition to other formalities to be observed as detailed in the document shall clear the site to the entire satisfaction of DAFFPL.

7. Coordination with other Agencies:
   Work shall be carried out in such a manner that the work of other agencies operating at the site is not hampered due to any action of the contractor. Proper coordination with other agencies will be the responsibility of the contractor. In case of any dispute, the decision of Engineer-in-charge shall be final and binding on the contractor.

8. DAFFPL reserves the right to accept any tender in whole and reject any or all tenders without assigning any reason. DAFFPL also reserves the right to allow public enterprises (Central/State) Price / purchase /contract / service preference as admissible under the Indian Government Policy.

9. BID PRICES:
   a) Prices shall be furnished strictly in the Price Bid format of the tender

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document.

b) Bidder should quote their lowest and best offered price. Prices so quoted will remain firm till satisfactory completion of order. The price will not be subjected to escalation for any reason whatsoever.

c) Bidders quoted prices shall be deemed to include entire Specification of item and all obligations and responsibilities to be carried out / executed by the Bidder as per terms of tender document. It is clearly understood by the Vendor that it is for the Vendor to ascertain and assess the applicable Acts/ Regulations/ Laws etc., entirely of their own. It is also for the Vendor to ascertain and assess the applicability of taxes, duties, levies etc. In case of any difference of opinion between Vendors proposal and interpretation by any tax/assessing (or similar) authorities, on the rate or terms and conditions related to taxes and duties etc., owners liability shall be strictly as per terms/provisions of the contract based on tender document and Vendors offer.

d) No other charges accept those mentioned in the tender document will be payable to vendor.

10. The materials should be properly packed so as to withstand all transit hazards. Materials are required to be dispatched by the vendor to the locations, on freight paid DOOR- DELIVERY CONSIGNEE COPY ATTACHED basis along with copies of Inspection release note & internal test certificates & other documents as mentioned elsewhere in this tender document.

11. All shipment shall be under deck unless carriage on deck is unavoidable.

12. Bidder to note that Special Packaging Requirement as in technical specifications of this tender. The materials should be properly packed so as to withstand all transit hazards (both ocean & inland transit).

13. Indian agent Commission will not be paid by the owner.

14. TAXES & DUTIES:

a) Bidder(s) quoted prices shall be inclusive of all taxes, duties, cess, levies etc.,

b) The invoice should clearly mentioned that applicable Excise Duty, Education Cess or any other taxes charged and paid / payable on quoted item to enable the owner to claim MODVAT / Input credit.

c) The statutory variation in Excise duty, Education Cess and Sales tax / VAT on finished goods and introduction of new tax, from bid due date till the contractual completion period shall be to owner account against submission of the documentary evidence. However, any increase in the rate of these taxes and duties beyond the contractual delivery period shall be to Seller account. Any decrease in the rate of these taxes and duties shall be passed on to the owner. Any additional excise duty due to increase in turn-over

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would be to seller account.

d) It is for the Bidder to assess and ascertain the rate of excise duty, education Cess and sales tax/VAT applicable on quoted items. It is clearly understood that Owner will not have any additional liability towards payment of Excise Duty, Education Cess and Sales Tax/VAT which is based on Bidders wrong assessment / interpretation of applicability of such Excise Duty and/or education cess and / or Sales Tax/VAT.
e) Successful bidder shall carry out its obligations towards services at site as mentioned in technical specifications without any extra charges.
f) Octroi/Entry tax, if any, in the any state of India shall be directly paid by the vendor, if applicable.
g) DAFFPL shall not be liable, in case the tax authorities assess the tax elements in a different way on account of any reason, whatsoever.
h) Taxes and duties other than those specified in this document, if any, shall be included in the quoted prices and no separate reimbursement shall be made by DAFFPL.

15. Income Tax / Corporate Tax:
    a) As regards Income Tax, Surcharge on Income Tax or any other Corporate Tax payable by the Bidder for reason of the contract awarded, and / or on their expatriate personal, the Owner shall not bear any Tax liability whatsoever, irrespective of the mode of construction of contract / order. The Bidder shall be liable and responsible for payment of such tax, if attracted under the provision of Indian Income Tax Act.
    b) Bidder may note that if any tax is deductible at source as per Indian Income Tax Law, the same will be so deducted before releasing any payment to the Bidder and a TDS (Tax deducted at source) certificate will be furnished to the Bidder.
    c) Accordingly, Bidder shall have the responsibility to check and include such provision of taxes in the prices.
    d) In case of delay in delivery due to reasons attributable to Bidder, any new or additional taxes or duties levied by Statutory authorities during this period shall be borne by the Bidder.

16. EMD / BID SECURITY
    a) The bidder shall furnish, as part of his bid, a bid security in original for the amount specified in the tender document by way of pay order, bank guarantee on Rs.100/-value non-judicial stamp paper or demand draft.
    b) The bid security is required to protect the Owner against the risk of Bidders conduct, which would warrant the security forfeiture.
    c) If bid Security / EMD is in the form of bank guarantee, it shall be in the form of irrevocable bank guarantee (in the format attached) issued by any Indian Scheduled Bank (other than Co-operative Bank) will be accepted.
    d) Bid Security / EMD shall be issued in favour of M/s Delhi Aviation Fuel

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Facility (P) Limited, New Delhi.

e) Unsuccessful bidders bid security without any interest will be discharged/ returned as promptly as possible, but not later than 60 days after the expiry of the period of bid validity prescribed by the Owner.

f) The successful bidder bid security without any interest will be discharged, upon the Bidder accepting the Contract/ Purchase Order and furnishing the Contract performance bank guarantee to DAFFPL.

g) The bid security may be forfeited:
   i. If a bidder withdraws his bid during the period of bid validity or
   ii. In the case of a successful bidder, if the bidder fails or refuses to:
      - Accept the Purchase Order in accordance with agreed terms and conditions.
      - Furnish Contract performance bank guarantee as per bid document/ Purchase Order.
   iii. Detection of submission of false / forged documents and fraud.

h) Bid Security / EMD should be in favour of "Delhi Aviation Fuel Facility Private Limited", payable at New Delhi and submitted to the relevant office of DAFFPL as mentioned in covering note of the tender document. Covering letter to bid Security / EMD must indicate the tender number. This is essential to have proper co-relation at a later date. The bid security / EMD shall be strictly in the form provided in the bid document before the due date & time of bid submission.

i) Central Public Sector Undertaking of Govt. Of India are exempted from furnishing the bid security. Firms registered with NSIC/ MSME are also exempted from furnishing bid security, provided they are registered for the tendered items and up to the monetary limit they intend to quote. Provided further that they submit a copy of the current and valid registration certificate for the quoted item and monetary value along with their bid(s). Owner reserves right to verify the registration certificate provided, with relevant authorities.

17. CONTRACT PERFORMANCE BANK GUARANTEE [CPBG]

a) As a Performance security, the successful Bidder, to whom the work is awarded by, shall be required to furnish within 30 days of notification of award of contract (Letter/ Fax/e-mail of Intent) a Performance Bank Guarantee on RS.100/- VALUE non-judicial stamp paper in favour of the Owner (M/S DAFFPL).

b) The Bank Guarantee amount shall be equal to TEN PERCENT (10%) of the Total Order Value and it shall guarantee the faithful performance of the Order in accordance with the Terms and conditions specified in the documents and specifications.

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c) CPBG shall be in the form of an irrevocable Bank Guarantee (in the format attached) issued by any Indian Scheduled Bank (other than Co-operative Bank).
d) The Bank Guarantee shall be valid for the entire period of the Contract, namely, till the end of the guarantee / warranty period. The guarantee amount shall be payable on demand to the Owner.
e) In case, the Contract Performance Bank Guarantee stated above gets reduced/ deducted for reasons of non-fulfillment of any Contractual obligations upto the completion of guarantee period, the bidder shall immediately take action to increase the value of Bank Guarantee to TEN PERCENT (10%) of the Contract price, to cover his guarantee/warranty obligations.
f) The Performance Guarantee will be returned to the bidder without any interest at the end of the warranty / guarantee period subject to fulfillment of all contractual obligations by the Bidder. The bank guarantee shall have a claim period of 3 months beyond the contractual guarantee period.
g) The proceeds of performance security shall be appropriated by the owner as compensation for any loss resulting from vendor's failure to complete his obligations under the contract to the prejudice to any of the rights or remedies the owner may be entitled to as per terms and conditions of contract. The proceeds of this performance security shall also govern the successful performance of goods and services and vendors all obligations during the entire period of contractual warrantee / guarantee.

18. PRICE REDUCTION FOR DELAY IN DELIVERY:
a) The completion period quoted must be realistic & specific. The inability of successful bidder to execute orders in accordance with the agreed completion schedule will entitle DAFFPL, at its options, to:
b) Accept delayed delivery at prices reduced by a sum equivalent to half percent (0.5%) of the total order value for every week of delay or part thereof, limited to a maximum of 10% of the total order value. Date of completion of work shall be considered for calculation of price reduction
c) The price reduction clause shall become applicable for works done beyond the schedule completion period.

19. INSURANCE
Supplier shall carry and maintain any and all statutory insurance(s) required under Indian Laws and Regulations, including Workmen compensation Act/ESI/Third party liabilities etc. and insurances for their personnel engaged in performance of the work at their own cost.

20. INSPECTION:
a) Material / construction shall be inspected by owner or its representative. Charges other than third party inspection, is entirely vendor responsibility

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and in no way should affect the completion schedule.

b) OWNER may, at its own expense, witness any test or inspection. In order to enable OWNER to witness the tests/inspections OWNER will advise the bidder in advance whether it intends to be present at any of the inspections.

c) Even if the inspection and tests are fully carried out, the Vendor shall not be absolved from its responsibilities to ensure that the Material(s), raw materials, components and other inputs are supplied strictly to conform and comply with all the requirements of the Contract at all stages, whether during manufacture and fabrication, or at the time of Delivery as on arrival at site and after its erection or start up or consumption, and during the defect liability period. The inspections and tests are merely intended to prima-facie satisfy OWNER that the Material(s) and the parts and components comply with the requirements of the Contract. The Vendor s responsibility shall also not be anywise reduced or discharged because OWNER or OWNER s representative(s) or Inspector(s) shall have examined, commented on the Vendor s drawings or specifications or shall have witnessed the tests or required any chemical or physical or other tests or shall have stamped or approved or certified any Material(s).

d) Although material approved by the Inspector(s), if on testing and inspection after receipt of the Material(s) at the location, any Material(s) are found not to be in strict conformity with the contractual requirements or specifications, OWNER shall have the right to reject the same and hold the Vendor liable for non-performance of the Contract.

21. GUARANTEE/WARRANTY:

a) Materials shall be guaranteed against manufacturing defects, materials, workmanship and design for a period of 24 (Twenty Four) months from the date of completion of job. Warranty for replacement of material / accessories should be provided free of charges at our premises. The above guarantee/warranty will be without prejudice to the certificate of inspection or material receipt note issued by us in respect of the materials.

b) All the materials including components and sub contracted items should be guaranteed by the vendor within the warranty period mentioned above. In the event of any defect in the material, the vendor will replace / repair the material at DAFFPL concerned location at vendor risk and cost on due notice.

c) Alternatively, DAFFPL reserves the right to have the material repaired / replaced at the locations concerned, at the vendors risk, cost and responsibility, in case, vendor does not replace / repair the material.

d) The Vendor shall provide similar warrantee on the parts, components, fittings, accessories etc. so repaired and / or replaced.

e) Vendor shall guarantee that the performance of the EQUIPMENT supplied under the CONTRACT shall be strictly in conformity with the specifications and shall perform the duties specified under the CONTRACT.

f) RISK PURCHASE CLAUSE: We reserve the right to curtail or cancel the order

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either in full or part thereof if bidder fails to comply with delivery schedule and other terms & conditions of the order. DAFFPL also reserves the right to procure same or similar materials/equipment through other sources at vendor's entire risk, cost and consequences.

22. TEST & PERFORMANCE CERTIFICATES: Bidder shall furnish Material test and Performance Certificates for the materials along with the challans and invoice.

23. **PAYMENT TERMS**

- **For Price component of Supply**

  i. **On delivery of material:** 80% of the supply price including all taxes, levies & freight etc., will be paid on prorata basis as per approved billing schedule against receipt of material at site and upon submission of following documents:

     - Copies of invoices showing goods description, quantity, unit price and total amount.
     - Railway receipt/ lorry receipt/ delivery of challan duly acknowledged by the Consignee.
     - Manufacturer's guarantee certificate.
     - Inspection certificate and dispatch clearance issued by the nominated inspection agency and supplier's factory inspection report.

  ii. 10% of the supply price including taxes, duties & levies, etc., shall be payable on prorata basis on completion of erection and certification by Site Engineer/PMC.

  iii. Last 10% of the supply price shall be paid on successful commissioning of all equipment and issue of acceptance certificate for the same by OWNER/Consultant.

- **For the Price component of erection:**

  i. 80% of the erection price will be paid progressively on prorata basis on physical progress of work certified by Site Engineer of DAFFPL as per the approved billing schedule and upon submission of the following documents:

     - Copies of invoices
     - Copy of certified progress of work
     - Proof of payment of ESI and deposition of EPF etc.,
     - Wage Sheet
     - Certified Time Sheet

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ii. 10% of erection price shall be payable on prorata basis on successful completion of erection and certification by Site Engineer.

iii. Last 10% of the erection price shall be paid on successful commissioning of all the equipment and issue of acceptance certificate for the same by DAFFPL.

24. **Annual Maintenance Contract (Five Years)**

i. 90% of relevant charges in four equal installments towards maintenance shall be paid at the end of each quarter against submission of pre-receipted invoice and necessary certification by site in charge.

ii. 10% of total charges towards maintenance shall be paid at the end of total maintenance period of 5 years against submission of pre-receipted invoice and necessary certification by DAFFPL/Facility Operator.

iii. Contractor shall execute a Bank Guarantee equivalent to the cost of the Annual Maintenance Contract to cover the five year AMC period. This bank guarantee shall be submitted one month before the end of the Warranty period failing which the existing performance Bank Guarantee shall stand forfeited.

iv. No Interest charges for delay in payments, if any, shall be payable by the Owner.

25. **RECOVERY OF FAILURE OF ITEMS:**

In case the items supplied by the Supplier fails during erection, testing and commissioning due to manufacturing defect the Supplier shall become liable to reimburse to the DAFFPL the landed cost for replacing the defective items including all costs incurred up to delivery thereof at site, all duties, freight, insurance, labour, material, charges for cutting, removing, replacement, engineering and construction supervision charges of consultant, and replacing of defective part(s), including cost of incidental activities.

26. **Labour License**

Before starting of work, CONTRACTOR shall obtain a license from concerned authorities under the Contract Labour (Abolition and Regulation) Act 1970, and furnish copy of the same to DAFFPL.

27. **Labour Relations**

- In case of labour unrest/labour dispute arising out of non-implementation of any law, the responsibility shall solely lie with the CONTRACTOR and he shall remove/resolve the same satisfactorily at his cost and risk.
- The CONTRACTOR shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his staff and labour and to preserve peace and protection of persons and properly in the neighborhood of the Works against such conduct.

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28. **Employment of Labour**

The CONTRACTOR shall not recruit personnel of any category from among those who are already employed by other agencies working at site but shall make maximum use of local labour available

29. House Keeping

- It is the responsibility of the CONTRACTOR to maintain general cleanliness and proper housekeeping at work site. CONTRACTOR shall organize disposal of excavated earth /garbage/ rubbish/ scrape, electrode butts etc. on day to day basis to identified disposal areas/safe areas as per DAFFPL.
- The CONTRACTOR shall dispose off the unserviceable materials, debris etc. to the earmarked area within / outside the Plant premises as decided by the DAPPL. No extra payment shall be paid on this account. Serviceable materials shall be stored in designate area separately after obtaining acknowledgement of DAFFPL Officer.

30. **VARIATIONS IN QUANTITIES**

The quantities indicated in the Tender are approximate. The quoted rates will be applicable for variations without any limit. No revision of rates will be permitted for such variations in the contract value, including variations of individual quantities, addition of new items, alterations, additions/deletions or substitutions of items, as mentioned above. Quantities etc. mentioned and accepted in the joint measurement sheets shall alone be final and binding on the parties.

31. **TECHNICAL INFORMATION**

Drawings, specifications & details shall be the property of the Owner and shall be returned by the Vendor on demand. The Vendor shall not make use of drawing and specifications for any purpose at any time save and except for the purpose of the Owner.

The Vendor shall not disclose the technical information furnished to or gained by the Vendor under or by virtue or as a result of the implementation of this Purchase Order to any person, firm or body or corporate authority and shall make all endeavors to ensure that the technical information is kept CONFIDENTIAL.

The technical information imparted and supplied to the Vendor by the Owner shall at all times remain the absolute Property of the Owner.

32. **SERVICES OF VENDOR'S PERSONNEL**

Upon two weeks advance notice, the Vendor shall depute the necessary personnel to site for supervision of erection and startup of the equipment and train few of the Owner's personnel for the operation and maintenance of the equipment if required, by the Owner. The terms and conditions for the services of the Vendor

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shall be mutually settled.

33. Only in the event of causes of Force Majeure occurring within the contractual delivery period and if they impede the performance of contract, the delivery dates shall be extended on receipt of application from the bidder / Owner without imposition of penalty. Only those causes which depend on natural calamities, civil wars, fire and national strikes which have duration of more than seven consecutive calendar days are considered the causes of force Majeure. The decision of Owner shall be final and binding on vendor.

34. The Vendor must advise the Owner by a registered letter duly certified by Local Chamber of Commerce or statutory authorities and Owner must advise the Vendor by a letter, the beginning and the end of the delay immediately, but in no case later than within 10 days of the beginning and end of such causes of Force Majeure condition as defined above. Provided further that if the performance in whole or part of any obligation under this contract is prevented or delayed by reason of any such event for period exceeding 60 days either party may at its option terminate the contract.

35. Repeat Order: DAFFPL reserves the right to place repeat order up to the order quantity within SIX MONTHS from the date of original order on mutual agreement basis.

36. **COMPLETION OF WORK AND COMPLETION CERTIFICATE**
As soon as the work is completed in all respects, the contractor shall give notice of such completion to the site in charge or the Owner and within thirty days of receipt of such notice the site in charge shall inspect the work and shall furnish the contractor with a certificate of completion indicating:

    - defects, if any, to be rectified by the contractor
    - items, if any, for which payment shall be made in reduced rates
    - the date of completion.

37. Any reference to the Govt. Acts /Regulations etc. in the Bid Document is only indicative, and it is entirely for the bidder to ascertain the applicable Acts/Regulations.

38. Rejected material lying in Owner premises must be replaced within 30 days from date of final report on rejection of material.

39. RECOVERY OF SUMS DUE: Whenever, any claim against bidder for payment of a sum of money arises out of or under the contract or in any other form, the owner shall be entitled to recover such sums from any sum then due or when at any time thereafter

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may become due from the vendor under this or any other form and should this sum be not sufficient to cover the recoverable amount of claim(s), the vendor shall pay to DAFFPL on demand the balance remaining due.

40. PATENTS & ROYALTIES: The vendor shall fully indemnify owner and users of materials specified herein/supplied at all times, against any action, claim or demand, costs and expenses, arising from or incurred by reasons of any infringement or alleged infringement of any patent, registered design, trademark or name, copy right or any other protected rights in respect of any materials supplied or any arrangement, system or method of using, fixing or working used by the vendor. In the event of any claim or demand being made or action sought against Owner in respect of any of the aforesaid matter, the vendor shall be notified thereof immediately and the vendor shall at his/its own expense with (if necessary) the assistance of Owner (whose all expense shall be reimbursed by the vendor) conduct all negotiations for the settlement of the same and/or litigation which may arise thereof.

41. LIABILITY CLAUSE: In case where it is necessary for employees or representatives of the Vendor to go upon the premises of owner, vendor agrees to assume the responsibility for the proper conduct of such employees/representatives while on said premises and to comply with all applicable Workmen s Compensation Law and other applicable Government Regulations and Ordinances and all plant rules and regulations particularly in regard to safety precautions and fire hazards. If this order requires vendor to furnish labour at site, such vendors workmen or employees shall under NO circumstances be deemed to be in owner s employment and vendor shall hold himself responsible for any claim or claims which they or their heirs, dependent or personal representatives, may have or make, for damages or compensation for anything done or committed to be done, in the course of carrying out the work covered by the purchase order, whether arising at owner s premises or elsewhere and agrees to indemnify the owner against any such claims, if made against the owner and all costs of proceedings, suit or actions which owner may incur or sustain in respect of the same.

42. COMPLIANCE OF REGULATIONS: Vendor warrants that all goods/Materials covered by this order have been produced, sold, dispatched, delivered and furnished in strict compliance with all applicable laws, regulations, labour agreement, working condition and technical codes and statutory requirements as applicable from time to time. The vendor shall ensure compliance with the above and shall indemnify owner against any actions, damages, costs and expenses of any failure to comply as aforesaid.

43. REJECTION, REMOVAL OF REJECTED GOODS AND REPLACEMENT: In case the testing and inspection at any stage by inspectors reveal that the equipment, materials and workmanship do not comply with specification and requirements, the same shall be

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removed by the vendor at his/its own expense and risk, within the time allowed by the owner. The owner shall be at liberty to dispose off such rejected goods in such manner as he may think appropriate. In the event the vendor fails to remove the rejected goods within the period as aforesaid, all expenses incurred by the owner for such disposal shall be to the account of the vendor. The freight paid by the owner, if any, on the inward journey of the rejected materials shall be reimbursed by the vendor to the owner before the rejected materials are removed by the vendor. The vendor will have to proceed with the replacement of the equipment or part of equipment without claiming any extra payment if so required by the owner. The time taken for replacement in such event will not be added to the contractual delivery period.

44. NON-WAIVER : Failure of the Owner to insist upon any of the terms or conditions incorporated in the Purchase Order or failure or delay to exercise any rights or remedies herein, or by law or failure to properly notify Vendor in the event of breach, or the acceptance of or payment of any goods hereunder or approval of design shall not release the Vendor and shall not be deemed a waiver of any right of the Owner to insist upon the strict performance thereof or of any of its or their rights or remedies as to any such goods regardless of when such goods are shipped, received or accepted nor shall any purported oral modification or revision of the order by DAFFPL act as waiver of the terms hereof. Any waiver to be effective must be in writing. Any lone incident of waiver of the any condition of this agreement by DAFFPL shall not be considered as a continuous waiver or waiver for other condition by DAFFPL.

45. NEW & UNUSED MATERIAL: All the material supplied by the vendor shall be branded new, unused and of recent manufacture.

46. CANCELLATION:
    a) DAFFPL reserves the right to cancel the contract/purchase order or any part thereof through a written notice to the vendor if –
        i. The vendor fails to comply with the terms of this purchase order/contract.
        ii. The vendor becomes bankrupt or goes into liquidation.
        iii. The vendor fails to deliver the goods on time and/or replace the rejected goods promptly.
        iv. The vendor makes a general assignment for the benefit of creditors.
        v. A receiver is appointed for any of the property owned by the vendor.
        vi. Any other conditions where owners commercial interest get affected.
    b) Upon receipt of the said cancellation notice, the vendor shall discontinue all work on the purchase order matters connected with it. DAFFPL in that event will be entitled to procure the requirement in the open market and recover excess payment over the vendor s agreed price if any, from the vendor and also reserving to itself the right to forfeit the security deposit if any, made by the vendor against the contract. The vendor is aware that the said goods are

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required by DAFFPL for the ultimate purpose of materials production and that non-delivery may cause loss of production and consequently loss of profit to the DAFFPL. In this-event of DAFFPL exercising the option to claim damages for non delivery other than by way of difference between the market price and the contract price, the vendor shall pay to DAFFPL, fair compensation to be agreed upon between DAFFPL and the vendor. The provision of this clause shall not prejudice the right of DAFFPL from invoking the provisions of price reduction clause mentioned aforesaid.

47. ANTI –COMPETITIVE AGREEMENTS/ABUSE OF DOMINANT POSITION: The Competition Act, 2002 as amended by the Competition (Amendment) Act, 2007 (the Act), prohibits anti- competitive laws and aims at fostering competition and at protecting Indian markets against anti- competitive practices by enterprises. The Act prohibits anti- competitive agreements, abuse of dominant position by enterprises, and regulates combinations (consisting of acquisition, acquiring of control and M&A) wherever such agreements, abuse or combination causes, or is likely to cause, appreciable adverse effect on competition in markets in India. DAFFPL reserves the right to approach the Competition Commission established under the Act of Parliament and file information relating to anti-competitive agreements and abuse of dominant position. If such a situation arises, then Vendors are bound by the decision of the Competitive Commission and also subject to penalty and other provisions of the Competition Act.

48. ASSIGNMENT: The Vendor can / does not have any right to assign his rights and obligations under these general purchase conditions without the prior written approval of DAFFPL.

49. GOVERNING LAW: These General Purchase Conditions shall be governed by the Laws of India.

50. AMENDMENT: Any amendment to these General Purchase Conditions can be made only in writing and with the mutual consent of the parties to these conditions.

51. The following expressions used in these terms and conditions and in the purchase order shall have the meaning indicated against each of these:
    a) **OWNER,** Client, Purchaser, buyer **:** means DAFFPL
    b) **VENDOR**, tenderer, Bidder, Contractor, Seller, Supplier, manufacturer stated anywhere in the tender document carry the same meaning: It means the person, firm or the Company / Corporation to bidding and shall include its successors and assigns.
    c) **INSPECTOR/ TPIA:** Person/agency deputed by Owner for carrying out inspection, checking/testing of items ordered and for certifying the items conforming to the purchase order specifications..
    d) **GOODS / MATERIALS:** means any of the articles, materials, machinery,

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equipments, supplies, drawing, data and other property and all services including but not limited to design, delivery, installation, inspection, testing and commissioning specified or required to complete the order.

e) **SITE / LOCATION:** means any Site where DAFFPL desires to receive materials anywhere in India as mentioned in tender
f) **CONTRACT**, Order or Purchase Order/CALL-OFF means the agreement for supply of goods/ materials for required quantity between Owner and Vendor, for a fixed period of time on mutually agreed terms and conditions.
g) The term MR means Material Requisition containing technical requirements and scope of work (technical), GPC means General Purchase Conditions containing commercial terms & conditions, PO means Purchase order issued after award of contract incorporating agreed deviations in MR, ATC means Agreed Terms & Conditions , RFQ means Request For Quotation.
h) For the purpose of contract, the trade terms FOB, CFR and CIF, DAP shall have the meanings as assigned to them by INCOTERMS 2010 published by ICC, Paris.

52. REFERENCE FOR DOCUMENTATION :

The number and date of Collective Request for Quotation (CRFQ) must appear on all correspondence before finalization of Contract / Purchase Order.

After finalization of Contract / Purchase Order: The number and date of Contract /Purchase Order must appear on all correspondence, drawings, invoices, dispatch advices, (including shipping documents if applicable) packing list and on any documents or papers connected with this order.

53. ARBITRATION

a) Any 'dispute or difference of any nature whatsoever, any claim, cross-claim, counterclaim or set off of the Owner against the Consultant or regarding any right, liability, act, omission or account of any of the parties hereto arising out of or in relation to this agreement shall be refereed to the Sole Arbitration of the nominated Director of the Owner or of some Officer of the Owner who may be nominated by the nominated Director. The consultant will not be entitled to raise any objection to any such arbitrator on the ground that the arbitrator is an officer of the Owner or that he has dealt with the matters to which the contract relates or that in the course of his duties as an Officer of the Owner, he had expressed view on all or any other matters in dispute or difference. In the event of the arbitrator to whom the matter is originally referred being transferred or vacating his office or being unable to act for any reason, the nominated Director as aforesaid at the time of such transfer, vacation of office or inability to act may in the discretion of the nominated Director designate another person to act as arbitrator in accordance with the

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terms of the agreement to the end and intent that the original Arbitrator shall be entitled to continue the arbitration proceedings notwithstanding his transfer or vacation of office as an officer of the Owner if the nominated Director does not designate another person to act as arbitrator on such transfer, vacation of office or inability of original arbitrator. Such person shall be entitled to proceed with the reference from the point at which it was left by his predecessor. It is also a term of this contract that no person other than the nominated Director of the Owner or a person nominated by such nominated Director as aforesaid shall act as arbitrator hereunder. The award of the arbitrator so appointed shall be final, conclusive and binding on all parties to the agreement subject to the provisions of the Arbitration & Conciliation Act,1996 or any statutory modification or reenactment thereof and the rules made there under for the time being in force shall apply to the arbitration proceedings under this clause.

b) The arbitrator shall have power to order and direct either of the parties to abide by, observe and perform all such directions as the arbitrator may think fit having regard to the matters in difference i.e. dispute, before him. The arbitrator shall have all summary powers and may take such evidence oral and/or documentary, as the arbitrator in his absolute discretion thinks fit and shall be entitled to exercise all powers under the Indian Arbitration & Conciliation Act 1996 including admission of any affidavit as evidence concerning the matter in difference i.e. dispute before him.

c) The parties against whom the arbitration proceedings have been initiated, that is to say, the Respondents in the proceeding, shall be entitled to prefer a cross claim, counter claim or set off before the Arbitrator in respect of any matter in issue arising out of or in relation to the Agreement without seeking a formal reference of arbitration to the nominated Director/officer for such counter-claim, or set off and the Arbitrator shall be entitled to consider and deal with the same as if the matters arising therefore has been referred to him originally and deemed to form part of the reference made by the nominated Director/officer.

d) The arbitrator shall be at liberty to appoint, if necessary any accountant or engineering or other technical person to assist him, and to act by the opinion so taken.

e) The arbitrator shall have power to make one or more awards whether interim or otherwise in respect of the dispute and difference and in particular will be entitled to make separate awards in respect of claims of cross claims of the parties.

f) The arbitrator shall be entitled to direct any one of parties to pay the costs to the other party in such manner and to such extent as the arbitrator may in his discretion determine and shall also be entitled to require one or both the parties to deposit funds in such proportion to meet the arbitrators expenses whenever called upon to do so.

g) The parties hereby agree that the courts in the city of Delhi alone shall have

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jurisdiction to entertain any application or other proceedings in respect of anything arising under this agreement and any award or awards made by the Sole Arbitration hereunder shall be filed (if so required) in the concerned courts in the city of Delhi only.

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Tender Package for Automation of Fuel Farm and Hydrant system

Modernisation of Fuel Farm-IGI Airport,
Shahbad Mohammadpur, New Delhi

February 2018

Delhi Aviation Fuel Facility Private Limited

DAFFPL

Mott MacDonald

Tender Package for Automation of Fuel Farm and Hydrant system

Modernisation of Fuel Farm-IGI Airport, Shahbad Mohammadpur, New Delhi

February 2018

Delhi Aviation Fuel Facility Private Limited

Aviation Fuelling Station, Shahbad Mohammad Pur, IGI Airport New Delhi-110061

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Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
P1	22.01.2015	VST/NSN	HBC	V S Thakur	Issued for Approval
P2	12.05.2015	VST/NSN	HBC/KBT	V S Thakur/VKG	Issued for Approval
P3	27.08.2015	HVM	KBT/THS	V S Thakur/VKG	Issued for Approval
P4	02.09.2015	HVM	KBT/THS	V S Thakur/VKG	Issued for Approval
P5	10.09.2015	HVM	KBT/THS	V S Thakur/VKG	Issued for Approval
P6	10.12.2015	HVM	KBT/THS	V S Thakur/VKG	Issued for Approval
0	12.05.2016	HVM	KBT/THS	V S Thakur/VKG	Issued for Execution
1	26.12.2017	HVM	KBT/THS	JU	Revised as per client comment Issued for Execution
2	02.08.2018	HVM	KBT/THS	JU	Revised as per client comment Issued for Execution

Information class: Standard

Modernization of Fuel Farm of Delhi Aviation Fuel Facility Pvt. Ltd. IGI Airport, New Delhi

Tender Package for Automation of Fuel Farm and Hydrant System	**Project No.:322538**
	Reference: Existing fuel farm facility
	No. of Sheets: 165

Job Number	Facility Location Code	Document Number
322538	Shahbad Mohammadpur, IGI Airport-New Delhi	322538-NSD-011

☐ **Code 1**: Approved and Work may Proceed.

☐ **Code 2:** Revise & Re-submit. Work may Proceed subject to incorporation of comments.

☐ **Code 3:** Revise & Re-Submit. Work should Not Proceed.

☐ **Code 4:** Review Not Required. Work may Proceed.

Approval to proceed shall not be deemed as Acceptance or Clearance of Design, Calculations, Analyses, Test Procedures/Methods, or Selection of Materials by the Contractor. The Contractor shall Not be relieved from full compliance of Contract Requirements and Technical Specifications.

Dated: **Delhi Aviation Fuel Facility Pvt. Ltd.**

Document No.

2	02.08.18	Execution	HVM	KBT/THS	JU	
1	26.12.17	Execution	HVM	KBT/THS	JU	
0	12.05.16	Execution	HVM	KBT/THS	VS Thakur	
P6	10.12.15	Approval	HVM	KBT/THS	VS Thakur	
P5	10.09.15	Approval	HVM	KBT/THS	VS Thakur	
Rev	**Date**	**Issued For**	**Prepared By:**	**Checked By:**	**Approved By:**	**Approved By:**
			Mott MacDonald Pvt. Ltd.			**Client**

Contents

Abbreviations

AI	Analog Input
AO	Analog Output
AFC	Approved for Construction
ACK	Acknowledge
AFFAS	Aviation Fuel Farm Automation System
CCN	Change Control Note
CP	Cathodic Protection
CQP	Contract Quality Plan
CIU	Communication Interface Unit
DPT	Differential Pressure Transmitter
ESD	Emergency Shutdown System
EWS	Engineering Work Station
FAT	Factory Acceptance Test
FIU	Field Interface Unit
GB	Giga Bytes
HDD	Hard Disk Drive
IER	Instrument Equipment Room
ISA	Instruments Society of America
LAN	Local Area Network
Mbps	Mega Bytes per Second
MTBF	Mean Time between Failures
OWS	Operator Work Station
PC	Personal Computer
RIU	Remote Interface Unit
SAT	Site Acceptance Test
TE	Temperature Element
VDU	Video Display Unit
WS	Work Station
CCTV	Close Circuit Television
CPU	Control Processor Unit
EOD	End of Day
EOM	End of Month
FCV	Flow Control Valve
FDS	Functional Design Specification
FOC	Fibre Optic Cable

FSB	Full Speed Bus
GUI	Graphical User Interface
HMI	Human Machine Interface
HSE	High Speed Ethernet
MCC	Motor Control Centre
MIS	Management Information System
HMI	Man Machine Interface
MOS	Manual Override Switch
MTBF	Mean Time between Failures
MTTR	Mean Time to Repair
ODBC	Open Data Base Connectivity
OIC	Operator Interface Console
OPC	OLE for Process Control
OSBL	outside Battery Limit
PAGA	Public Addressing and General Alarm
PDM	Positive Displacement Meter
PLC	Programmable Logic Controller
RDBMS	Relational Data Base Management System
RFI	Radio Frequency Interference
RAID	Redundant Array of Independent Disk
RTU	Remote Terminal Units
SCADA	Supervisory Control and Data Acquisition
SER	Sequence Event Recorder
SIT	System Integrated Test
SNMP	Simple Network Management Protocol
SOV	Solenoid Operated Valve
SQL	Structured Query Language
TAS	Terminal Automation System
TDM	Terminal Data Manager
TFMS	Tank Farm Management System
TFT	Thin Film Transistor
TLF	Tanker Lorry Filling
TT, T/T	Tank Truck
TUV	Technischer Überwachungs-Verein (German Technical Supervisory Association)
VAC	Volts alternating current
VDC	Volts direct current
VFD	Variable frequency drive.
VRS	Vapour Recovery System

W&M	Weights & Measures – Government Department
MCT	Multi Cable Transit
PPE	Personal Protection Equipment
IEC	International Electro Technical Commission
IS	Intrinsic Safety
JB	Junction Box
LCD	Liquid Crystal Display
MCB	Main Circuit Board
PSV	Pressure Safety Valve
TSV	Thermal Safety Valve
UPS	Uninterruptible Power Supply
LS	Limit Switch
ATF	Aviation Turbine Fuel
BAS	Building Automation System
LT	Level Transmitter
MOV	Motor Operated Valve
OFC	Optical fibre Cable with Converter
PT	Pressure Transmitter
RTD	Resistance Temperature Detector
SLCV	Sludge Control Valve
SCV	Slow Acting Check Valve
TM	Terminal Manager
LDS	Leak Detection System
TCP	Transmission Control Protocol
FCU	Field Communication Unit
DI	Digital Input
DO	Digital Output
LO	Lock Open / Full Open
LC	Lock Close / Full Close
LSS	Long Standing Still
MSBT	Maximum Spring Break Torque
QAP	Quality assurance Plan
RC	Regular Cycling
SET	Spring End Torque
SRT	Spring Return Torque
SST	Spring Standing Torque
EPC	Engineering, Procurement and Construction
FED	Front End Design

FLD	Functional Logic Diagram
HSE	Health, Safety and Environment
MTO	Material Take Off
NDT	Non-Destructive Testing
P&ID	Piping & Instrument Diagram
PFD	Process Flow Diagram
QA / QC	Quality Assurance / Quality Control
QES	Quality and Environmental System
QRA	Quantitative Risk Assessment
SLD	Single Line Diagram
SOW	Scope of Work
TBE	Technical Bid Evaluation
OSBL	outside Battery Limit
DCS	Distributed Control System
O&U	Offsite & Utilities
I/O	Input / Output
BL	Battery Limit
TPH	Tons per Hour
MW	Mega Watt
FCS	Field Control System
ASME	American Society for Mechanical Engineers
QA/QC	Quality Assurance / Quality Control
API	American Petroleum Institute
NB	Nominal Bore
SCH/Sch	Schedule
FLG	Flanged
ANSI	American National Standard Institute
OD	Outside Diameter
WN	Weld Neck
mm	mili meter
ASTM	American Society for Testing and Materials
DIN	Deutsches Institut für Normung
CS	Carbon Steel
MODBUS	A serial communication Protocol
r. m. s	Root Mean Square
HART	Highway Addressable Remote Transducer
TOV	Total Observed Volume
GOV	Gross Observed Volume

GSV	Gross Standard Volume
mA	Milli Ampere

1 General

Introduction This document deals with the Technical Specifications for the design, supply, erection, testing & Commissioning of Automation of Existing Fuel farm System for Modernization of DAFFPL's Fuel Farm at IGI Airport, Shahbad Mohammadpur, New Delhi. The Owner for the facility is DAFFPL. This document shall be used as a reference for the bidding of the said works. The parties who wish to take up the work are hereafter termed as "Contractor's". The successful "Contractor" after the approval of the "Owner" shall be termed as the "Contractor". All the works shall be carried out as directed by the Owner's Engineer, herewith, termed as "Owner's Representative".

This document deals with the Technical Specifications for all the works and all the required material and workmanship.

M/s. Delhi Aviation Fuel Facility Private Limited (DAFFPL) is a joint venture between Indian Oil Corporation Limited (IOCL), Bharat Petroleum Corporation Limited (BPCL) & Delhi International Airport Limited (DIAL). M/s Indian Oil Sky Tanking Limited (IOSL) is responsible for running day to day operations of receiving the Jet fuel, storing the same in Fuel Farm and refuelling the Aircrafts. It is facilitating day to day operations effectively so that the Jet Fuel is received, stored and delivered safely to the aircrafts. DAFFPL also has to envisage the future requirements and make provision for the same. The existing system has aged considerably and in view of this it is contemplated to revamp the system incorporating latest safety measures and technology.

1.1 The Project Preamble

DAFFPL proposes for the Modernization and Automation system of their existing Fuel Farm facility at Shahbad Mohammadpur, IGI Air Port, New Delhi.

This existing fuel farm facility shall be made fully automatic using state of art automation control by SCADA system. Presently system is working manually. The details of existing facilities are as follows:

a) Tankages: 4 X 6000 KL each and 2 X 9000 KL each. (Total 42000 KL).
b) Aviation Turbine Fuel (ATF) is received from IOCL and BPCL from Brijwasan Terminal through Pipe lines with a flow rate of 200 KL/hou.
c) 8 bay Tank Truck decantation facilities with 2 X 75 m3/Hr (75 KW) pumps.
d) Within the ATF hydrant pump house, 2x75 KW Jockey Pumps, 8x160 KW (3600 LPM) pumps + 2 x 220 KW (4000 LPM) pumps are installed.
e) This station takes care of ATF supply currently for Terminal 2 (Cargo) & Terminal 3.
f) Power supply is from two sources – 11 KV and 33 KV coming from two different substations.
g) Firefighting facilities covering the tank Farm, operational area, office building etc. are already provided. DAFFPL has recently replaced the old DG sets with new 2 X 1010 KVA DG sets.

2 Scope of Work for Automation of Fuel Farm & Hydrant System

2.1 Scope of Work

a) This specification defines the minimum requirements of fuel farm terminal automation system designed for reliable, effective and optimum control & monitoring of terminal operations. This specification covers the complete design & engineering, technical specification of Aviation Fuelling Station Control System using SCADA / PLC system.

b) This scope of work for the job shall broadly comprise Not Limited of the following sub-systems:

i. Contractor to Design the system engineering of complete Automation system as per attached specification including interfacing with following sub-systems.

- PLC / SCADA System
- Tank Farm Management System
- MOV & ROSOV interface System
- Emergency Shut Down System
- CCTV System
- Field Instrumentation & Communication, Control & Power cables
- Hard ware & Software, Interface sub system with PLC, SCADA
- Suitable Redundant UPS for above system.

ii. Contractor to supply the complete hardware and software for fuel terminal Automation systems including all installation material required to meet the specified functional requirements including Factory testing, Third party Inspection and Acceptance of complete system.

iii. Packing, forwarding, transportation, custom clearance, insurance, storage etc. of the equipment, machines, hardware of Automation System

iv. Installation, Field Testing, commissioning and field Acceptance, Test Run & stabilisation of complete Automation System.

v. Documentation, training, Annual maintenance Contract (AMC), warranty, As Built drawings etc.

vi. Supply of special tools and test equipment's, spares required for testing, calibration, commissioning and maintenance of the system

vii. Any other instrument / equipment / service which are not explicitly mentioned above or in the BOQ but deemed necessary for the successful operation of the system complete in all respects shall be in contractors' scope.

2.2 Introduction to Facilities:

The proposed system shall consist of Fuel farm storage, Receipt pipelines, Transfer lines, Hydrant pipelines up to boundary limit of the facilities.

a) The Fuel farm Facility consists of storage tank farm, which consists of 06 Nos. aboveground vertical, cone roof tanks for storage of Jet-A1 fuel. The details of the tanks are: 4 tanks each of 6,000 KL capacity (20M dia x 20 M height) + 2 tanks each of 9,000 KL capacity (24M dia x 20 M height). Total storage capacity of 42,000 KL, with a provision of space for more 02 Nos. tanks for future. Aviation Turbine Fuel received through pipe lines from Terminals of IOCL, BPCL with a flow rate of approximately 200 KL/hour. Facility also exists for Tank Truck loading / unloading by 8 nos. of bays in TT decanting gantry. ATF will unloaded & pumped through pipe lines to these storage tanks.

b) It was observed that different size and type of valves were fitted on the inlet and outlet nozzles of the tanks. In view of Report & Recommendation of MB Lal Committee, Remote Operated Shut Off Valve (ROSOV) – Triple Offset Butterfly Valve are being installed as tank body valves.
c) Moreover, as per 'M.B. Lal Committee recommendation the first body valve on the tank should be Remote Operated Shut Off Valve (ROSOV) on the tank nozzle inside the dyke. The Remote operation will be from outside the dyke as well as from the control room. ROSOV should be Fail Safe and Fire Safe. It should have only “Close” operation from Control Room. However, it should have “Close” and “Open” operation from the panel located outside the dyke.
d) Push buttons assembly should be mounted outside the dyke, at a place where it is easily accessible and visible to the operator.
e) Push buttons on other existing MOV’s also should be brought just outside the dyke. The cables leading to the control room should be Fire Safe.
f) MOV control system shall comprise of smart Electro-Hydraulic and Motor Operated Actuators, two wire communication bus All the Motors of actuators Operated Valves shall be connected in a two wire loop originating and returning, which shall be created in the main PLC system. All the actuators shall communicate to PLC system over MOD bus protocol.
g) Each storage tank shall have ROSOV ON / OFF valves on inlet and outlet connections. These valves are to be operated from control system based on the product level in the individual tanks and valves status like ‘Open’ or ‘Close’ to be indicated on screen of control system. These Hydro Electric ROSOV valves are to be interlocked on inlet with high level and on the outlet with low level of individual tanks.
h) These tanks will have Radar type tank gauging system for the measurement of level, average temperature & density of the product on the SCADA system. Each tank shall have tank side indicators provided for indicating level and temperature. These indicators shall be connected to the communication interface unit in multi-drop mode and in turn connected to the tank farm management system. The tanks are also provided with high level switches which are used for alarm & tripping.
i) The tanks shall also be provided with high level switches. These switches are used for alarm / tripping purpose. Motor operated valves shall be provided at the inlet, outlet and recirculation lines of each storage tanks to control the receipt / despatch operation. The fuel is pumped with 10 nos. of ATF Hydrant pumps (P-301 to P-310 of discharge 275 m^3 / hr each are installed in the fuel farm area for refuelling the aircrafts .The ATF Hydrant pump is selected and operated by interlocking logic provided for selecting the tank for transferring the product through the outlet ROSOV based on the level of individual tank.
j) In the ATF Hydrant Pump House, 2 Nos. Jockey Pumps each of 55 KW, 8 Nos Pumps each of 160 KW (3600LPM) and 2 Nos. pumps each of 200 KW (4000LPM) pumps, have been installed. These pumps refuel the aircrafts currently parked at Cargo Terminal No. 2 & Terminal No. 3.
k) For each hydrant pump there will be a Filter water Separator provided with an automatic slug control valve on the downstream of the vessel. This control valve will be actuated through float type level switch installed in the sump of the vessel. When there is water contained in FWS, Level Switch will open the drain control valve and SLCV will be closed during this period. Otherwise when there is no water in FWS, LS will actuate the SLCV.
l) The hydrant pumps are partially provided with VFDs. The VFD shall be controlled by the control system. Each pump discharge is to be provided with flow meter for measuring the pump discharge volume i.e. flow indication, totalising. Recording of these data shall be provided in the PLC control system.
m) A motorised valve (MOV’s) is provided at the hydrant discharge header, which is operated from control system (PLC / SCADA) and valve status are hooked to the central control system. This valve is interlocked with emergency shut-down switch. As the system is basically pressure based, a pressure transmitter with local indication is to be provided on main hydrant header after hydrant shut-off valve. It is required to indicate and record pressure in control system. The system controls

the pumps on a pressure responsive basis to maintain pre-set pressure in the fuelling hydrant header, changing over to become flow responsive system as the flow meter in the hydrant line senses a flow of fuel. The control system ensures that pressure in the hydrant header is maintained at a pre-set value. In the event of any decrease in the header pressure, the selected hydrant pump will start running and the control system checks for any flow in the line after a pre-set time. If there is no flow sensed, the running pumps get stopped.

n) If any aircraft gets connected to the hydrant line for fuelling, the pressure in the line gets reduced and the selected pump will be called into operation by the control system. The control system after starting the pump VFD will slowly increase the speed of the pump till the pressure in the pipeline is maintained at the pre-set. As the pump runs up and is capable of producing a flow of fuel by using variable speed drive, the restoration of pressure is now performed and any required fuel demand can now be satisfied if within a capacity of the single pump running.

o) Due to increase in load at the apron, hydrant header pressure decreases below the set point value / flow rate of running hydrant pump increases beyond the value set, and is maintained for a period greater than the delay time set in, the second pump in sequence gets started. The control system takes the decision to start-up or shut-down pumps from pressure & flow signals received from the field instruments.

p) The order in which pumps are started and stopped in the automatic mode shall be set by the program on the matrix of 10 x10. The X axis represents main hydrant pumps numbered left to right as 1 to 10 inclusive. The Y axis represents the pump sequence demand numbered top to bottom as 1 to 3 inclusive.

q) The indications of selected pump running, flow-rate pump failure and pump not in sequence and pump demand is met with, shall be provided on screen. Shutting down sequence is arranged as a reverse order of the starting up sequence. If the system is put into manual mode of operation, pump start and stop and speed control is to be controlled from the operator station. Manual control shall be provided in the SCADA HMI software for each hydrant pump and these shall be active only when system is in manual mode.

r) In the normal operation a sequence demand indicator will flash first followed shortly by a pump running indicator as the programmed pump begins to produce flow. The order in which sequence demand occurs depends on the settings pre-set on the flow discriminator modules. Sequence 1 corresponds to flow discriminator 1, sequence 2 with flow discriminator 2, etc. The order in which pumps start and stop is determined by the programmed points of 4 x 4 matrixes.

s) Shutting down sequence is again determined by the settings on the flow discriminator modules and would in normal circumstances be arranged as a reverse order of the starting up sequence. Normally the pump demand indicator will extinguish first followed shortly by the pump running indicator in shutting down sequence.

t) If the system is put into manual mode of operation, pump start and stop is to be controlled by the SCADA / HMI. The pump running and pump demand indicators will operate as in automatic mode, but will have no effect on the operation. Manual control push buttons shall be required for each hydrant pump and these shall be active only when system is in manual mode in the field.

u) All the ATF from sampling points and tank drains etc. will be collected in an underground tank installed outside the tank farm .The ATF from underground tank meeting the specification requirements, will be pumped back to the above ground storage tanks through FWS having Automatic Slug Control Valve. The ATF, which does Not meet the specifications, shall be pumped in the slop tank. The downgraded ATF, which doesn't meet the specification requirements, is to be disposed off. Proximity provision shall be mounting with drain valve for Acknowledgement for open and close status.

2.3 Site Conditions

2.3.1 Location

The site is located at Shabad Mohammadpur adjoining to Indira Gandhi International Airport, New Delhi. The site is approachable by road.

2.3.2 Environmental Design Parameters

Project	:	Delhi Aviation Fuel Facility Private Limited
Site address	:	DAFFPL's Fuel Farm, IGI Air Port, New Delhi
Nearest Railway Station	:	New Delhi Railway Station
Nearest Airport	:	Indira Gandhi International Airport, New Delhi
Altitude	:	237 m
Operating Max. Temperature	:	48.4 °C
Operating Min. Temperature	:	- 2.2 °C
Design Temperature	:	54.0°C
Humidity, Maximum	:	100 %
Humidity, Minimum	:	25 %
Maximum Rainfall	:	20-30 mm in one hour duration
Designed Wind Velocity	:	47 m/s
Barometric Pressure	:	0.98 bar
Seismic Zone	:	Zone IV as per IS: 1893

Note: Where design and operating conditions, different from the above are required for particular equipment, they are described in the specification of the equipment concerned.

2.4 Codes and Standards

The following standards shall govern the design and selection of above system:

ISO 9001-2008	:	Quality Management System.
ANSI/ISA S84-1	:	Reliable Calculation.
ISA- 71.04	:	Environmental Conditions for Process Requirements and Control System: Airborne contaminants.
IEC-801/sn-500 81/82	:	Electromagnetic Compatibility for Industrial Process Measurements & Control Equipment.
IEC-68	:	Environmental Testing
IEC-61508	:	Functional Safety – Programmable Electronic System
IEEE	:	Institute of Electrical & Electronic Engineering
BS 5490	:	Specification for Degree of Protection Provided by Enclosures

IEC-61131 Parts 1-4	:	Programmable Controllers
ISO 4185	:	Standard for measurement of liquid flow in closed Conduit weighing method
API-RP 551	:	Process Measurement Instrumentation
API-RP 540	:	Recommended Practice for Electrical Installations in Petroleum Processing Plant
IS 11260	:	Stabilized power supplies AC Output
DIN 43760	:	Resistance temperature detectors
MC 96.1	:	Thermocouple
TIA/EIA 568A	:	Telecommunication cable standard
ISO 4266	:	Petroleum and liquid petroleum products – Measurement of level and temperature in storage tanks by automatic methods.
IS 2801	:	PD meter Accuracy
OIML R85	:	Automatic level gauge for measuring the level of liquid in fixed storage tank
API MP MS 7-4	:	Static temperature determination using fixed automatic tank thermometer
ISO/TC28/Section 3	:	Terms relating to calculation of oil quantity.
API MP MS 3-1A	:	Standard practice for manual gauging of Petroleum and Petroleum product in stationary tank
API MP MS 3-1B	:	Standard practice for level measurement of liquid hydro carbon in stationary tank for automatic tank gauging.
ISA –S5.1	:	Instrument Symbol & Identification
IS 3624	:	Specification for Pressure & Vacuum Gauges
IEC-529/NEMA/ IS 2147/ IS 13947:1992	:	For execution of Instrument Enclosures
DIN V 19250-1994	:	Safety consideration for fail safe control for control and Instrumentation equipment
DIN V VDE 0801	:	Principle of Computers in Safety Related Systems

Standards not indicated in the above lists are also acceptable (subject to approval by “Owner Representative” if they are established to be equal or superior to the above standards.

In the event of any conflict between the Code and the Standards referred to in this specification and the requirements of this specification, then the requirement of this specification will govern.

2.5 SCADA & PLC System

The control system shall be fully automatic and enable the facilities to operate safely. The operator and engineering consoles, printers, controllers, I/O modules, barrier, marshalling racks, power distribution

boards, etc. shall be installed in the central control room in the existing fuel farm facility. The display language shall be in English, which is the default language of the system. The display colours shall be chosen to give operator comfort with long term operations.
Operation of the Fuel farm system is envisaged from the HMIs and hence system monitoring, graphic building, Trending, alarming and event recording, history etc. is envisaged. Manual operation & forcing of any element connected to PLC shall be possible from keyboard.

2.5.1 System Architecture

System architecture shall be open, providing data movement horizontally and vertically throughout the operation structure.

The system architecture shall accommodate both functional and geographical distribution of the hardware, software & database over terminal while allowing system wide access to the distributed data. The automation system shall use modular architecture to permit wide range of system configuration and facilitate system flexibility and expandability. It shall include real time control at field level, supervisory control, centralized order allocation, transaction processing and product inventory tracking at terminal level & comprehensive product movement at the management level.

Centralised Automation System shall have the following facilities as a minimum. Please refer attached system Architecture drawing no. (322538-NIC-0001-01)

Redundant Server Based System for SCADA HMI Interface modules for:

a) Field instrumentation.
b) Tank Farm Management System.
c) Safety PLC
d) MOV & ROSOV
e) MCC Interface for Pumps and Drive.
f) VFD Interface for Hydrant Pumps.
g) Existing Cathodic Protection for both T3 & T2 Terminal.
h) Existing ESD (Emergency Push Button) on T3 & T2 Terminal.
i) 2X1010 KVA DG set.
j) CCTV.
k) External Lighting.
l) All the ESD push buttons of fuel farm facility shall be connected serial on two wire system.
m) Interface to any of the centralised system of the Airport (if required for MIS purpose).
n) HMI / SCADA package shall be server version and shall be with latest WINDOWS based OS.
o) 2 Nos. Operator Interface Consoles (OIC 1 for SCADA runtime package and operation interface + OIC 2 Engineering Station cum Operation Interface) comprising of the version of HMI / SCADA package along with Windows XP7 operating system located at Main control room and its associated printers.
p) TFMS shall be installed at main control room CIU shall be one no installed at the same location and Fuel farm area tank level indicator to be interface with the CIU.
q) PLC in hot- standby configuration with required server/marshalling/power distribution cabinets
r) Dual redundant communication on high speed local area network conforming to IEEE 802.3, IEC, CSA Standards & utilize industry standard protocols with 100 MBPS speed & physical connections utilizing 100 base2, 100base5, 100base FO design
s) Printer server
t) Network printer.
u) Report printer.

v) Alarm & Event Printer.
w) SCADA / HMI Package.

2.5.2 Design Specification of SCADA

a) The SCADA system shall be of the latest evolutionary type with 'Open System Architecture' having networking capability with other systems distributed geographically in the various units of a plant over a plant wide information network such as Ethernet and other industrially recognised open network.
b) The SCADA system will be installed and implemented for co-ordination of all the activities within the facility area and the hydrant system, controlling and monitoring the operation of the facility, Emergency Shutdown System.
c) The SCADA system shall monitor and control the movements of JET A1 fuel handled and administered within the facility.
d) The SCADA System Shall be communicate with fire engines or related system.
e) The SCADA system shall be used for automatic Tank gauging inventory reconciliation.
Following functions shall be provided in the system as a minimum. System shall provide interface to Tank Farm Management System, which shall allow the following:
i) Product level, temperature and density measurements for Jet A1 fuel.
ii) Volume calculation according ASTM/API tables, which include total observed volume (TOV), gross observed volume (GOV), gross standard volume (GSV), available pump able volume and available space.
iii) Product flow calculation.
iv) High, High-High, Low, Low-Low alarm.
v) Gauge diagnostics and status information.
vi) Differential Pressure (DP) reading v/s flow rate / throughput for the Filter water separators to be recorded and graphical representation to be made available on SCADA system
vii) System diagnostics.
viii) Batch handling.
ix) Pump/Running status.
x) MOV Open/Close status
xi) Product recovery tank level status.
xii) ESD status, which will include the location of Emergency Push Button.
xiii) Logic for Jet A1 Hydrant pumps sequence / start/stop/VFD speed control to be built into system.
xiv) Tank stock inventory function.
xv) MIS functions (Scheduled reports, demand reports etc.)
xvi) System shall provide interface to Airport Centralised System. It shall be possible to exchange data to and from SCADA system to these external systems.
xvii) System shall provide interface industrial Ethernet to other PC's or servers on TCP/IP
Following reports shall be possible form the SCADA system in general. Detailed report formats based on "Contractor's" requirement shall be finalised during detailed engineering of system:
- Alarm Summary Report.
- Event Report.
- Daily / Hourly Total Volume/flow.
- Daily Leak Detection Report (Future).
- ESD Report.
- Running Hours for each of Jet A1 Hydrant pump.

2.5.3 Technical Specification for SCADA system

The SCADA system shall be provided with the following features:

a) Microprocessor based programmable system with standard hardware and software.
b) Dual redundant configuration with simplex direct hardwired I/O.
c) Support dual redundant, high-speed communications link through Ethernet and OFC.
d) Support industry standard full duplex communication protocol such as TCP/IP.
e) Installed in its own freestanding cabinet.
f) Capable of interfacing with the Analogue I/O 4-20 mA, Digital I/O – volt free contact & 24 VDC, RTD,TC inputs.
g) Supplied with dual 230 VAC input power supplies (UPS supply).
h) Provide regulatory PID control algorithms, Boolean logic functions.
i) Support programming in accordance with IEC 61131.
j) Provide serial MODBUS RTU Protocol. The communication speed will be configurable from 9200 to 19200 baud minimum.
k) Provide Man Machine Interface via 3 to 4 Operator Stations.
l) Provide data acquisition, data processing, alarm management, data recording and replay, trending and report generation facilities.
m) Event and alarm monitoring and reporting.
n) Operational monitoring & control.
o) Data Collection and storage.
p) Presentation and organisation of data / information security.
q) Configuration facilities.

SCADA shall have 35 custom graphic screens as a minimum. Graphical interface screens shall be developed based on requirements furnished during the detailed engineering.

Graphic screens shall provide dynamic indications of the following as a minimum:

i) Measured value of each analogue input displayed in numeric, bar or trend type format.
ii) Status of valves.
iii) Alarms.
iv) Inputs inhibit / override status of instruments or equipment.
v) Start-up overrides.
vi) ESD status.
vii) Cathodic Protection system.
viii) Fire alarm system status.
ix) Apron area system ESD status.
x) Fuel farm.

SCADA shall have a group display of minimum 8 analogue/ digital points. Each point shall be operable from the group display and shall be identified by the tag name and descriptor. Alarm & digital status shall be displayed. SCADA shall also have custom functional keys dedicated for predefined displays e.g. Graphics, groups, trends etc.

2.5.4 Operator Interface Consoles

The programming & operating terminal (OIC) shall be used for plant operation, programming, program storing, fault diagnostics and alarm monitoring. It shall be supplied with following:

a) Dedicated industrial Grade 26” size colour LCD screens unless otherwise specified, keyboard and printer.
b) Dedicated operator keyboard & mouse as a minimum.

c) Security lock and key and necessary levels of password protection to prevent any un-intentional program modifications. All illegal entries shall be rejected and shall be identified by warning signal on screen.
d) Manual override of any input or output contact connected to SCADA / PLC shall be possible from keyboard.
e) It shall be possible to modify, add or delete the application program on line without affecting the outputs. An element can be forced ON and forced OFF on line using the workstation.
f) The Console shall display logic and/or ladder diagram indicating power flow and shall show description and status of each contact. It shall also be possible to display process alarms and diagnostic messages as and when they appear. Further it shall also be able to display I/O map in a user-defined format. PLC Ladder logic/Functional logic diagram shall be user friendly.
g) It shall be possible to print out the ladder/logic diagram on the network printer. The printer in addition shall also print out:

- The diagnostic message as and when generated and diagnostic reports, when called for.
- Process alarms connected to the programmable logic controller as and when they appear Alarm report whenever initiated.

a) The choice of printing alarms on this printer shall be operator selectable from a key lock switch on SCADA / PLC console. The I/O maps showing status of all inputs and corresponding outputs in a user-defined format.
b) The SCADA/PLC console shall be provided with self-diagnostics feature which shall display error messages and initiate an audible alarm if the fault is detected.
c) The system shall be able to identify the failure at least up to the module level including I/O system and redundant processor through detailed console display and report print out.

2.5.5 Power Supply to The System

UPS of appropriate size will be installed along with power distribution system. Each system cabinet shall have UPS distribution for all instruments connected with it with suitable isolation scheme specified in this tender document.

UPS power distribution network shall be designed such that a single power fault in any sub-distribution system shall not cause a trip of the entire system. The power distribution system shall contain the necessary isolation and auto switching and other measures to maintain the system integrity if one feeder fails or develops a ground fault.

Redundant UPS of suitable capacity configured in hot standby mode shall be provided to cater power supply to the following:

a) PLC / SCADA and its associated panels / sub-systems.
b) Tank Farm Management System.
c) Motorised Valves Field Control Station.
d) Fire Control Panel.

2.6 Process displays

2.6.1 Overview display

a) Overview display shall incorporate a minimum of 500 analogue or discrete inputs which can be monitored simultaneously on the console screen (Referred as pages). Each page shall be organized into a suitable number of groups. Each group shall be identified separately. Each group shall further incorporate suitable number of inputs (Referred as tags). Suitable identification and description to be shown for each group on overview display to relate it to a group or loop display.

b) All Analog points in the overview shall be represented as variable lengths indicating deviation above or below the normal operating value or set point.
c) Alarms shall be displayed in change of colour against each variable if the variable crosses a set value. Control loops operating in manual mode shall be indicated.
d) An input in alarm condition shall be identified by flashing.
e) In case, any hardwired instrumentation backup is provided, overview pages shall be assigned indicating the tag number and type of hardwired instrument.

2.6.2 Group Display

a) Group display shall be limited to the group of inputs as displayed in the overview display. Each group shall preferably include eight (8) numbers of inputs.
b) Each input in the group shall be identified by the tag number, unit of measurement and process description, which shall be displayed on the OIC screen.
c) Display, as a minimum, shall show following degree of details:
   i) Process variable in Analog form shall show, as a percentage of the transmitter span on a linear scale bar graph of 0- 100% or engineering units and in digital form as alphanumeric display in engineering units.
   ii) Set point value in Analog form as a percentage of transmitter span on linear scale bar graph of 0 - 100% engineering units and in digital form as alpha-numeric display in engineering units.
   iii) Output value in Analog form as a percentage of linear scale bar graph of 0- 100% and digital form as percentage.
   iv) Controller mode i.e. auto, manual, cascade, computer.
   v) Process alarm on process variable, deviation or velocity.
   vi) Selected loop within the group shall be identified by cursor marking or similar identification.
   vii) The contact input/output shall be represented by simulated graphic lamps and configurable alphanumeric status description.
   viii) It shall be possible to control the process from group views. Following control actions shall be possible.

- Increase/decrease of set point value either slow or fast.
- Change of controller mode i.e. Auto/manual transfer.
- Changing output to the final control element.
- For digital points, start/stop or open/close command.

It shall be possible to repeat any tag number in more than one group/console. However it shall be possible to control or change configuration from only pre-assigned group/console.

2.6.3 Loop Display

Loop display shall provide a separate detailed display for each of the process inputs. The graphic representation of Analog and digital points shall be similar to group display. However in addition following information shall also be presented in alphanumeric form as a minimum:

a) Controller tuning parameters.
b) Process variable zero and span values.
c) Alarm set point on various parameters.
d) Limits on set point, output, velocity etc.
e) Controller action (direction/reverse).
f) Failure position of final control element.
g) Computational constants like ratio or bias.
h) Integrated value.
i) Output to the final control element.

j) Engineering units.

It shall be possible to change the following through the keyboard of operator console:

a) Changing tuning constants.
b) Changing limits on set point, output, velocity etc.
c) Changing alarm set points.
d) Changing control mode.
e) Changing output to the final control element.
f) For digital points, it shall be possible to issue start/stop or open/close command.

The change in loop configuration like changing scale, zero and span, changing configuration of any loop shall be possible from engineering display on operator or engineering console

Loop control parameters changes as specified in the specification shall be restricted by a key lock control.

The loop display shall also contain a trend displaying process variable, set point and output with a sample interval time of maximum 1 second and full scale time base of minimum 60 seconds for tuning the process control loops.

2.6.4 Graphic Display

a) It shall be possible to display dynamic graphic of different sections on plant on the operator console screen. Graphic displays shall be field configurable only through engineering keyboard with standard/user defined graphic symbols. Different plant sections dynamics shall be displayed on different pages.
b) The system shall have the capability of having and developing graphic symbol library as per ISA-5.1 and 5.3. In addition, standard industrial symbols like pumps, tanks etc. shall also be provided as a standard.
c) Graphic displays shall be interactive type through which it shall be possible to control the process. It shall also be possible to send motor start/stop and shutdown valve open/close command, as specified in project specifications, from this display.
d) It shall be possible to view the process variable and alarm point and view and change set point valve, manipulated variable, controller mode etc. from graphic display. Also pumps status and valve status shall be displayed on the graphic display with different colours.
e) Various colours used in the generation of graphics like colour of the process lines, utility lines, Instrument signal lines and event modifier conditions shall be finalized during detailed engineering.

f) The colours used to identify event-modified conditions shall generally be as follows unless otherwise indicated during detailed engineering.

- Red : All alarm annunciation.
- Blue : Valve open, pump running.
- Green : Valve closed, pump stopped.
- Flashing green : Shut down valve transition state.

It shall be possible to go from graphic page to related graphic pages or any group view or alarm summary in single keystroke using soft key function.

2.6.5 Trend Display

The system shall be capable of displaying the following trends:

a) Real time trends of the parameters as specified in project specification. Displaying current data as defined in this specification. However it shall be possible to assign any parameter for real time trend.
b) Historical trend for number of parameters as specified in the project specification. (For all the Analog parameters as per I/O list as a minimum) However, it shall be possible to assign any parameter for historical trending.
c) Historical data shall be stored on the non-volatile memory device like hard disc/ removable discs in such a way that such historical data can be utilized for archival storage and subsequent recall.
d) Real time and historical trend shall be possible on any parameter or variable like measured variable, set point, output, calculated variable digital input, output etc.
e) It shall be possible to sample and store data of instantaneous and average value at the intervals mentioned below. However it shall be possible to display by scrolling or expanding the time base for all the trends. At intervals 2 second and below for the real trend.
f) At 1 minute, 10 minute & 1 hour interval / configurable for historical trends. Historical data trends shall be displayed for a period of minimum up to 72 hours for a data-sampling rate of 1 minute.
g) Fast trend requirement, (trends with sample time faster than Real time trend) if any, shall be specified in the project specification.
h) Selection of the tag number and sampling time for real time and historical trending shall be possible from operator keyboard.
i) The system shall also have a multi trend capability in such a way that it shall be able to display set point, measured variable and output on the same display, the trend of either the same process variable or any other process variable.
j) Trend display shall be single line type or bar graph type with additional information like loop tag number, engineering units, span, present value of the trended point, alarm status etc. displayed.

2.6.6 Alarm Monitoring and Display

a) It shall be possible to display process as well as system alarms on the operator console for operator's attention and action. Alarms shall appear immediately on the operator console as and when they occur on priority basis.
b) It shall be possible to set process alarm limits from the engineering keyboard i.e. alarm limits on absolute value of measured variable; rate of change of measured variable; high and low deviation set points; high, extra-high, low and extra-low points on process variable and output etc. In addition, it shall be possible to derive alarm conditions on the basis of few calculations performed by the system.
c) Alarm message shall be displayed by flashing the page and group number of the input under alarm irrespective of type of display. It shall be possible to access the group or tag in alarm condition with a maximum of two key-strokes of operator's console keyboard. The plant overview

d) Display, in addition to display alarm message, shall also be able to provide warning by changing colour of excessive deviation of process variable from their set value.
e) All alarms shall be displayed as and when they occur or generated with change in the colour of display in the following sequence, activating an audio signal:

- Continuous flashing : Un-acknowledged alarm
- Steady display : Acknowledged alarm

f) The system shall not put off the audio alarm and visual flashing even after the condition returns to normal unless it is acknowledged by the operator.
g) In addition to alarms appearing on different displays as mentioned in this specification, the system shall also be able to display alarm summary and alarm history as per this specification. All alarms, which are recorded in to alarm summary, shall also be stored in to history alarm system.

2.6.7 Alarm Summary Display

It shall be possible to display summary of all alarms in the sequence of their occurrence and shall disappear from display only when they are acknowledged and cleared. The alarm display shall list the following for each alarm as a minimum:-

a) The date and time of occurrence.
b) Point identification (i.e. Tag number).
c) Point description.
d) Type of alarm (absolute value or deviation).
e) Serial number of alarm in the sequence of its occurrence.

The system shall be able to display on alarm summary a minimum of 100 alarms.
Alarms shall be listed in the form of alarm list like current, List I, List II etc. The minimum number of alarms per list shall be 25.

2.6.8 Alarm History

The history of alarm conditions shall be maintained in the data base for alarm history display and printed on shift wise basis for the parameters specified in the project specifications. The alarm display and print out shall list the following for each alarm as a minimum:-

a) The date and time of occurrence.
b) Point identification (i.e. Tag number)
c) Point description
d) Type of alarm (absolute value or deviation).
e) Time of acknowledgement.
f) Time of return to normal.
g) Serial number of alarm in the sequence of its occurrence.

The system should display on alarm summary a minimum of 300 alarms. Alarms shall be listed in the form of alarm list i.e. current, List I, List II etc. Minimum number of alarms per list shall be 25.

2.6.9 System Alarm

System shall have capability of on-line self-diagnostics as mentioned in this specification. Any abnormal conditions in and sub-system or any other functional device shall be displayed as system alarm message on the operator console irrespective of the display selected.

2.6.10 Event History Collection

Each event history file entry shall contain the time and date of concurrence, the tag ID, the tag description and value / state and the type of event. The following events as a minimum shall automatically be stored in history files for later reporting and analysis.

2.6.11 Process Events

All discrete process events shall be stored in history files. These shall include:

- Inputs changing state.
- Analog inputs going into or out of alarm.
- Equipment changing state (running / stopped, open / closed).

2.6.12 Operator Events

All operator actions which affect the process shall be stored in history files. This shall include any operator command such as:

- Opening/closing isolation valves.
- Starting/stopping of pumps and motors.
- Changes to set points.
- Changing control blocks between automatic, computer and manual.

2.6.13 Engineer Events

All engineer actions, which change the control and monitoring of the process, shall be stored in history files:

- Placing stations and devices on-line or off-line.
- Changes to alarm set points.
- Inhibiting/enabling alarms.
- Changes to tag parameters.

2.6.14 System Events

The following system events shall be stored in history files:

- Failed process input/output modules.
- Communication errors.
- Program error messages.
- Switchover between primary and back up.
- Failed controller modules.
- Other function module failures.

2.6.15 Logging Function

a) It shall be possible to log all measured and computer parameters, operator actions, alarms etc. from operator consoles.
b) Logs shall be required on hourly, shift-wise (8 hourly) and daily basis and some cases for weekly and monthly basis as specified in project specification.
c) All parameters required for logging shall be stored in memory in accordance with data base update rate. However, it shall be possible to perform basic arithmetic calculations such as averaging, summing, efficiency calculations etc. prior to logging.
d) In general, the log format shall be user definable. However the typical log formats for hourly, daily and shift-wise reports shall be as defined in the project specifications. For extended logging like weekly and monthly reports, system shall have capability of writing programs in high level language. High level language compiler software, sufficient free memory space and necessary hardware shall be provided.
e) Number of log reports format etc. Number of pages in each log report shall be sufficient to accommodate all the parameters for logging as defined in the project specifications.
f) Hourly report shall be printed only as and when initiated on demand by the operator and shall not be printed automatically after the end of the hour. All other reports shall be printed automatically at the end of the pre-defined time as well as on demand by the operator.
g) The maximum storage time for log information shall be 15 minutes after the pre-defined print out time for a format, within which time log report must be printed. In case report could not be printed within the schedule defined time, data shall remain stored till the report is finally printed.

2.6.16 Logging Hardware

Following hardware shall be provided:

a) Logging printer. It shall be used for:
   i) Printing of hourly, shift wise, daily and weekly log.
   ii) Shut down report printing.
   iii) Any other report defined in the project specification.

b) Alarm and event printer. It shall be used for:
   i) Log the process and system alarm messages as and when they occur.
   ii) Print the alarm history for every shift of operation or on demand from operator console.
   iii) Log events such as operator actions as defined in this specification, as and when they are initiated.

Alarms and Events shall be clearly distinguishable on the report.

Print out shall show as a minimum the tag number, description, date and time of occurrence, time of acknowledgement and time of return to normal

2.7 PLC System

2.7.1 General

a) The system shall be microprocessor based having functional distribution and data base distribution sub-system wise. This system shall also have networking capability with other systems distributed geographically in the various units of a plant, over a plant wide information network such as Ethernet or other industrially recognized open network.
b) The system shall be designed 'Fault Avoidant' as a minimum by selecting high-grade components of proven quality and proper design of system electronics. Full 100% redundancy shall be provided, as a minimum, as per this specification to improve the system availability and reliability. Due considerations shall be given to the environmental conditions particularly for field mounted sub-system, as specified in project specifications, during system design.
c) All sub-systems of the system shall be able to operate satisfactorily from 15°C to 45°C and 20% to 100% non-condensing humidity.
d) Isolation shall be provided for all field signals and between workstations and related subsystems.
e) System software shall be governed by the operating system running in a real time mode and shall meet all functional requirements specified in this specification as a minimum. Any other Standard/ Special Software Package, if available, shall also be offered describing the full capabilities.
f) It shall be possible to study the process dynamics of process control loops including response time, dead time, etc. directly from Engineering/Operator Console. Software Package for study of process dynamics shall be quoted separately.
g) Whenever repeat alarms are specified in the project specifications, potential free contacts shall be provided by the system.
h) The system shall have the capability of detecting the open sensors. The open sensor reading either upscale or downscale shall be field configurable.
i) The Scan time of programmable Controller shall be of order of 250 milliseconds for logic and 300 milliseconds for closed loop and it shall be configurable .Scan time of PLC is defined as cycle time taken by the system to read input, process input executing logic and update control output for all logics configured within system.
j) On-line replacement of any module shall be possible in such a way that removal and addition of a module shall be possible without de-energizing the system. Furthermore, there should not be

any interruption of the system while replacing a faulty module wherever redundant modules are provided. All supplied hardware and software upgrades shall be possible to be implemented on line with, redundant device and I/O operational.

k) The system shall be suitable for power supply as specified in this specification. Suitable battery backup shall be provided for volatile memory protection only.

l) Modbus Communication between PLC To VFD shall be provide

m) PLC shall be communicated with Fire alarm panels (like Fire hydrant Pump control panel, Foam pump Control panel and more whichever related with fire panel).

2.7.2 Expandability

The system shall be of modular construction and expandable in future by adding additional modules. The type of modules shall be kept to the minimum possible in order to have interchangeability and low inventory.

2.7.3 Upgradeability

The system shall provide a logical planned implementation of evolving technologies and provision for up gradation of existing equipment.

2.7.4 System Access Security

All operator commands shall be automatically checked for validity of authorization by system. Validity checks shall be automatically performed by the system to ensure that control parameters entered by the operator are within defined limits.

Access to all system functions shall be protected by a multi-level password system.

2.7.5 System Diagnostics

System diagnostics shall support fault isolation to a specific module or channel or subsystem device, which can be subsequently removed or replaced. It shall include both hardware and software routines which upon detecting an abnormal conditions, reports this information on standard diagnostics displays on the OIC printers.

Once a diagnostic test has detected a failure, a descriptive alarm shall be generated and bump less transfer to control to a dual redundant component shall be triggered wherever specified.

2.7.6 Diagnostic Display

The system status level shall be accessible by a single dedicated key.

A flashing diagnostic message prompt shall be displayed and allow the user to immediately view the specific error message in a single key stroke without going through the diagnostic hierarchy.

A system status display shall provide the current status of the every subsystem. Subsystem with a diagnostic alarm shall be identified by flashing indicator. The system status display shall include information on the communication systems including status of the communication modules for every subsystem.

The subsystem level status display shall provide detail information on the subsystem itself and the status of the individual modules contained therein

I/O status display shall provide detailed information of each I/O channel of the associated device.

2.7.7 Spares Philosophy / Installed spares

20% Installed spares shall be provided in each sub-system for each type of module to enhance the system functional requirements includes hardwired instrumentation. This shall also include provision of 20% of all installed hardware i.e. Relays, auxiliary modules (i.e. receiver cards, trip amplifiers, isolators, annunciators, etc.), terminals etc. and 20 % additional power distribution with feeders of each size and rating.

In addition the system shall have the following minimum spare capability:

2.7.8 Controller Subsystem

The controller racks shall have 20% usable free space for installing additional I/O modules in future. However, the control processor shall have additional 20% capacity to handle these I/O's. This shall include any hardware like Cabinet, Rack, Terminals, wiring space etc. that would be necessary to install additional modules.

2.7.9 Display Capability

Each operator console shall contain 20% usable spare group and related display capability in addition to as specified in this specification.

The system shall have capability to extend its historical trending, logging and user's memory by 20% to meet future expansion with / without adding additional memory modules.

2.7.9.1 I/O Subsystem

I/O of programmable logic controller shall have 20% usable spare. This shall include any hardware like Cabinet, Rack, Terminals, wiring etc. that would be necessary to install additional modules.

If Input is from intrinsically safe field instrument than intrinsically safe barriers shall be provided for analog input modules. Only Active Barriers shall be employed for achieving galvanic isolation, wherever applicable.

2.7.9.2 Processor System

Processor system of programmable logic controller shall have capability to execute additional 40% logic. Further it shall be possible to extend the memory by at least 40% at a later stage.

2.7.9.3 Communication Sub-System

The communication sub-system shall have sufficient capability to execute additional 20% data transfer. Further, it shall be possible to extend the memory by at least 20% at a later stage. The communication sub-system shall be dedicated for each controller and it shall not be shared in any manner with other controllers.

2.7.9.4 Spare Space

Usable spare space in panels and cabinets to install 50% spare hardwired items like barriers, trip amplifiers, receiver switches, panel mounted instrument, relays etc. in future.

2.7.9.5 Additional Software Capacity

Sufficient additional software capacity shall be available in the system to take care of spares requirement as specified in this specification to meet all functional requirements as per this specification.

2.7.10 Software

2.7.10.1 Software Revision Levels

Standard system operating software delivered to the installation site shall be the most recent field proven revision level available at the beginning of the Pre–Factory Acceptance Test (FAT) which is applicable to the system hardware.

The system shall allow for upgrading of system operating software on all redundant modules of the system without necessity of shutting down the process, without losing the window to the process (operator interface) and without losing any control functions.

2.7.11 Technical Specification of PLC System

a) Programmable logic controller shall be microprocessor based system which shall be used to execute all the logic for safe start up, safe shut down, safety interlock of each equipment and operation of the Fuel Farm
b) PLC shall be dual redundant with dual processor modules, dual power supply modules and single I/O modules.
c) The configuration languge shall feature the choice of ladder,functional logice block ,sequential function chart or structure text programming and shall comply with IEC 61131
d) PLC shall have very high noise immunity in order to ensure safe & reliable operation when subjected to electrical radio frequency interference & electromagnetic disturbances expected in a plant. The design of the electronics shall be in compliance as per IEC-801-2, IEC-801-3, IEC-801-5: Electromagnetic compatibility for industrial process measurement and control equipment.
e) PLC system shall meet the following:-

- Industrial noise test NEMA1 – 109
- Showering Arc Test.
- Surge withstand capability Test : IEEE 472/ANSI C 37.90A
- 2 KV/5 KV Isolation Test : IEC 255-4
- PLC system shall also comply to UL 508 & CSA C22.2 No 142 Standards for industrial control equipment.

a) PLC Operation shall be unaffected by a momentary power loss of the order of 20 milli seconds.
b) The system shall be programmed in principle as per the logic diagrams. “Owner” reserves the right to revise or review the logic diagrams even after acceptance of any offer.
c) On line replacement of any module in the programmable logic controller shall be governed by this specification in general.

2.8 Safety PLC

2.8.1 Introduction

This specification defines the minimum requirements of Design, Supply and Installation for a Triple Module Redundant (TMR) Safety Instrumented System for Automatic Overfill Prevention for Tanks, Emergency Shutdown and Fire & Gas requirements of the facility. The scope of this document is limited to Programmable Electronics (PE) devices used in TMR Safety Instrumented System such as Programmable Logic Controllers (PLCs) and specifically excludes field elements such as cabling, junction boxes, input devices (transmitters) and output devices (actuators, final control elements).

Minimum hardware and application software requirements of this system is defined. It includes the minimum requirements for the design, materials, fabrication inspection, testing and commissioning of the TMR Safety Instrumented System. The VENDOR shall be responsible for integrating all SIS hardware, software and interfaces to TAS System, system testing, documentation, delivery, installation supervision and field commissioning support for the SIS as defined within this specification.

The Safety PLC based ESD system would primarily consist of integration (with the Safety PLC) of various field instruments as per the MB Lal Recommendation.

2.8.2 SCOPE OF WORK

2.8.2.1 BIDDER'S SCOPE OF WORK FOR THE JOB SHALL BROADLY COMPRISE OF THE FOLLOWING:

i. Design and system engineering of complete Safety PLC based Automation System as per given System Architecture.

ii. Dynamic & static graphic representation of the all the operating facilities in installation on the basis of system architecture as well as site survey/study by vendor is required at Operator Interface Consoles.

iii. Manufacture, Supply, Installation, Cable laying, Field Testing, Commissioning, Trial Run, Site Acceptance and Stabilization of the complete system of complete Safety PLC System (hardware and software) consisting of sub – systems as per enclosed System Architecture Dwg **:**

(1) Emergency shutdown sub-system [based on SIL2 (or better) certified Programmable Logic controller] as per system architecture enclosed.

(2) Hi-Hi Level Switch on Product Tanks

(3) ESD PB Station

(4) FLP /WP Hooter

(5) FLP Junction Boxes (Power / Control Signal)

(6) Uninterrupted Power supply system

(7) Laying / Glanding / Termination / Loop Checking of signal / power / control cables

iv. Cabling (laying), Field Testing, Commissioning, Integration (hardwiring/ digital interface with PLC), Site Acceptance Test of following instrumentation/ sub-systems with the proposed Automation System including development & successful implementation of serial interface as well as supply/ laying/ termination of signal/ communication cables .

(1) ROSOVs (Remote Operated Shut-Off Valves to be installed by DAFFPL) – to be hardwired with safety PLC

(2) Hydrocarbon Detectors / Transmitters(to be installed by vendor) - to be hardwired with safety PLC

(3) Hydrocarbon (HC) detectors shall be installed near all potential leak sources e.g. tank dykes, tank manifolds, pump house manifolds, etc. Further, HC detectors of proper type should be selected and should be proof tested.

(4) Proposed Tank Farm Management system (Hi Level Contact O/P) - to be hardwired with safety PLC

(5) Existing MOVs – to be hardwired with safety PLC as applicable.

(6) Existing MCC panels / VFD control panels (of Product transfer Pumps) are to be modified for provision of ESD ports. Such ESD ports are to be hardwired with safety PLC to stop these pumps on actuation of ESD Push Button.

v. Vendor to submit the following calculation along with technical bid**.**

- Processor loading for PLCs
- Network loading.
- I/O requirement vis-à-vis provision in the selected PLC
- Heat load calculation.
- Actual UPS Capacity based on full load condition.
- Schematic for automation/PLC/SCADA system

Subsequent to award of job vendor is required to visit Installations/ locations for the following engineering activities-

- Ascertaining the type and quantity cable (power / control / signal) required based on the cable routes as provided by the Owner Representative / Owner
- Ascertaining the size and quantities of cable trays (for power / control / signal) required based on the cable routes as provided by Owner Representative / Owner

- The finalized cable route drawings, cable schedules & estimated quantities for cable trays and cables are to be prepared by vendor after for procurement of cables & cable trays by vendor.
- Any other instrument/ equipment/ service which are not explicitly mentioned in the tender but deemed necessary for the successful operation of the system complete in all respects, shall be in bidder's scope
- Emergency Shutdown System Field cabling Philosophy – Field instrumentation specified for integration with ESD –PLC system shall be provided with dedicated FRLS cabling (signal/ power/ control) & FLP Junction Boxes (signal/ power/ control)

2.8.3 Background

The key mission of Safety Instrumented System (SIS) is to predictably reduce risk to tolerable level. The SIS performs this task by decreasing the frequency at which unwanted accidents occur. The amount of risk reduction that an SIS is capable of providing is represented by its Safety Integrity Level (SIL)

Each facility has set of associated risks which depends on lots of criteria's hence initial step is to carryout Risk Analysis and determine the Safety Instrumented Functions and its Safety Integrity Level. The method used for the selection of SIL should be risk-based, evaluating the potential consequences and likelihoods, as well as the effectiveness of process safeguards. SIS implementation, and therefore SIL selection, should consider legislation, regulation, and national and international standards. Analogy, of applying SIL from some other depot or small storage facility of other companies with different nature of business in not advised

2.8.4 General

1) Safety Instrumented System shall be of a triple module redundant (TMR) as minimum, TUV approved SIL 3 system according to IEC 61508/61511 with a 3-2-0 degradation scheme. The basic architecture will utilize three independent internal buses and logic paths for all signals. The failure of any single component shall not result in a failure to correctly execute safety functionality and process shutdown shall not occur as a result of any single component failure in the SIS including power supply. It shall, however, be possible, within such system, to apply simplex I/O for non SIF signals. The required number of I/O (Simplex, Triplex) shall be as given below:
    a. Triplex cards for all input signals from initiators and output signal to final elements when used as in SIF logic and other signals which are used for ESD.
    b. Simplex cards to be used for signals for monitoring purpose only (for e.g. gas detector used for monitoring only without voting)
2) The selection of TMR architecture as the basis is based on it's proven and documented suitability for SIL1, 2 and 3 applications. There is no intent to apply this architecture as a basis for SIL 4 applications, as requirements of this level are not normally seen within the Storage Terminals
3) TMR SIS design shall be suitable for SIL3 applications. The complete SIS from input cards, logic solver to output cards shall be designed to comply with SIL 3 requirements to obtain full benefit of TMR majority voting in providing safe, reliable operation of the plant and minimizing the spurious shutdowns. SIL Study will be taken up by COMPANY and results of SIL study shall be implemented by VENDOR whether or not such requirements are covered elsewhere.

4) All hardware components, system software and application software shall be TUV certified. Supplier shall submit TUV "Conditions of use" document with the bid for Company's review and approval.
5) It is permissible to combine several SIFs, ESD functional logic and Gas Detectors requirements within the same TMR SIS. This should only be done where the effect of a common system failure would not unnecessarily cause additional production loss.
6) The communication links between SIS and TAS System shall be redundant with automatic bump-less switch over and electrically isolated. Complete information including the diagnostics shall be communicated from SIS to TAS System.
7) The SIS shall be designed to insure sequence event logging and it shall be done through a common workstation (PC based) connected to the TAS system. This station shall have the ability to print the log of events on request. It shall gather time stamped data from the SIS.
8) To allow a manual correlation between a printed event log from the TAS system, the SIS internal clock shall be synchronized and Time synchronization shall be provided. The requirement for a dedicated logging device and time synchronization shall be reviewed if the SIS and the TAS System can be tightly coupled with an in-built time synchronization and the transfer of time stamped data.
9) The Scan time of programmable Controller shall be of order of 100 milliseconds and it shall be configurable .
10) The maintenance and engineering workstation in the Control Room shall display all alarms including diagnostic and faults alarms. The diagnostic alarm description shall be in simple English and does not necessitate referring any other vendor manuals.
11) The diagnostics of the system shall allow identifying all faults that a system component can alarm on the network up to and including the card level for all types of cards. For I/O cards, the diagnoses, in addition, shall also cover each channel data. The diagnostics shall be presented through graphics depicting the cabinet and locating the faulty component. The status of the component shall be green if healthy and red if an alarm condition is present.
12) Separate programming terminal (laptop) shall be provided.

2.8.5 SIS System hardware

2.8.5.1 Basic Requirement

1. The system design shall be such that each of the Enclosure unit when sharing the same Safety PLC or Safety Controller system shall be segregated so as to be isolated from the other Enclosure's when maintenance activities are underway. Application software shall also be segregated within one controller/electronic for corresponding Enclosure.

2. In SIS, any interconnection between field devices shall be hardwired.

3. The SIS configuration and I/Os finalized shall be further validated by VENDOR to meet the specified scan time, I/O allocation strategy, additional interfaces, UPS power supply distribution, marshalling cabinets etc. with all associated impacts shall be considered and added accordingly without any cost impact to COMPANY.

2.8.5.2 Main Processors

1. Each Safety PLC/Safety Controller system shall contain triplicated modular redundant (TMR) main processors operating asynchronously and in parallel. Each processor/CPU module shall

consist of a microprocessor, memory, math co-processor, and necessary communication processors.

2. The processors shall be mechanically and electrically isolated. Each shall provide protection against overload current and line voltage spikes.

3.

4. Each processor shall retain its memory in the event of a power failure or internal malfunction for a minimum of six months. Battery backed up RAM shall be capable of retaining the application program in memory for a minimum of 6 months after power loss; as an alternate program can be backed up by EEPROM memory. It shall be possible to replace battery online without affecting the operation and without removing any card from the system. An alarm shall be provided in the TAS HMI for 80% discharge of the battery.

5. Each processor shall provide sufficient memory for the initial configuration including application software plus 40% excess for future expansion. Also vendor shall demonstrate the CPU utilization capacity during FAT and SAT. If such utility is not available, Vendor shall develop such utility software for this purpose before start of the FAT.

6. A real time clock with a 5 msec resolution shall be available for time dependent functions such as rate calculations, alarm time stamping.

7. Each processor shall be capable of scanning and updating the I/O and executing user defined logic at 200msec or less.

8. The processor shall be furnished with on-line programming, diagnostics and status indicators facility.

9. Each processor shall be rack mounted and installed in cabinets.

10. Processor shall provide required signals to provide dynamic power flow logic display for sequence and cause and effect on TAS HMI.

11. Time synchronization with TAS systems.

2.8.5.3 Reliability

1. The SIS shall be a fault tolerant microprocessor based design, which protects the controlled process from intermittent, transient, and permanent system faults. Any single system fault shall not degrade system safety or functionality or impact operation of the controlled process.
2. Multiple faults resulting in a system failure shall result in the system reverting to a predefined de-energized fail safe status. This includes all module removal and cable faults.
3. The system shall be designed for maximum reliability, safety, and integrity while maintaining an availability which shall be 99.99% or better in both fail-safe and fail-danger modes where availability is defined as:
   Availability % = ((Mean Time To Failure (MTTF) / (MTTF + Mean Time To Repair (MTTR))) X 100

   Availability figures must be provided by the VENDOR as part of his quotation, with method of calculation and all assumptions clearly stated.

2.8.5.4 System Redundancy

1. SIS at each Enclosure shall be configured in a triple modular redundant format using two-out-of-three voting to establish I/O signal integrity. Each of the I/O signal paths shall be completely isolated and operate completely independently of each other.
2. There shall be no single failure point that could affect more than one channel. Failure of any single active component supplied within the system shall not cause a shutdown action, and during such a

   failure, the system shall remain on-line and shall maintain the process safety protection. Additionally, the system shall accommodate a means for alarming the fault.
3. The system shall have a 3-2-0 mode of operation. Failure of one triplicated channel shall result in a dual fail-safe mode of operation. A failure of a second triplicated channel shall result in a safe plant shut down. Diagnostics in English language without using codes shall indicate each failure level (including I/O card level) and provide mechanisms for a user initiated shutdown within each failure mode.
4. It shall be possible to replace and repair any faulty system module without degrading the safety of the system. Repair shall not require disruption of the scanning process or "freezing" of output states, the transition to the healthy module shall be bump less (i.e. no loss of control). No operator action shall be required to restore the system to normal operation other than simple mechanical replacement of modules.
5. Input and output signals shall be voted independently. Output signals shall be designed as de-energize to trip. The entire output voting network shall be automatically tested for stuck-on and stuck-off components at a regular interval not exceeding two hours. This time shall be adjustable.
6. Each SIS module shall be able to be removed and installed without powering down. Furthermore the replacement of an I/O module shall not disturb the field wiring. Each I/O card shall be provided with an adjacent spare hot spare slot for on-line replacement of cards.
7. If available protective covers shall be supplied for each module so that all circuits are protected when the card is removed from the rack. Ribbon/system cables if used shall be with adequate shielding to protect from interferences.

2.8.5.5 I/O General

1. The module type identifier shall be automatically recognized by the TMR system.
2. The system shall be capable of accepting signals from externally or internally powered smart or conventional transmitters (in analog mode). There shall be no effect on the SIS system during communications to smart transmitters with hand held HART communicators.
3. Each module input or output point shall have field side status indication in addition to the fault diagnostics required in the specification. Inputs and Outputs shall also have individual load/fuse status indication.
4. All analog and discrete input and output modules shall be available as full TMR or simplex type to cost effectively accommodate different safety integrity levels.
5. The I/O modules shall be rack mounted and installed in the cabinets.
6. When for storage terminal operational reliability, several field devices are used for the same service to allow a dedicated processing (e.g. two out of three) in the SIS, the field devices shall be wired to completely separate input or output cards.
7. For each Enclosure, a hardwired push button shall be available in MCR and on the SIS system panel. These push buttons will be connected to the ESD logic to initiate a shut down and in parallel will cut the power supply to all outputs to generate a ESD action. From MCR and from the local switch, three contacts shall be used, one for power supply shut down (if required) and the second as logic shut down input, a third contact is a direct entry to the TAS for alarm and log the event in

TAS. All the hardwired push buttons shall be of guarded type with a flap in the front to avoid accidental trips.

8. All inputs to the SIS system initiating a shutdown shall have maintenance override facility.

2.8.5.6 Input Modules

1. The SIS system must have input modules capable of accepting input signals directly from all of the following categories:

   Field switches - volt-free contacts and solid state devices (32 channels, maximum).

   Analog 4-20 mA, 0-5 VDC, or 0-10 VDC signals from 2 or 4 wire transmitters (16 channels, maximum).

   Volt Free contact from other subsystems.

2. Where inputs have 2 independent sensors for redundancy or 3 independent sensors for 2 out of 3 voting as specified in the SIS functional design information supplied by others, the diagnostics shall be included in the application program and shall be provided by the SIS system VENDOR. As a minimum, where multiple sensors are used, a failure of one field input shall not disable any other input and repair must be possible on-line, without impacting other inputs.

3. Digital input signals shall be conditioned by a low-pass filter, typically up to 15 ms, to reduce the effects of noise and contact bounce. A minimum of 1000 VDC up to-isolation shall be provided between each input signal and microprocessor. Each individual input signal path on the input module shall be automatically tested for proper operation at least every 10 minutes. Analog input signals shall have a minimum of 150 VDC input over range protection.

4. Each digital input shall be individually fused with blown fuse indication and provided with knife disconnect terminals for complete isolation capability. Common fuse blown indication shall be provided in the SIS EWS and the TAS HMI.

5. Each TMR input module shall be able to segregate field input signal into three separate paths and sent to each processor independently.

6. In general, SIF initiators shall be certified by TUV, EXIDA or equivalent to SIL capability to standardize the design and to avoid additional instruments to achieve the targeted SIL classification.

2.8.5.7 Output Modules

1. The SIS system must have output modules capable of driving output signals for all of the following categories:

   a. Solenoid valves, Hooters, MOVs, motors and pumps (Volt free contacts 24 VDC, 1A).

2. Output modules shall fail to the open state upon two-processor failure. Digital outputs shall be current rated for an inductive load with a minimum of 1 amp per point at 60° C.

3. Outputs shall provide a 2 out of 3 voted output through integral module design. Each individual output point shall be automatically tested for proper operation at least every 10 minutes.

4. Digital output modules shall operate properly with a +/- 10% signal voltage. provide a minimum of 1000 VDC up to-isolation between each output signal and microprocessor, and accept surge current on each point of 12A per cycle for AC voltage and 2.5A per second for DC Voltage.

5. Digital output modules which support line fault monitoring shall also be available. The module shall be capable of detecting and alarming open or shorted field circuits as well as power monitoring. Load monitoring shall be required if any energize to trip signals are specified.

6. Each digital output shall be individually fused with blown fuse indication and knife disconnects terminals for complete isolation capability.

2.8.5.8 Analogue I/O

1. The SIS systems shall be capable of accepting both high level and low level analog signals directly through an input module without the use of external monitor switches.

2. Analog I/O shall have 12 bit minimum analog to digital or digital to analog conversion. Accuracy shall be at least +0.25% of full scale over the entire operating range.

3. The VENDOR shall provide any dropping resistors necessary for analog modules operating with 4 to 20 mA DC.

4. Analog indication of all the analog inputs along with the respective set points shall be communicated to TAS to display in the HMI Screen

2.8.5.9 Spare Capacity/Expandability

1. 20% installed and wired from marshalling cabinet to system cabinet. This 20% is to be distributed in cards with one or two channels in each card, Terminal block, wiring, barriers, 20% spare space is to be provided.

The basic system shall consist of the following major sub-system.

2.8.6 Input / Output Sub-System:

The subject PLC System min. size shall be as above. However “Contractor “shall refer P&ID’s for total nos. of I/O. The minimum Input / Output shall be required as given in the attached I/O list. 322538-NID-0002

a) Printed circuit boards for I/O modules shall be designed so that it is not necessary to remove power or field wiring to replace any input / output module.
b) The I/O modules shall be mounted in the I/O racks located in the control room. I/O module shall be 16 channels DI, 16 channels DO, 8 channels AI, 8 channels AO, 4 channel pulse input.
c) Each I/O shall have optical / galvanic isolation from external control circuit. I/O status indication shall be provided for each I/O module.
d) Each I/O shall be protected against reversal of polarity of power supply to I/O.
e) Each module shall have LED for each I/O channel to indicate the status of each I/O.

f) Each I/O shall be provided with filters to filter out any noise in input line or noise because of input contact bouncing. All I/O's to be double ended i.e. 2 wires/ input & not common return for all inputs.

g) D/O's shall be provided with potentially free / dry contacts unless otherwise specified.

h) The interrogation voltage to the I/O contact shall be powered from separate redundant power supply and shall not be part of PLC.

i) Input type shall be intrinsically safe with barriers for Analog modules and explosion proof type for Digital modules.

j) All inputs shall be double ended i.e. two wires per input & not with common return for all inputs.

Output contacts from the PLC shall be potential free dry contacts with contact rating as per this specification. Wet contacts/ powered contacts etc. shall not be acceptable.

k) "Final Input/Output list shall be calculated on actual's at the time of detail engineering and shall be submitted to DAFFPL by the successive bidder

l) All the output shall be driven by the relays and the relay shall have 2 NO and 2 NC contacts.

m) The output contact rating shall be as follows:

SN	Description	Voltage	Current Rating
1.	All output cards driving solenoid valve & relay contactors unless otherwise specified.	24 V DC.	2.0 A

n) Each output shall be short circuit proof and protected by fuse. Visual indication of fuse blown must be provided.

o) The MCC's inputs/outputs shall be interposed with a relay of ratings as mentioned above.

p) The communication of I/O system with central processor shall be carried out redundant with complete error checking.

2.8.7 Analog Input Requirements

The system shall be capable of supporting the analog process input signals 4 – 20 mA DC (2 wire).

2.8.8 Analog Output Requirements

Analog outputs with standard 4 – 20 mA, fully isolated from ground shall be available. Open analog outputs shall result in an alarm in the associated configured controller. Functions like auto read back check etc. shall be possible by the Analog Output card.

2.8.9 Discrete Input Requirements

The system shall be capable of supporting both on / off and latched discrete input applications. Standard switch input shall be available to sense switch inputs using 24 VDC.

2.8.10 Discrete Output Requirements

The following is a list of the minimum discrete type output that shall be available:

a) Discrete (on / off)

b) Single pulse (configurable width)

c) Contacts outputs shall be relay contacts.

"Contractor" shall be able to supply, as a standard offering, output modules with fused outputs.

The duration of the single pulse outputs shall be individually adjustable over a range of 1 to 10 seconds. The adjustment shall be configured from an engineering work station.

2.8.11 Central Processing Unit

a) The processor shall have capability to implement all the control functions required to implement the logic scheme attached along with, as logic/ladder diagram.
b) The CPU shall be a plug-in module providing program execution, system timing, local and remote I/O access, alarming, data storage, and communication handling. The CPU shall be a 32-bit microprocessor. It shall execute application programs, conforming to the IEC 61131-3 standard, and use a real-time, multitasking operating system.
c) The size of the memory shall be sufficient for storage of the program instructions required by the logic schemes and other functional requirements. Offer shall indicate the amount of memory capacity occupied by the actual program and spare capacity available for later program modifications or additions.
d) Memory shall be non-volatile. However in case volatile memory is provided, battery back up shall be provided with a minimum of 3 months lifetime to keep the program storage intact.
e) A battery drain indication shall be provided at least one week before the battery gets drained. A potential free contact shall be provided for hardwired annunciation in the central control room.
f) Watchdog timer shall be a software device. The healthiness of processors shall be continuously monitored by watchdog timer. Any hardware or software problem in the processor system, which shall include, CPU, memory, power supply, communication interface etc. shall cause the watch dog timer to report processor failure.
g) Redundancy shall be provided in such a way that in case of failure of the main processor, the standby shall take over automatically. The changeover shall be bump less and the system shall be fail proof, unless any other requirement is specified in the project specifications. Redundancy shall be provided for complete processor system included CPU, memory, power supply and communication sub system.
h) It shall be possible to generate the first out alarm (contact output) by the PLC in case where a group of parameters are likely to trip an equipment or system.
i) The CPU shall capable of controlling both local I/O in the chassis, I/O expansion racks and remote Ethernet and RS 485 I/O modules.
j) The processing of a typical logic program consisting of a mix of Analog and digital commands shall not exceed 2 milliseconds for 1024 instructions. I/O devices located in the same backplane as the CPU should be scanned in less than 0.5 milliseconds.

2.8.12 Power Supply Distribution

PLC shall be powered with 230 VAC + 10%. Power pack shall be 100% redundant with safety factor of 1.5. AC power distribution shall be designed such that a single power drop in any branch shall not trip the entire system. Interrogation voltage shall be designed such that a single fault in any branch shall not cause trip of the logic other than where fault has occurred.

2.8.13 System Communication

a) Communication shall be based on the ISO open system Interconnect (OSI) reference model to provide a migration path to evolving communication standards. The communication networking shall be selected with optimal loading and higher throughput. Maximum network loading shall not exceed 60% of the total offered capacity. The PLC communication subsystem shall be a digital

communication bus that provides a high speed data transfer rapidly and reliably between the processor, I/O sub-system, PLC console and other devices connected in the PLC system.

b) Redundancy in PLC communication subsystem shall be provided as follows unless otherwise specified:

i) The communication subsystem between PLC processor and I/O subsystem shall be single unless otherwise specified. This shall include single communication bus and single interfaces/buffers.

ii) The communication subsystem between processor subsystem and console shall be dual redundant, consisting of two separate communication interfaces and two buses, each one configured in redundant mode, unless this is only used as programming aid.

iii) In case of redundant PLC communication sub system, on the failure of the active device, the redundant device shall take over automatically without interrupting the system operation. Information about the failed device shall be displayed at local as well as on PLC console. It shall be possible to manually switch over the communication from main bus / device to redundant bus / device without interrupting any system function.

iv) The mechanism used by the system for error checks and control shall be transparent to the application information / program. Error checking shall be done on all data transfers by suitable codes.

v) The system shall have necessary facility to connect to the Airport IT wide LAN for remote data monitoring. All necessary hardware and software for the same shall be in the scope of the

Automation “”Contractor”. However a point networking cable at both the control room shall be provided by Airport IT “sub-contractor” (If required)

2.8.14 Network Requirements

a) The communication shall be on a high speed LAN conforming to IEEE 802.3 Standards and utilize industry standard protocols with minimum 100 MBPS bandwidth.

b) Communication shall be dual redundant and shall be capable of sustaining loss of one media channel without loss of data or performance degradation.

c) Ethernet switches with auto sensing for 10/100 MBPS port selection & simple network management protocol support are to be used for establishing LAN interconnectivity in dual redundant configuration. All the STP/ UTP/ Co-axial cabling within Ethernet network shall have 100% redundancy or better.

d) 20% spare ports are to be provided on each of the Ethernet switches.

e) Communication software shall employ a peer to peer communication protocol between all subsystems wherever applicable.

f) Loss of subsystem or module shall not disrupt communications to other subsystems or result in performance degradation and shall cause automatic isolation and shall generate a diagnostic message at the OIS and logged

g) Interfacing of field serial communication links shall be through PLC except Tank Farm Management System.

2.8.15 System Software

a) The system software shall include all programs for the PLC and PLC console which are required to perform all PLC functions including communication and self-diagnostics.

b) Logic program shall be recorded on the DVD, compact disc or cassette tape, which shall be delivered in triplicate together with the system.

c) The PLC programming language for implementation of logic operations shall be based on the following representations:

- Logic diagrams - Binary logic symbols such as AND, OR, NOT Gates, Timers and Flip-Flops.

- Ladder diagram - Series parallel connection of relay contacts.

d) The system shall have an extensive set of self-diagnostic routines which shall be able to identify the system failure at lease up to module level including redundant components and power supplies through detailed on-screen displays and report print out. Diagnostic software shall have the capability to provide information about the failed module/system either in the form of a system configuration display or provide information in the form of a statement.

e) Self-diagnostic software shall have capability to detect faults which make the system permanently close/open in the I/O modules or I/O signal conditioning modules.

f) Necessary antivirus software shall be provided with license.

g) The software package shall allow off-line program development and on-line editing, annotation, monitoring, debugging, uploading and downloading of programs to the PACs via RS-232-C, RS-485 and Ethernet data highway.

h) The software package shall include a software license agreement allowing the Owner the right to utilize the software as required for any current or future modification, documentation, or development of the system furnished for this project.

i) The software shall include a security feature to prevent unauthorized personnel from modifying and downloading the program to a PLC. The security shall consist of an ID and Password sign-on to access on-line functions.

j) The following industry specific functions shall be provided as standard and without licensing fees:

- Natural Gas Metering functions for AGA3, AGA5, AGA7, AGA8 (Gross I & II), AGA8 (Detailed), AGA9, AGA10, ISO1567 and NX-19

- Hydrocarbon liquids metering tables 5A, 5B, 6A, 6B, 23A, 23B, 24A, 24B, 53A, 53B, 54A, 54B, 59A, 59B, 60A, 60B, F1 and F1M according to the Manual of Petroleum Measurement Standards.

2.8.16 Equipment Assembly

2.8.16.1 General

System cabinets shall be freely accessible from front and/or back as required. A minimum space of 1500 mm shall be provided between the back of the panels and the cabinets. Following cabinets shall be required, in general:

a) Power distribution cabinet (for AC distribution and DC distribution).

b) Controller and data acquisition sub-system cabinet.

c) PLC processor cabinets and PLC I/O system cabinets.

d) All the cabinets and panels shall be completely wired and/ or tubed, if required. Interconnections shall preferably be done with the help of pre-tracked cables.

2.8.17 System Cabinets

a) All the cabinets shall be mounted on base frame structure enclosed type and shall be designed for bottom entry for cable connection. Cabinet structure shall be sound and rigid and shall be provided with removable lifting lugs to permit lifting of the cabinets.

b) Cabinets shall be fabricated from cold rolled steel sheet of minimum 1.6 mm thickness including doors suitably reinforced to prevent warping and buckling. Whenever any instrument is flush installed on the cabinet, the sheet thickness shall be 3 mm. Cabinets shall be thoroughly de-burred and all sharp edges shall be grounded smooth after fabrication.

c) Each cabinet shall be maximum 2100mm × 1000mm × 800mm. Construction shall be modular to accommodate 19" standard electrical racks. All racks shall be of same height. Maximum swing out for pivoted card racks, doors and drawers shall be limited to 600 mm.

d) Cabinets shall be equipped with front and rear access doors. Doors shall be equipped with lockable handles and concealed hinges with pull pins for each door removal. The system processor panels, input/output modules panels and all system panel that have diagnostic LED shall be provided with toughened/ shatter proof glass door to view the status indication LED's.

e) In order to effectively remove dissipated heat from the cabinets, vent louvers backed by wire fly screen shall be provided to cabinet doors. In case louvers are insufficient, ventilation fans shall be provided. Additionally dual ventilation fan shall be provided in each cabinet housing any electronics / any heat dissipating items. Fan failure alarm & inside cabinet temperature measurements shall be provided in the operator console as a mandatory requirement.

f) Illumination shall be provided for all cabinets by fluorescent lamps and door operated micro switches.

g) Equipment, within the cabinet, shall be laid out in an accessible and logically segregated manner. Clamping rails shall be provided for incoming cables to prevent excessive stress on the individual terminal. All metal parts of the cabinet including doors shall be electrically continuous and shall be provided with a common grounding lug.

h) All digital out signal shall be through 02 NO/NC contacts 24V DC interposing relay.

2.8.18 Earthing

a) Each panel, cabinet, console, and other equipment in control room shall be provided with an earthing lug. All these lugs shall be properly secured to the AC mains earthing bus.

b) All circuit earthing points of electronic instruments, shields and drain wires of signal cables shall be connected to instrument earth bar which is electrically isolated from the AC mains earthing bus. This earth bar shall be typically 25 mm wide and 6 mm thick of copper. The instrument earthing is connected to independent instrument system earthing pits through insulated wires.

c) Earth pits required for complete system earthing including its interconnection with system as well as with complex-wide earthing network shall be provided. Cable sizing shall be carried out based on possible fault levels and allowable earthing resistance.
The following earthing shall be provided:

i) AC safety earth points and instrumentation circuit earth points shall conform to NEC, Article 250.

ii) The "AC safety earth bar shall be directly bolted to the cabinet without the use of insulators.

iii) A 35 mm2 screw – type compression connector shall be provided on either end of each earth bar for interconnecting with other earthing buses or to the Instrument System Earth Pit

iv) Earthing bars inside termination cabinets shall be made of solid copper measuring normally ¼ x 1 in, suitably drilled and tapped for screw terminals and wire lugs, or fitted with screw – type compression lugs.

v) The earth bus bars shall be labelled as follows:

vi) "AC SAFETY EARTH" for all exposed metal surface of cabinets, racks, chassis GND (ground connections), etc. Individual wiring interconnections shall be minimum 1.5 mm 2 copper wire, green or green with yellow tracer or green with yellow tracer insulation.

vii) "SHIELD CONNECTION " for connecting cable and wire shields Interconnections between shield consolidation points and the bus bar shall be minimum 1.5 mm 2 copper wire, green or green with yellow tracer insulation.

viii) "DC REFERENCE EARTH" (i.e. for all DC analog / digital commons). Interconnections between DC common consolidation points and the bus bar shall be minimum 1.0 mm 2 copper wire, insulation to be green or green with yellow tracer. This earth shall be connected with system earth pit.

ix) All barriers, if used, shall be securely grounded. Safety barrier ground wire shall be capable of carrying a maximum fault level current of 0.5 A at 250 V r.m.s per barrier.

2.9 Acceptance criteria of PLC & SCADA System

2.9.1 Functional Requirement of Software Development & Quality Assurance

a) The "Contractor" shall operate an established and accredited third party certified Quality Procedure for the design, development, production, installation and servicing of software. These procedures shall have particular reference to software documentation and the management of change and revision.
b) Copies of the "Contractor" current QA documentation relating to the above mentioned topics shall be provided for approval to "Main Contractor Representative"
c) The "Owner Representative" reserves the right, at any reasonable time, to carry out a check at the Contractor's offices to ensure that QA procedures are being adhered to.
d) The "Contractor" shall prepare a Software Development Plan as part of his overall Quality Plan. This shall clearly define those activities relating to the supply of software.
e) If the Software Development Plan is revised at any time during the Contract, then the proposed changes shall be submitted to the "Owner representative" for review. Changes to the Software Development Plan shall be made only with the approval of the "Owner Representative". Any changes made to the Software Development Plan shall accord with the Contractor's Configuration Management Procedures.

a. The Software Development Plan shall fulfil the following requirements;
f) Clearly define the responsibilities and authorities of the key personnel responsible for the design, development, testing and integration of the software.
g) Define the minimum skill and experience levels required for "Main Contractor Personnel" involved in modifying and developing software, including auditing and testing.
h) Define the scope and extent of software reuse.
i) List the contractual deliverables.
j) Specify the guidelines, standards, Codes of Practice, methodologies, languages and tools to be applied at each phase of development.

k) Make reference to the "Contractor" quality control and quality assurance procedures that will apply to this Contract.
l) Clearly state the review activities: this shall clearly differentiate between internal activities and those which involve the "Owner representative".
m) Specify or reference the procedures to be adopted to ensure the security of the software. Identify the milestones when software reviews will be carried out.

2.9.2 Software Codes of Practice

The "Contractor" shall modify or develop software to defined Codes of Practice for each language used. The Codes of Practice shall define the design rules, prohibited features and layout rules appropriate to the language or programming method. These rules should address the following;

a) Source code or diagram layout.
b) Commenting.
c) Module header blocks.
d) Module length and complexity.
e) Naming and type conventions.
f) Use of common/global data.
g) Loop and condition constructs.

h) Defining and prohibiting bad practice specific to each language.
i) Avoidance of the use of unconditional jumps.
j) Excluding the use of recursive structures.
k) Avoiding the use of software interrupts.
NOTE: A copy of the code of practice used shall be provided by the “Sub Contractor”.

2.9.3 Software Reuse

The “Contractor” shall employ software reuse techniques wherever practical in order to minimise the development, coding, testing, documentation, and maintenance activities. The “Contractor” shall identify in the Software Development Plan the scope and extent of software reuse.

2.9.4 Software Reviews

The “Contractor” shall define a software review programme as part of the software development programme. In establishing the software review programme the “Contractor” and “Owner representative” shall agree which activities shall be attended by the “Owner representative” or designated representative. All of the “Contractor” review activities shall be conducted to defined procedures. They shall verify that:

a) The “Owner” functional requirements are fulfilled.
b) The software shall conform to the specified coding and annotation standards.
A review check list shall be compiled to ensure the addressing of the relevant criteria. This check list shall address points such as:
a) Structure.
b) Consistency.
c) Completeness.
d) Efficiency.
e) Expandability

2.9.5 Verification

During each design phase the “Contractor” shall verify that the refined design which represents the output of that phase meets the requirements of the previous phase.

2.9.6 Software Security

2.9.6.1 Theft

The “Contractor” shall describe in the Quality Plan the measures he proposes to employ to protect the software against theft and unauthorised access during development. This description shall define the physical restrictions as well as procedural measures and specific tests to be carried out on the software. The “Contractor” shall ensure that the described measures are implemented to protect the software from unauthorised access.

2.9.6.2 Viruses

The “Contractor” shall ensure that all software is developed in environments certified free from computer viruses. To achieve this, the “Contractor” shall use proprietary virus detection software and suppression tools.

All software delivered to Site shall be accompanied by evidence that demonstrates that the media are free from viruses.

2.10 Software Licences

2.10.1 General

The copyright of all software specially developed for the project shall become the property of the “Owner” on Taking Over of the Works or Part of the Works.

Licensees for all proprietary software supplied shall be provided to the “Owner Representative”.

2.10.2 Standard Software

In respect of standard software the “Contractor” shall ensure, prior to procurement, that all licences can be transferred to the “Owner”. Where possible the “Owner” shall be a sub-licensee on all software licences when they are originally procured by the “Sub Contractor”. All licences shall be transferred to the “Owner” following Taking Over.

2.10.3 Developed and Configured Software

In respect of developed and configured software, the “Owner representative” ship of, and intellectual property rights to, the software shall reside with the “Owner”. On completion of Taking over the “Contractor” shall deliver to the “Owner” all sources and executable code, all software development documentation, and all specialist development tools required for maintenance.

2.11 Factory Acceptance Test Document

Prior to carrying out any testing, the “Contractor” shall prepare for the approval of the “Owner representative” a detailed Factory Acceptance Test (FAT) document which shall fully detail the scope of the tests to be carried out during the Pre-FAT and the FAT.

The FAT document shall detail tests, which will provide documented evidence that the system meets the functional and performance requirements of the FDS, and shall provide a permanent record of these tests and their results.

The FAT shall provide the following:

a) Schedule of inspection, measuring and test equipment used.
b) Detailed description of the simulation procedures to be adopted for the Pre-FAT and FAT.
c) Detailed schedule of preliminary system checks and test procedure prerequisites.
d) Detailed schedule of specific planned and unstructured tests.
e) For each test the “Contractor” shall detail the following:
   i) Purpose of the test (objective).
   ii) Scope of the test.
   iii) Prerequisites for carrying out the test.
   iv) Verification procedures to be adopted.

v) All special software and hardware tools required to perform the test.
The FAT shall give details of:
i) The procedures to be followed to correct any deficiencies that are recorded.
ii) Any reference documents.
iii) Any special terms and abbreviations used.
iv) Any special safety procedures to be adopted during testing.

For each documented test, a space shall be provided in the FAT document for comment and for the "Contractor" and the "Owner representative" to sign off the test as completed or to provide brief details of the reason for failure.

The FAT document shall be divided into separate sections or volumes for each section of works.

2.12 Factory Acceptance Tests

2.12.1 General

The following requirements shall be observed:

a) Prior to commencement of the FAT, all test documentation, reviews and verification procedures relating to the software and hardware under test shall have been satisfactorily completed.
b) Where the "Contractor" wishes to refer to type tests in lieu of actually performing the tests, copies of the type test certificates shall be submitted as evidence of conformance to the specification.
c) None of the system software or hardware shall be modified during the tests unless there is an exceptional need to do so in order to carry out the test.
d) The test document may be modified with the permission of the "Owner representative" during the actual test if found to be incorrect. Any change to the test document shall be marked in red on the 'in-use' FAT document and the FAT record copy.
e) The tests shall be carried out in accordance with the procedures detailed in the FAT document.

2.12.2 Phasing of the Test Programme

The tests shall be carried out at the "Contractor's" works in two phases as follows:

a) Pre-FAT on hardware and software.
b) FAT.

Under normal circumstances the Pre-FAT shall be carried out by the "Contractor" alone, although the "Owner representative" reserves the option to attend the "Contractor's" premises for this test. The Pre-FAT testing shall include checks to ensure that the system successfully passes the FAT when this is carried out.

After completion of the Pre-FAT test, the "Contractor" shall submit a report to the "Owner representative" for information. The report shall summarise the Pre-FAT activities and findings, including an itemised list of any deficiencies found and the remedial measures taken to rectify the problem.

Subject to the satisfactory completion of the Pre-FAT, the FAT shall be carried out by the "Contractor" and shall be witnessed by the "Owner / Owner Representative".

2.13 Site Acceptance Tests

2.13.1 General

The following requirements shall be observed:

a) Prior to commencement of the SAT, all test documentation, reviews and verification procedures relating to the software and hardware under test shall have been satisfactorily completed.
b) None of the system software or hardware shall be modified during the tests unless there is an exceptional need to do so in order to carry out the test.
c) The test document may be modified with the permission of the "Owner representative" during the actual test if found to be incorrect. Any change to the test document shall be marked in red on the 'in-use' SAT document and the SAT record copy.
d) The tests shall be carried out in accordance with the procedures detailed in the SAT document.
e) The SAT shall encompass the normal modes of operation and failure modes and shall demonstrate correct functionality of the system in accordance with the Specification.
f) Tests shall be carried out on the fully assembled equipment comprising the HMIs and PLCs. All signals between the HMIs and the PLC's shall be tested.

2.13.2 Scope of the Test

a) Prerequisites for carrying out the test.
b) Verification procedures to be adopted.
c) All special software and hardware tools required to perform the test.

The SAT shall give details of the following:

i) The procedures to be followed to correct any deficiencies that are recorded.
ii) Any reference documents.
iii) Any special terms and abbreviations used.
iv) Any special safety procedures to be adopted during testing.
v) For each documented test, a space shall be provided in the SAT document for comment and for the "Contractor" and the "Owner representative" to sign off the test as completed or to provide brief details of the reason for failure.
vi) The SAT shall be divided into separate sections or volumes each relating to separate areas of the Works.

2.13.3 Test Details

Tests shall be carried out to demonstrate all aspects of HMI functionality. Notwithstanding this the "Contractor" shall devise tests to demonstrate the following:

2.13.3.1 PLC Control Functionality

The "Contractor" shall demonstrate correct functionality of the system in accordance with the requirements of the Specification.

2.13.3.2 Tests on PLC to HMI Communications

a) Tests shall be carried out to demonstrate that:
b) Effective communications are established and monitored between the HMI and each process control PLC.

c) The database in each PLC and HMI is correctly configured in accordance with the agreed schedules.
d) Appropriate parts of the HMI database are updated when the HMI reads from a PLC.
e) Blocks of data in the PLCs are read by the HMI at the appropriate frequencies or, where relevant, simply on an 'as required' basis.
f) The appropriate parts of the PLC database are altered when the HMI writes to the PLC.
g) The databases of neither the HMI nor the PLCs are corrupted when there is a communications failure, and that an appropriate alarm is raised on the HMI to indicate this failure.
h) There are operator prompts to carry out archiving to electronic media as file areas become full.
i) The operation of the automatic screen updating procedure functions when changes are made to screens.

2.13.4 HMI Functionality

The "Contractor" shall devise tests to demonstrate the correct functioning of the following:
a) Display status of each device such as a valve, drive, value sensor, etc.
b) SCADA hand selection and control.
c) Set-point adjustment.
d) Duty/standby adjustment.
e) Adjustment of PID control parameters,
f) Check of default parameters.
g) Check of accuracy of all displayed values such as level, flow rate, kWh, etc.
h) Trending.
i) Archiving.
j) Report generation.

2.13.4.1 HMI to HMI Communications

The tests shall demonstrate the functioning of communication links used for carrying out the transfer of data under the following circumstances:
a) When information on a Section of the Works is called up from another section.
b) When automatically and/or manually prompted to move updated screens from one part of the site to another.
c) When archive files are moved from one Section of the Works to another.

The "Contractor" shall demonstrate monitoring of HMI communications links and the functioning of the system in the event of a failure of any link and on subsequent recovery of the link.

2.13.4.2 File Development

The "Contractor" shall demonstrate that the HMI is able to carry out the following procedures:
a) Monitor the development of real time and historical files within the HMI.

2.13.4.3 Power Supply and UPS Functionality

The "Contractor" shall demonstrate functionality of HMI in the event of a power failure (i.e. as a result of the UPS not continuing to support that part of the HMI load) to each part of the system.

The "Contractor" shall demonstrate the annunciation of the fault and the orderly shutdown of that part of the HMI affected by the failure of the UPS.

The “Contractor” shall demonstrate the ability of the UPS to hold up the HMI at that Section of the Works for the specified duration.

2.13.4.4 System Response

The “Contractor” shall prepare a comprehensive cause and effect response log for each operator initiated action. The log shall detail the cause, effect and the time interval between. These times shall be compared with times specified within the Specification (if specified). Where times are in excess of these times or, if times are not specified, outside times conducive to efficient operation of the plant, the “Contractor” shall rectify the system software and/or hardware as necessary.

2.13.4.5 Test Records

Records shall be kept relating to all tests carried out. The records shall include details of the test specification, versions of software items under test or referenced in the test, any test arrangements used, the input test parameters and the output results.

The test records shall form part of the Final Documentation.

2.14 Site Acceptance Test Document

Prior to carrying out any testing, the “Contractor” shall prepare for the approval of the “Owner representative” a detailed Site Acceptance Test (SAT) document which shall fully detail the scope of the tests to be carried out during the SAT.

The SAT document shall detail tests, which will provide documented evidence that the system meets the functional and performance requirements of the Specification, and shall provide a permanent record of these tests and their results.

The SAT shall provide the following details of the installation check comprising:

a) Visual safety check
b) Check on power supply, earthing and isolation integrity
c) 100% point to point check of cable connections.
d) A schedule of inspection, measuring and test equipment used.
e) A detailed description of any simulation procedures to be adopted for the SAT.
f) A detailed schedule of preliminary system checks and test procedure prerequisites.

g) A detailed schedule of specific planned and unstructured tests.
h) For each test the “Contractor” shall detail the following:

2.15 User Documentation

User documentation or post-installation documentation shall comprise the following:

a) Operations manual.
b) Complete and fully updated versions of the:

- FDS (Functional Design Specifications)
- FAT document
- SAT document.

The Operations Manual shall describe the system as installed and provide sufficient information for users, maintainers and developers to execute their responsibilities throughout the working life of the Plant.

c) The documentation shall comprise sections on the following:
i) General documentation.
ii) Operational us.
iii) Maintenance.
iv) System development data comprising:

- Software documentation.
- Operating system modification data.
- Source code listings
- Data structures.

The contents of each section shall follow generally and where appropriate the contents detailed in the aforementioned IEE guidelines.

3 Tank Farm Management System

3.1 Introduction

The Tank Farm Management System (TFMS) is a sub system of 'Terminal Automation System'. This document identifies the job requirements/specifications pertaining to the scope of Bidder for Tank Farm Management System of "Delhi Aviation Fuel Farm Facility (DAFFPL) for Modernization of Existing Fuel Facility Project – Aviation Fuel Terminal".

The requirements, which have not been explicitly identified, but required for the completion and satisfactory performance of the entire Tank Farm Management System is implied.

3.2 System Requirements

This section specifies the requirements for the tank monitoring system including field equipment, field to control room interface and man machine interface.

The manufacturer of the tank gauging system shall be manufacturing according to international standards ISO 9001 and ISO 14001. Each radar/ Guided wave radar level tank gauging shall be individually tested for accuracy over a distance from 1 to 20 meters as minimum. The test shall be performed in a test range approved by an international accredited institute. The system shall be capable to generate, capture and provide inventory data / information for display, reporting and further data handling to perform inventory management.

The Tank farm management system shall be able to measure tank levels, temperature and pressure and water level in metric units. Based on the measured values the system shall provide:

a) Observed product density.
b) Volume calculation according to ASTM/API tables, which include total observed volume (TOV), gross observed volume (GOV), gross standard volume (GSV), available pumpable volume and available space.
c) Product flow calculation.
d) High, High-High, Low, Low-Low alarm.
e) Gauge diagnostics and status information.
f) Leakage alarm.
g) System diagnostics.
h) Batch handling.

The system shall meet performance parameters as specified in the applicable OIML tank gauging documents.

The system shall be able to perform alarm and error handling for all system components. As a minimum all field equipments shall be of protection class IP 65 (NEMA 4).

All the offered instruments shall communicate over the same field bus to save cable costs.

All configurable devices shall have an optional hardware based write protection, which can be sealed.

All tank and field mounted equipment shall be designed for continuous operation in ambient temperature of (-) 2.2° C to 48.4°C and relative humidity of 100 % condensing. For hot climates, self-ventilating sun radiation protection shall be provided.

The control room equipment shall be designed for continuous operation in ambient temperature of (0 to 50) deg C and relative humidity of 95%.

All field devices, during normal operation, bench testing or field services shall be designed to be immune to radio frequency & electromagnetic interference with field strength of 15 Volts/meter or less over frequency range of 50 to 450 Hz.

Measuring range, strapping tables, spectrum analysis, software upgrades and modifications shall be possible to configure and monitor from the control room.

3.3 Scope of Work

The Bidder's scope for Tank Farm Management System (TFMS) for Modernization of existing fuel facility of DAFFPL includes Not Limited to following:

a) Detailed Design and Engineering of TFMS to ensure satisfactory performance.
b) Procurement, Manufacture, Assembly.
c) Integration, Factory/Shop Testing.
d) Packaging, Forwarding, Supply, Insurance, Custom clearance (if any), Unloading at site, Storage, with required modification on the tanks.
e) Calibration, Field-testing, Installation/Erection, Pre-commissioning, Commissioning, Stabilisation of the complete TFMS system.
f) Supply of Spares.
g) Documentation.
h) Providing comprehensive AMC for a period of 5 years after two years of warranty for the successful Operation of TFMS. The complete requirements shall be executed with single point responsibility.

Note: Preparation and submission of all necessary documents during various stages of the project as listed in this tender document. Since it is existing fuel farm facility the Vendor should visit at site before offering the TFMS system and also verify the tank nozzle etc.

3.3.1 Scope of Supply

The scope of supply shall broadly include the following.

a) Radar level gauge (With +/- 1 mm accuracy).
b) Averaging Temp. Sensor / Spot Temp. Sensor (to be connected to Primary Level Gauge)
c) Water Interface Probe (to be connected to Primary Level Gauge).
d) Pressure transmitter for density measurement.
e) Tank side indicators (to be connected to respective primary level gauges)
f) Communication Interface Unit or Field Communication Unit.
g) TFMS software & Human Machine Interface.
h) Cable, Junction box and other hardware.

i) Hand held calibrator

3.3.2 Radar Gauges

The Radar Gauges shall meet the parameters Not Limited to the following:

a) Radar type tank gauging system shall employ Frequency Modulated Continuous Wave design.
b) The radar gauge, during normal operation, bench testing or field service, shall not generate microwave power levels hazardous to humans. The maximum power level as per API MPMS 3.1B appendix B.2.4.2 shall not exceed 2 mW.
c) The radar gauge shall have the approval from Federal Communication Corporation (FCC, USA).
d) For custody quality applications, the intrinsic or bench tested accuracy of the level gauge shall be equal to or better than ±1 mm over the entire measuring range. The test shall be performed in a test range approved by an international accredited institute.
e) The installed accuracy for the inventory control application shall be equal to or better than ±1 mm. Field calibration shall be in compliance with API MPMS 3.1B.4.5. The installed accuracy shall be verified during commissioning period. The verification procedure shall be in compliance with API MPMS chapter 3.1A and 3.1B.
f) Local level indicators integral to the field control units shall display exactly the same readings as indicated in the control room operator console.
g) Signal frequency shaping before broadcast shall be fully processed. Signal monitoring and registering of product surface reflection shall provide full frequency picture for possibility of complete reflection interpretation. This should support fine-tuning, trouble-shooting and antennae contamination monitoring and signalling.
h) The gauge frequency sweep must be liberalized against an ultra-stable digital reference using an internal crystal oscillator.
i) Sensor & electronics shall be integral in one unit. Internal electronics in the level gauge shall be temperature stabilized. Electronics Not be placed in antenna as it is exposed to tank atmosphere.
j) Entire gauge head assembly shall be mounted on the top of the tank and the sub-components i.e. antennae, electronics, housing etc. shall be designed as separate units so that they can be freely independently interchanged without EEPROM change either at factory or at site.
k) The MTBF figure for the system based on installed units in the field shall be more than 65 years. The calculations shall be provided to prove the same.
l) The antenna design shall be such that minimum influence from the tank wall is provided. Both inclination and orientation of the antenna shall be adjustable. It shall have sloping surfaces to ensure condensation drip-off.
m) The material of the antenna shall be proven to be compatible for the chemical composition of the tank products and shall be acid proof stainless steel and Teflon.
n) The radar gauge antenna shall be factory designed to be easily removable from the still pipe to allow access for manual gauging, temperature, dipping and sampling without affecting / altering the reference height of the tank. The access to the still pipe shall be made without special tools or extra spool piece.
o) Radar type of level gauging and control room field interface shall have full galvanic isolation and surge protection at communication and power cabling connections.
p) Radar gauge shall have the ability to digitally integrate peripherals with 2-wire intrinsically safe power and communication wiring. It shall be possible to integrate peripherals without the need for separate / external barrier circuitry units.
q) The Level Transmitter (Radar Type) shall be Microprocessor based with Foundation field bus digital signal output / 2nos Alarm Contact super Imposed with a digital signal.

r) Applicable peripherals shall be equipped with electrical circuitry for lighting protection at interface cabling to level gauge.
s) An integrated water interface-cum-temperature probe shall be provided with suitable anchoring facility. Exact calibration range shall be confirmed during detailing
t) All necessary manuals like installation, maintenance, operational with calibration certificates. Master instrument calibration certificate photocopy for NIST
u) All equipment's and accessories shall be Ex-Proof and shall have PESO/CCOE approval.

3.3.3 Pressure transmitter

a) The transmitters shall generally be diaphragm type with a local indicator for output indication.
b) Transmitters shall be electronic, 2-wire SMART type with foundation field bus Protocol and capable of delivering 4-20 mA into at least 500 Ohms load when powered with 24V DC supply from receiver instrument. They shall be protected against short circuit and reverse voltage. Retrofit models are not acceptable.
c) Peak-to-peak ripple and total noise level in the electronic signal shall not exceed 0.25% of the maximum signal.
d) The instrument shall not be affected by radio frequency variations such as walkie-talkie, wireless paging system and other power and communication equipment.
e) The local indication shall be 4 digit LCD type in engineering units of kg/cm^2 (g) / mmWC, for pressure transmitters, as specified in the data sheets.
f) The calibrated range shall be selected in such a way that normal operation lies within 30-70% of the calibrated range.
g) All wetted parts including the measuring element shall be made of material that is corrosion resistant to process fluid. In general, SS 316L or better material may be used for all applications. Body and cover material shall be SS 316.
h) Measuring elements in vacuum applications shall have under range protection down to full vacuum without any shift in calibration.
i) The instrument cases shall be normally tropicalized and weather proof to IP65 as per IEC529 as a minimum.
j) All transmitters shall have external span and zero adjustments from front face of instrument / by using a hand held configuration, non-interactive allowing easy range change at site.
k) All conduit connections shall be of ½" NPT (f) unless otherwise specified in the data sheets. If two entries are provided, one shall be supplied with an SS conduit plug.
l) The instruments shall be intrinsically safe certified by statutory bodies like DGMS / CENELEC / BASEEFA / PTB / UL / FM / CSA / other international statutory authority for use in area classification mentioned in data sheets. Necessary copies of electrical compliance certificates shall be furnished to "Owner representative" for review.

3.3.4 Tank Side Indicator

a) Indicator shall be 2 wire communicating and loop powered.
b) The indicator directly communicates with radar transmitter.
c) The tank side display at tank base level shall show level and temperature measurement and water interface level, density measurement and alarm / other diagnostic information.
d) The level reading shall be the same as shown in TFMS PC in control room.

3.3.5 Average Temperature Assembly

a) The temperature sensor shall be multiple spot type of RTD Pt100.
b) Averaging temperature element shall include a specified number of RTD elements at graduated lengths housed in common flexible metal Thermo well. System shall conform to API MPMS 7-4.

c) The system shall automatically do the averaging of the elements submerged in the tank product.
d) The sheathing material shall be SS and suitable for temperature range of (-) 2.2° C to 48.4° C.
e) The multipoint temperature RTD's shall be wired directly into the local data acquisition or control unit & temperature signals shall be communicated to remote workstation via communication bus.
f) The offered average temperature sensor should be from the original equipment manufacturer of Radar gauge only.
g) Kindly include below Point "First PT 100 shall be 300 mm from the bottom so that real time temperature is given even at low product level. In case the product level goes below 300 mm last healthy reading shall be shown in control room operator console".

3.3.6 Communication Unit

a) The communication unit shall act as an interface between field instruments and TFMS software and its task shall be to continuous poll data from the field and to store it in its buffer memory. Whenever a request for data is received, the communication unit can immediately send data from its updated buffer memory.
b) The standard system shall provide a redundant RS 232 or RS 485 communication interface for data transmission to PLC, Man Machine Interface, site management system and a modem for remote communication.
c) The field instruments shall be able to communicate with 2 wire field bus via the communication unit to the operator interface at the distance of 4 Km without any additional hardware.
d) The field bus protocol shall have a baud rate of 4800 as minimum and provide maximum resistance to interference.

3.3.7 TFMS Software & Human Interface

a) TFMS software shall perform enhanced inventory management and tank monitoring facility by means of software applications running on Windows XP / 7 platforms designed on industrial standard open connectivity architecture
b) Human machine interface shall consist of a Workstation type computer machine, user configurable graphical interface and shall perform calculations, alarm handling, configuration and data storage. It shall have the specifications as mentioned in the datasheet.
c) The operator interface graphics shall have the following functionality:
   i) All standard windows shall have the ability to be customized on demand.
   ii) The system interface shall have independently supported and microprocessor controlled communication on all ports.
   iii) All engineering function interface shall be provided for system configuration and set up. All configuration change shall be password – protected.
   iv) A group configuration function shall be provided which permits the plant operator to define the grouping of tanks for display on the group view screen and the group inventory screen. Similar function shall be available for alarms.
   v) A value entry function shall be provided which permits the operator to manually enter the process values and operating parameters for each tank.
   vi) The system shall be able to accept multiple users with different privileges independently of the windows operating system. Logging on and off of different users shall be stored as an event for traceability. The system administrator with highest level of authority and password handles the assigning of user accounts.
   vii) The system shall be capable of storing unique volume tables and correction factor with at least 1000 strapping points for each tank. These tables will provide level to volume conversion of tank.

viii) The system shall provide open connectivity for users to extract appropriate data using commercial of the shelf software e.g. MS Excel or MS Access etc.

ix) The operator interface shall have full network support over LAN. In case of networking the system shall have clock synchronization for all operator stations.

x) The following modules / views are required as minimum for the tank inventory system:

a) Batch handling

b) Rate of Change Computation (Flow)

c) Alarming: audio / visual alarms

d) User configurable tank grouping, Product level measurement

e) Observed product density.

f) Volume calculation according to ASTM/API table, which includes Total Observed Volume (TOV) Gross Standard Volume (GSV) Available (pump able) Volume and available space.

g) Events

h) Field commands.

i) Manual overwrites.

j) Views: tank as well as group related.

k) Tank detail.

l) Tabular data.

m) Bar graphs.

n) Tank icons.

o) System diagnostics.

p) System and data recovery.

q) Leakage alarm.

r) The system shall be able to generate Tank reports, Inventory balance reports, alarm reports as a minimum and all the reports shall be publishable on printer, via e-mail or as a file. All reports may be retrieved through on local communication.

s) The system shall have input for ambient air temperature. The system shall be able to use this temperature value, combined with the product temperature for the compensation of thermal tank shell expansion.

t) The system shall generate High, High – High, Low, Low – Low & safe alarms for all the measured parameters. It shall also generate leakage alarms for based on the change in levels or the net standard volume of the products in the storage tank.

u) The system shall be capable of performing self-checks on each tank gauge and data collection or control unit.

v) The system shall be capable of performing historical and real time trending analysis. It shall have the capacity to store reports on hard disc for traceability.

w) The system shall provide audible and visual indication to the operator of an alarm condition and provide the operator the ability to acknowledge the alarm and disable the audible indicator. It shall also provide the ability to disable the alarm to the operator.

x) The system shall provide importing and exporting flow indications based on volume movements in the tank. Indications of estimated end time of batch shall be provided based on user set points. The batch handling shall be able to handle multiple destinations and R1 sources. The batch function shall generate printable batch reports.

y) The system shall be able to communicate with remote station via internet and telephone connection for remote viewing of data. The system should be connected via OPC server link to remote station.

z) The TFMS software shall be full compliance with the OPC Foundation Data Access Interface specifications (DA 2.0) to make it possible to use with a variety of packages supporting OPC client functionality, such as Terminal Automation Software, SCADA or other user application programs written in Visual Basic or Visual C++.

aa) The system shall provide a calculated volume rate of change (Flow) based on the true level rate from the Radar gauge and the tank capacity level.

bb) Tank farm management system shall be communicating with min.10 Nos tanks.

3.3.8 Tank Inventory Management

- The HMI shall be able to calculate tank inventory values according to the API. All values in the calculation process shall be displayed.
- The system shall have an input for ambient air temperature. The system shall be able to use this temperature value, combined with the product temperature, for compensation of thermal tank shell expansion.
- The system shall be capable of storing unique volume tables and correction factors, with at least 1000 strapping points for each storage tank. These tables will provide level to volume conversion of the tank.
- All tank level alarms are to be repeated as signals to LRC and also as option to Pipeline Division

3.4 Data Sheets for TFMS System

3.4.1 Data Sheet for Radar Type Level Transmitter

General	
Type	Radar type to measure the tank level with local indication
Tag No.	Refer Follow sheet
P & ID No.	Refer Follow sheet
Line No. / Service	Refer Follow sheet
Range	Refer Follow sheet
Safety	Zone- 1 & 2, Gas Group IIA, IIB, Temp class T3 as per IEC 60079 Class 1, Div. Groups C, D in according to ANSI/NFPA 70 (FM)
Mounting	On top/ Main hole of Tank
Total Accuracy: Sensor & Transmitter	+/ - 1mm or better
Process Conn. Size, Rating & Finish	18" Flanged, 150#, RF, Serrated finish as per ANSI B16.5 (Flange Size to be verified at site)
Process conn. Material	CS
Calibrated Range	0 – 20 M
Protection Class	Weather Proof to IP65 as a min(NEMA 4) and ex proof, PESO
Reference height	Refer Follow sheet
Housing	Dia Cast Aluminium.
Cable Gland	Required as per system - Double Compressor cable Gland
O Ring	Viton
Transmitter	
Sensor Design	Frequency Modulated Continuous Wave design (FMCW)
Sensor Enclosure	PVDF / PTFE
Radar Frequency & Power level	*
Antenna type	Parabolic / Equivalent
Antenna Size	Suitable for tank nozzle
Antenna Material	Acid proof stainless steel / TEFLON
Antenna Frequency	10 GHz
Special design features for antenna	*; With sloping surfaces
Transmitter Type	Electronic ; Smart 2 wire Foundation Field bus
Output	Microprocessor based with Foundation field bus digital signal output / 2nos Alarm Contact
Local Indication	Required
Configuration	From front keypad of instrument
Switch Requirement	Required; 2 SPDT Contacts
Conduit entry size	1/2" NPT(F)
RFI/EMI protection	Instrument to be protected from Radio (R) Frequency (F) Interference (I) &
	Electro (E) Magnetic (M) Interference (I)
	conforming to SAMA PMC 33.1C
Surge & Lightning Protection	Required
Field Communication Protocol	*
Common Mode Rejection Ratio	>150dB
Communication Distance	1.0 Km Min.
Baud Rate	4800 min
Others	
Make	*
Model No.	*
Cable Glands	Required : ex-proof, double compression of brass, Ni coated 1/2” NPT
Make	Honeywell-Enraf / SAAB / E & H.

3.4.1.1 Follow Sheet for Radar Type Level Transmitter

Tag. No	Service	P&Id No.	Calibration Span mmWC	Tank Height & Diameter (mtrs)	Oper. Press. kg/cm2	Oper. Temp deg C	Temp. Range C	Specific Gravity	Tank/ Vessel MOC	Remarks (Accuracy)
LT-VF201	ATF Tank	322538-PIA-0002-01	20000	20.0 & dia 20.0	Atm	Amb	0-100	0.775 to 0.840	CS	+/ - 1mm or better

Tag. No	Service	P&Id No.	Calibration Span mmWC	Tank Height & Diameter (mtrs)	Oper. Press. kg/cm2	Oper. Temp deg C	Temp. Range C	Specific Gravity	Tank/ Vessel MOC	Remarks (Accuracy)
LT-VF204	ATF Tank	322538-PIA-0002-01	20000	20.0 & dia 20.0	Atm	Amb	0-100	0.775 to 0.840	CS	+/ - 1mm or better
LT-VF205	ATF Tank	322538-PIA-0002-01	20000	20.0 & dia 24.0	Atm	Amb	0-100	-do-	CS	+/ - 1mm or better
LT-VF206	ATF Tank	322538-PIA-0002-01	20000	20.0 & dia 24.0	Atm	Amb	0-100	-do-	CS	+/ - 1mm or better
LT-VF202	ATF Tank	322538-PIA-0002-01	20000	20.0 & dia 20.0	Atm	Amb	0-100	-do-	CS	+/ - 1mm or better
LT-VF203	ATF Tank	322538-PIA-0002-01	20000	20.0 dia 20.0	Atm	Amb	0-100	-do-	CS	+/ - 1mm or better

3.4.2 Data Sheet for Pressure Transmitter

General	
Description	Electronic Indicating Transmitter
Type	2 wire , Electronic (Smart) with Foundation field busProtocol
Tag no.	Refer datasheet
P&ID No.	Refer datasheet
Line No	Refer datasheet
Range	Refer datasheet
Mounting	1/2" NPT
Case	Mfr. Std.
Output	4 - 20 mA DC into 500 ohms load minimum with smart protocol
Power Supply	24 V DC
Housing type	Weather Proof to IP65(min) / NEMA - 4 as per IEC 529
Area Classification	Zone- 1 & 2, Gas group IIA , IIB , Temp class T3 as per IEC 60079
Intrinsically Safe	Yes
Electrical Connection	1/2" NPT(F)
Built in Indicator	Yes
Local Display	4 digits LCD Display, In Engg. units
Accuracy	+ 0.05% of URL to provide 0.0005 gm/cc density accuracy
Stability	+ 0.1% of upper range limit for 6 months / greater
Power (Hysterias + repeatability + Linearity	' +/- 0.05 % for density measurement at tank bottom
Turn Down Ratio	30 : 1
Drain/Vent	Required, plug of SS
Zero/Span	From front pad of instrument / By Hand-held terminal , non-interactive
Self Diagnostic facility	Required
Measuring Unit	
Service	Hydrostatic Head Measurement
Element	Piezoresistive /Capacitance / Resonance
Op. Temp Limits	(- 2.2°C to 48.5°C)
Body / Covers Material	SS316
Element	SS316
Fill Fluid	Silicon
Diaphragm Seal	
Wetted Parts Material	SS316
Other Material	*
Process Conn Size & Rating	2" (Flange size to be checked at site) Flanged, 150# / Tank bottom Manhole
Facing & Finish	RF, Serrated finish to ANSI B16.5
Capillary Material / Length	-
Armour Flexible Material	-

Flushing / Filling Connection	-
ACCSERIOS	
Valve manifold	-
Mounting Accessories	For 2" (Flange size to be checked at site) flange mounting
Isolation valve	2", (Flange size to be checked at site) Ball valve, full bore with SS316 wetted parts
Cable Glands	Required : flame-proof, double compression of brass, Ni coated 1/2" NPT
Others	
Make	*
Model No.	*

3.4.2.1 Follow Sheet for Pressure Transmitter

Tag. No	Service	EQPT No.	P & Id No.	Oper. Pr. Kg/Cm2 g	Range	Oper. Temp.0C	Design. Temp.0C	Remarks
PT-VF201B	ATF Storage Tank-VF201	Fuel Farm Tank-VF201	322538-PIA-0002-01	Atm	0-2.5	- 2.2°C to 48.4°C	70° C	
PT-VF204B	ATF Storage Tank-204 Density	Fuel Farm Tank-VF204	322538-PIA-0002-01	Atm	0.2.5	- 2.2°C to 48.4°C	70° C	
PT-VF205B	ATF Storage Tank-205	Fuel Farm Tank-VF205	322538-PIA-0002-01	Atm	0.2.5	- 2.2°C to 48.4°C	70° C	
PT-VF206B	ATF Storage Tank-206	Fuel Farm Tank-VF206	322538-PIA-0002-01	Atm	0.2.5	- 2.2°C to 48.4°C	70° C	
PT-VF202B	ATF Storage Tank-202	Fuel Farm Tank-VF 202	322538-PIA-0002-01	Atm	0.2.5	- 2.2°C to 48.4°C	70° C	
PT-VF 203B	ATF Storage Tank-203	Fuel Farm Tank-VF 203	322538-PIA-0002-01	Atm	0.2.5	- 2.2°C to 48.4°C	70° C	

3.4.3 Data Sheet for Capacitive Water Level Sensor

General	
Element	Capacitive / Equivalent Water Level Sensor along with Temperature sensor assembly
Active measuring range	1000mm
Area Classification	Zone- 1 & 2, Gas group IIA , IIB , Temp class T3 as per IEC 60079
Output / Transmission	4~20mA foundation field bus compatible digital signal
Probe mounting	Through a 2" (Flange size to be checked at site) 150" flanged tank nozzle at top of the tank
Field communication protocol	*
Protection	Prove IP 68 and WLS converter IP 65 (NEMA 4)
Ambient Temperature	(-2.2 to 48.5) deg C
Probe Material	PFA enveloped in stainless steel / equivalent with SS sheathing
Outer diameter of WLS	*
Accuracy	Better than 2mm
Cable entry	*
Others	
Make	*
Model No.	*

3.4.4 Data Sheet for Averaging Temperature Sensor

General	
Tag No.	Refer follow Sheet of LT
P&ID No.	Refer follow Sheet of LT
Service	Refer follow Sheet of LT
Range	Refer follow Sheet of LT
Safety	Explosion proof Eex d IIB T6 according to Cenelec and in addition zone 0/PTB Class 1, Div. Groups C, D in according to ANSI/NFPA 70 (FM)
Element	RTD, Platinum 100
Standard	DIN 43760
Accuracy	+/- 0.2 Degree
Resolution	+/- 0.1 Degree
No. of sensing points	Throughout the tank with minimum 1 meter interval
Sheath Diameter	3/4 "
Outer Material	SS 316
Process Connection	2" (Flange size to be checked at site), 150#, RF, Serrated finish as per ANSI B 16.5
Output	4~20mA foundation Field bus compatible digital signal
Junction box for temperature sensor	Required
Enclosure for temperature sensor	Explosion proof
No. of cable entries	*
Cable Glands	Required : ex-proof, double compression of brass, Ni coated 1/2" NPT
Others	
Make	*
Model No.	*
Note	The temperature sensor shall be of multiple spot types. The sensor shall be connected via a digital sensor selector switch with the Radar gauge to enable the gauge to provide for average vapour temperature as well as temperature profiling. *bidder to specify

3.4.5 Data Sheet for Tank Side Indicator

General	
Tag No.	Refer follow Sheet of LT
P&ID No.	Refer follow Sheet of LT
Service	Refer follow Sheet of LT
Safety	Explosion proof Eex d IIB T3 according to Cenelec and in addition zone 0/PTB Class 1, Div. Groups C, D in according to ANSI/NFPA 70 (FM)
Display	LCD
Communication	Digital, two wire communicating and loop powered
Ambient Temperature	(-2.2 to 48.5) deg C
Protection	Explosion proof Probe IP 68 / NEMA4
Power Supply	Loop Powered
Material	Cast Aluminium
Finish	*
Cable entry	*
Cable Glands	Required : ex-proof, double compression of brass, Ni coated 1/2" NPT
Others	
Make	*
Model No.	*

3.4.6 Data Sheet for Field Communication Unit

General	
System Description	The communication unit shall act as an interface between field instruments and TFMS software and its task shall be to continuous poll data from the field and to store it in its buffer memory
Location	In Control room

General	
Enclosure Protection	IP60 as a minimum
Design Data	
Area Classification	Safe Area
Supply Voltage	230 V AC+/- 10%,, 50 Hz +/- 5%
Communication with field devices	*
Communication with Plant Control System	On Ethernet Redundant
Redundant processor	Required
Power supply redundancy	Required
Power Consumption	*

3.4.7 System Hardware Requirements (Minimum)

3.4.7.1 Tank Farm Computer (Latest Work Station configuration)

The workstation shall be of latest hardware configuration available at the time of offer but as a minimum shall have:

a) Processor type Pentium Dual Core – 2 with 4 GB RAM or better.
b) System Capability - Real time clock
c) Hardware priority interrupt
d) General purpose register
e) Flexible addressing mode
f) Hardware bootstrap loader
g) Powers fail protection and auto start
h) Memory management and protection
i) Serial / parallel communication port
j) Ethernet 10/100Mbps, 3 NIC
k) Built in Graphic accelerator
l) Dual monitor ready

3.4.7.2 Secondary Storage Disk Sub-System

a) Type - Ultra SCSI
b) Formatted - 160 GB (min) capacity
c) Controller - 2 drives capacity
d) Access time - 50 m sec.

Combo drive

a) Formatted - 4 GB (min) capacity
b) Controller - 1 drive capacity

Video Display Unit

a) Screen size - 24" LCD monitor with TFT screen
b) Type - Non glare, Colour VGA monitor
c) Display - 1280 X 1024 resolution
d) Mounting - Table top
e) Mouse

3.5 Documentation Requirements

1. The documentation and drawings provided by the Bidder shall be in accordance with the standards and quantities specified in these specifications. Documents shall be in MS-Word, while drawings shall be in AutoCAD Latest version. Calculations sheets can be in MS-Excel and database in MS-Excel. All documents shall be in the English language. All manuals shall be clearly sectioned, paginated and referenced using a system that permits identification of revised sections, pages and references. Successful bidder will be provided with drawing and document format for the project.
2. Completion of the documentation requirements to the owner/consultant's satisfaction shall be a condition for fulfilment of the Bidder's obligations under the contract.
3. All Software, including display formats, report formats, diagnostic software and database(s) shall be provided by the Bidder as one master and two individual copies stored on media compatible with the system loading facilities supplied. Two additional formatted, but clean, storage media shall also be provided.
4. Operating and maintenance manual for the facilities shall be made available before commencing the commission for review and approval. Final operating manual shall be issued only after obtaining approval. The objective of the manual is to assemble all the instructions, data and drawings necessary for the operations personnel to start, operate, control, shut down and maintain the systems under normal and emergency.
5. Final As-Built: During the installation and commissioning of the system, the Bidder's site engineer shall mark-up the modifications/ corrections on two sets of the drawings. On completion, he shall leave one set to the owner/consultant's representative and shall carry the other set with him for final update of the system drawings.
6. Within 4 weeks of the complete commissioning, the Final As-Built drawings shall be delivered to the Owner.
7. The Bidder shall submit all documents (including drawings) for review by the Owner/consultant. Review and comment by the Owner/consultant, or any failure to review, shall not absolve the Bidder of the responsibility for the accuracy and completeness of the documents and for producing a working solution in accordance with good industry practice and meeting the requirements of the tender.

3.6 Functional Design Specification (FDS)

1. The Bidder shall prepare (after receipt of Purchase Order/Letter Of Intent) a FDS for approval. The FDS shall be submitted for review as one complete document. The FDS shall be revised by the Bidder in accordance with the Owner/Consultant comments and submit for approval.
2. The Bidder shall discuss the requirements with the owner/consultant and obtain all information necessary to perform the Work.
3. The approved FDS shall act as a working document for the detailed engineering and implementation of the Aviation Fuel Farm Automation System (AFFAS).

4. The FDS shall contain the following information as a minimum:

   i. The system objectives.

   ii. Each party's responsibilities.

   iii. Services offered.

   iv. Specifications and equipment quantities for all deliverables including systems.

   v. Equipment items, giving type, manufacturer, model etc.

   vi. The documentation to be delivered.

   vii. All spare parts, tools, test equipment and installation materials.

1. Overall System Specification including:
   a. Dimension, weight, power consumption, heat dissipation, position requirements for all equipment units and the complete system.
   b. System schematics and equipment layout drawings.
   c. Analysis of spare capacities and the ability to meet the performance criteria e.g. response times, availability etc.
   d. Analysis of system and communications network load.
2. Drawings including:
   a. Network cabling, system cabling and hook-up drawings.
   b. Electrical single line and earthing diagrams.
3. Interface Specifications including:
   a. System I/O interface specifications.
   b. Communications network specifications and definition of transmitted data.
   c. Communications RS-232/485, Modbus, Profibus for third party devices.
4. For all software to be developed, including application programs:
   a. A block diagram of software structure and program schedule.
   b. A software specification including flow charts, detailed descriptions, memory and timing requirements.
5. Guidelines for configuration in line with and consultation with the owner/consultant documenting philosophies developed.
6. These guidelines are to be used by the Bidder during the implementation phase of the project.
   a. A guideline for configuration of the AFFAS Operator Interface including operational procedures, commands, display presentations, hard copy print-outs and reports.
   b. A guideline for configuration of all data base requirements.
7. Definition of FAT, SAT and Final acceptance test.

3.7 System Manuals

1. **Operator's Handbook** – This shall describe (in a step-by-step manner) all hardware, software, keyboard functions, display presentation and printer output available to and required by the operator to achieve day-to-day operation and to restart in the event of a system failure. This shall also detail the configuration of the operator interface facilities including all displays, reports, calculations, trends,

alarm/event handling etc. It shall include description of the hierarchy, reference codes, memory utilization and capacity.

2. **Engineer's Handbook:** This shall describe the hardware, software, keyboard functions, display presentation, printer outputs and equipment procedures available to the maintenance engineer. These shall include all configurations, off-line and on-line programming facilities.

3. **Equipment Handbook:** This shall describe in detail specifications of all hardware units, which comprise the AFFAS. All layout drawings, printed circuit card descriptions, theory of operation, logic drawings and hook-up details shall be included together with description of the total equipment operation, input/output facilities. A bill of material listing all hardware supplied along with manufacturer part number, name plate data, overall dimensions shall be provided.
4. **Maintenance and Testing Handbook:** This shall describe the maintenance schedule, preventive maintenance, test procedures and corrective maintenance procedure including failure analysis. This handbook shall also include descriptions for the use of all diagnostics and test equipment supplied, together with detailed lists of spare parts as supplied. The maintenance handbook shall cover all the items supplied as a part of this contract including printers.
5. **Procedures for Returning/Replacement of Faulty Equipment:** The procedures for returning of faulty equipment to the Bidder, both during and beyond warranty, shall be documented; together with a description of the modification/upgrade procedures used for the supplied equipment. An appendix to this Handbook shall list all equipment items supplied, to printed circuit card level, and shall detail the original equipment suppliers, type numbers, modifications, quantities and serial numbers.
6. **Software Handbook:** This should detail the software provided within the various units comprising the TAS. It shall include operational descriptions/functions of the individual programs and the overall system. A comprehensive program schedule together with individual descriptions and flow charts for all application programs with complete source listings shall be provided. The handbook shall consist of configuration, graphics builder information, system initialization guide etc.

3.8 Installation Manuals

The Bidder shall provide a manual for the installation of each item of equipment and cabling etc. which is to be installed on site. The document shall incorporate all necessary instructions, precautions and checks for satisfactory installation. Drawings necessary for the installation of the equipment e.g. layout, fixing arrangement, termination details, etc. shall be included.

4 Training

Training for Owner's/Consultant's personnel (one group consisting of operators and other group consisting of hardware/software maintenance engineers

Bidder shall be responsible for furnishing details of course outlines, manuals of training, equipment necessary to conduct the training, exercises to evaluate progress of trainees'. Bidder shall also be responsible for any other requirements necessary to train the engineers deputed by owner within a time limit so that they acquire the necessary expertise to operate and maintain the programs and the equipment supplied.

4.1 Acceptance Criteria

4.1.1 Statutory approvals

"Contractor" shall be responsible for obtaining all statutory approvals, as applicable for all instruments and systems.

In addition, equipment/instruments/systems located in hazardous area, shall be certified by local statutory authorities for their use in the area of their installation. The Ex-Proof equipment and accessories shall have PESO/CCOE approval. In general following certification shall be given.

For all intrinsically safe/explosion proof / flameproof equipment/instruments/systems or equipment with any other type of protection allowable as per this package which are manufactured abroad and certified by any statutory authority like BASEEFA, FM, UL, PTB, LCIE, CENELEC etc.

4.1.2 Inspection & Testing

TFMS system shall be inspected for performance by "Owner / Owner representative" at "Contractor" work. The following type of tests will be carried out during the Inspection

a) Functional / Operational Test
b) Dimensional check.
c) Visual Check

Contractor shall confirm that all test and calibration equipment's are certified by Independent organizations and shall produce certificate from such certifying authorities. On demand, all such certificates shall be made available to "Owner representative"

4.1.3 Identification & Marking

Tagging and nameplates will be as per ISA S 5.1, The tag numbers for all instruments in field and in control room, junction boxes, tubing etc. shall be prefixed with unit no, minimum size 3"X1" and it will be attached to the instrument with the 16 gauge stainless steel wire.

All instruments shall have SS tag or nameplate of a permanent type with identification number and service description.

All panel instrument nameplates shall be constructed of white laminated plastic plates with black engraved lettering and securely fastened with 316 SS screws.

Transmitters shall be provided with a stainless steel name plate firmly attached to it at a visible place indicating the following information:

a. Manufacturer's name and trade mark.
b. Instrument Tag Number.
c. Model Number and Serial Number.
d. Body material, size & rating.
e. Calibration Range
f. Instrument Range.

4.2 Contractor Quality Control

4.2.1 QA Planning

a) "Contractor" shall submit a Quality Management system complying with the programme described in ISO 9001 – 2008.
b) "Contractor" shall submit QA plan covering various activities like design, engineering, material requirement, manufacturer inspection and testing, documentation and dispatch to site, erection and commissioning and maintenance of quality records for approval within two weeks from receipt of LOI/PO.
c) QA involvement shall commence at the initiation of the requisition and follow through to completion and acceptance, thus ensuring total conformity to the purchaser's requirements. "Contractor" shall submit the Quality plan "Owner representative" approval.

4.2.2 Preparation for Shipment

a) Prior to shipment, the material shall be dried and cleaned thoroughly of all grease, loose scale, rust, flux, weld spatter and rubble, both internally and externally.
b) All machined surfaces and threaded connections shall be protected by coating with rust preventive.
c) Screwed connections shall be protected with threaded forged steel plugs.
d) Any item that is liable to suffer distortion during transit and erection shall be suitably braced or dismantled and properly packed for shipment.
e) Unpainted items shall be suitably protected from corrosion during shipment and Subsequent outdoor storage for a period of approximately six months by coating with rust preventives.

4.2.3 Guarantee

The Contractor shall stand guarantee for their material / equipment / workmanship and performance for a period of 18 months from the date of supply or 12 months from the date of commissioning whichever is earlier. Guarantee certificates should be submitted along with despatch documents.

4.2.4 Codes & Standards

The Tank Farm Management System (TFMS) & Custody transfer application Mass flow meter shall meet applicable standards and regulatory agency requirements including, but Not Limited to, the standards and requirements of the following:

4.2.5 Safety Standards

a) Applicable Safety Standards: ATEX or IEC Ex is mandatory, FM

b) "Contractor" to specify the design classifications of the field equipment for operation in continuous hazardous area according to one of applicable standards above mentioned.

Standard No.	Title
IEC 61508-2, - 3	Functional safety of electrical/electronic/programmable electronic safety related systems
IEC 61511-1, -2, -3	Functional safety – Safety Instrumented Systems for the process industry sector

4.2.6 Application Standards

SN.	Standard No.	Title
1	OIML	International Organization for Legal Measurements
a	R85	Automatic level gauges for measuring the level of liquid in fixed storage tanks
b	R125	Measuring systems for mass of liquids in tanks
2	EI (erstwhile API)	Energy Institute (Erstwhile American Petroleum Institute)
a	EI (API) MPMS ch. 1	Vocabulary
b	EI (API) MPMS ch. 3.l A	Standard Practice for Manual Gauging of Petroleum and Petroleum Products in Stationary Tanks
c	EI (API) MPMS ch. 3.l B	Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging
d	EI (API) MPMS ch. 3.3	Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Pressurized Storage Tanks by Automatic Tank Gauging
e	EI (API) MPMS ch. 3.6	Measurement of Liquid Hydrocarbons by Hybrid Tank Measuring Systems
	EI (API) MPMS ch. 7.4	Static Temperature Determination Using Fixed Automatic Tank Thermometer
3	ASTM	(American Society for Testing and Materials); Applicable tables and Calculation methods for quantity assessment of liquids (metric units).
4	ISO/TC28/section 3	Terms relating to the calculation of oil quantity
5	ISO 4266	Petroleum and liquid petroleum products - Measurement of level and temperature in storage tanks by automatic methods.

4.2.7 Design Standards

a) ANSI American National Standards Institute

b) DIN Deutsche Industry Norm "German Industry Standards"

c) NFPA 70 National Fire Protection Agency; National Electrical Code (NEC)

d) IEC 529 Classification of Degrees of Protection provided

e) IEC 79 Electrical Apparatus for Explosive Gas Atmospheres.

f) NEMA ICS.6 Enclosures for industrial controls and systems.

4.2.8 Hazardous Area Classification

a) In general, for all hazardous area, intrinsically safe philosophy shall be followed. Instruments shall be certified for Zone -1, Group IIA/IIB, T3 application from recognized authority like CMRI, ATEX, FM, CENELEC, PTB, BASSEFA etc. Instruments, which are not available as per their standard design from any reputed manufacturer as intrinsic safe, can be supplied in flameproof design.

b) Bidder must select suitable galvanic isolating external barriers for intrinsically safe circuits. Barrier selection shall be based on following requirements:
- The barrier shall be of latest/ enhanced available versions of approved makes shall be selected.
- The model number selected should be well proven as per the criteria specified.
- The barriers selected should have back-up support and representative available locally.

c) Typically barrier selection must be made based on the following:
- Analog Inputs (4-20 mA) , Analog Outputs (4-20 mA)
- Digital Inputs, Digital Output
- Proximity Inputs.

In case, barrier is required for any other Input / Output, the same shall be of approved vendor. Approval of actual model number shall be obtained from Owner / Owner representative before proceeding.

d) Following minimum degree of Protection as per IEC 60529 shall apply to all Instrumentation equipment:

Indoor Equipment/Panel - IP 42 / 45

Outdoor Equipment/Panel- IP 65

e) All electronic field instruments located outdoors, exposed to direct sunlight and not meeting plant environmental conditions, shall be protected with sunshades.

f) All junction boxes in hazardous area shall be certified flame proof.

4.3 Conflicting Requirements

In the event of any conflict between the tender documents and related standards and codes or any other attachment to this tender, the Bidder shall follow the following documents in the order of their priority:

a. Statutory requirements.
b. Tender documents.
c. Codes and standards.

In case of contradiction between any specification, Bidder shall refer the matter to Owner/Consultant for clarification. Owner/Consultant decision in this regard shall be final and binding.

4.4 Weights & Measurement Approvals

a) Approvals according to OIML R85/ API Ch 3.1B.
b) German PTB / equivalent.
c) Netherlands Measuring Institute, NMI / equivalent.
d) W&M approval.
e) All calculations, conversions and corrections shall be API/ASTM compliant.

4.5 Deviation Table

Any deviation to the tender document shall be submitted by the Bidder along with the offer, duly justifying the reasons for deviation. Owner/consultant may accept or reject the deviation and inform all the vendors accordingly. The deviation shall be submitted in the format below.

User Documentation shall form an integral part of the Operations and Maintenance Manual for the Works.

5 Technical Specification for Field Instruments/ Transmitters

5.1 Scope of Work

This General specification together with the specification sheets attached herewith form the requirement for design, materials, packing, supply, inspection, installation, testing, commissioning, guarantee, of Field transmitters including accessories for the Modernization of Fuel Farm of DAFFPL, IGI Airport, New Delhi.

Though the Differential Pressure Transmitters / Level transmitters (DPT) & Pressure Transmitters (PT) specification sheets indicate materials for various parts, it shall be the Contractor's responsibility to select and recommend the correct materials for these parts to ensure compatibility with the process conditions specified in data sheets.

For Fire water Storage tanks three nos. DP type Level transmitters shall be supply and install on the existing FW storage tanks. Tag nos. and range is specify in follow sheet specification remain same.

In the event of any conflict between specification, data sheets, standards and codes, etc., Contractor shall refer to “Owner representative” for clarification and proceed only after obtaining the clarification.

Contractor shall strictly adhere to the documentation schedule attached with this specification and submit required number of data sheets catalogues, reproducible with prints.

5.2 Construction Method

5.2.1 Technical Requirements

a) The transmitters shall generally work on capacitance / piezo resistive / resonance technology with a local indicator for output indication.

b) Transmitters shall be electronic, 2-wire SMART type with HART Protocol and capable of delivering 4-20 mA into at least 500 Ohms load when powered with 24V DC supply from receiver instrument. They shall be protected against short circuit and reverse voltage. Retrofit models are not acceptable.

c) Peak-to-peak ripple and total noise level in the electronic signal shall not exceed 0.25% of the maximum signal.

d) The instrument shall not be affected by radio frequency variations such as walkie-talkie, wireless paging system and other power and communication equipment.

e) The local indication shall be 4 digit LCD type in engineering units of kg/cm^2 (g) / mmWC, for pressure transmitters, as specified in the data sheets. For level indicating instruments it shall be in 0~100%.

f) The calibrated range shall be selected in such a way that normal operation lies within 30-70% of the calibrated range.

g) All wetted parts including the measuring element shall be made of material that is corrosion resistant to process fluid. In general, SS 316L or better material may be used for all applications. Body and cover material shall be SS 316.

h) Measuring elements in vacuum applications shall have under range protection down to full vacuum without any shift in calibration.

i) The instrument cases shall be normally tropicalized and weatherproof to IP65 as per IEC529 as a minimum.
j) All transmitters shall have external span and zero adjustments from front face of instrument / by using a hand held configurator, non-interactive allowing easy range change at site.
k) The instrument shall be supplied with 2" pipe mounting accessories of SS 304 suitable for horizontal / vertical mounting.
l) All conduit connections shall be of ½" NPT (f) unless otherwise specified in the data sheets. If two entries are provided, one shall be supplied with an SS conduit plug.
m) The instruments shall be intrinsically safe certified by statutory bodies like DGMS / CENELEC / BASEEFA / PTB / UL / FM / CSA / other international statutory authority for use in area classification mentioned in data sheets. Necessary copies of electrical compliance certificates shall be furnished to "Owner representative"/"Owner / Owner Representative" for review.
n) "Contractor" to furnish a list of model nos. of Zener barriers of MTL / STAHL / Pepperl & Fuchs make that can be used with the instruments and also furnish the allowable entity parameters.
o) For differential pressure transmitters on level measuring service, suitable range suppression / elevation adjustment shall be provided wherever required.
p) For differential pressure measurement on flow service, a 5-valve manifold of Anderson-Greenwood model M6AVHS-4 / equivalent of SS316 material of construction shall be provided.
q) The prefer make of DPT is shall be from approved vendor list for differential Pressure measurement across the Filters.

5.3 Acceptance Criteria

5.3.1 Inspection and Testing

The Contractor shall prepare a detailed shop "Quality Assurance Program" to meet the requirement of this specification for "Owner Representative" approval. The supplier shall perform all tests and inspection necessary to ensure that the material and workmanship confirm to supplier's offer and submit the inter inspection/ test reports to "Owner representative" at the time of intimating them for inspection. The Ex-Proof equipment and accessories shall have PESO/CCOE approval.

5.3.2 Tag Plate

Each transmitter shall be provided with a Stainless Steel Tag plate permanently fastened to the superstructure at a visible place. The tag plate shall have following details:
a) Manufacturer's Name.
b) Tag number.
c) Model No. and Serial No.
d) Pressure & temperature rating.
e) Body & Element material.
f) Calibrated span & units.
g) Range limits and outputs.
h) Power supply and electrical classification.
i) Year of Manufacture.

5.3.3 Deviations and Rejection

All deviations in specifications shall be categorically stated. No deviation categorically stated shall be taken to be a complying case and, no deviation whatsoever shall be accepted at a later date. Hence, it is in the interest of the Vendors/Contractors that they highlight the deviations in a separate document titled "Deviations to Specification"

Any offer which does not highlight deviations and if deviations are detected during the course of evaluation is liable to be summarily rejected.

5.4 Contractor Quality Control

5.4.1 QA Planning

a) "Contractor" shall submit a Quality Management system complying with the programme described in ISO 9001 – 2008.

b) "Contractor" shall submit QA plan covering various activities like design, engineering, material requirement, manufacturer inspection and testing, documentation, dispatch to site, erection and commissioning and maintenance of quality records for approval within two weeks from receipt of LOI/PO.

QA involvement shall commence at the initiation of the requisition and follow through to completion and acceptance, thus ensuring total conformity to the purchaser's requirements. "Contractor" shall submit the Quality plan "Owner representative" approval

5.4.2 Guarantee

"Contractor" shall guarantee the performance of all equipment and system supplied under his scope in accordance with the approved design and specification and shall also guarantee material or design defects for the period of 12 months from the date of commissioning of the project or 18 months from the date of shipment of the entire system, whichever is earlier.

5.4.3 Documentation Schedule

Contractor shall strictly adhere to the documentation schedule attached with this specification and submit required no. of data sheets, catalogues, and softcopies.

Contractor shall submit 2 copies of the following along with the offer.

a) Technical data and specification / catalogues or leaflet information.

b) List of deviations to specification.

Contractor shall submit 1 copy of price list of spare parts required for commissioning and also 2 years trouble free operation along with price bid.

Contractor shall furnish 5 copies each of the following data/documents within 2 weeks after placement of order for "Owner representative" review/approval.

a) Drawing showing overall drilling and mounting dimensions.

b) Calibration certificates including functional test.

c) Material certificates of compliance.
d) Electrical certificates.
e) Installation, operation and maintenance manuals.
f) Priced list of tools and devices for maintenance.

5.5 Code reference

Unless otherwise mentioned, end connections shall be as detailed below:

The related standards mentioned herein shall be of the latest revision prior to the date of enquiry.

a) ANSI B16.5
b) ANSI B16.20
c) ANSI B2.1
d) ASTM for materials
e) All threaded connections shall be to NPT as per ANSI B: 2.1.
f) All flanged end connections shall be as per ANSI B: 16.5.
g) Grooves of RTJ flanges shall be octagonal as per ANSI B: 16.20.
h) Flange face finish shall be serrated concentric to paragraph 6.3.4.1, 6.3.4.2 and 6.3.4.3 of ANSI B: 16.5.

5.6 Data Sheets for Field Transmitters

5.6.1 Data Sheet for Differential Pressure Transmitter

General	Minimum Requirement
Description	Electronic Indicating Transmitter
Type	2 wire , Electronic (SMART) with HART Protocol
Tag no.	Refer Follow sheet
P&ID No.	Refer Follow sheet
Line No	Refer Follow sheet
Range	Refer Follow sheet
Mounting	2" pipe, Field
Case	Mfr. Std.
Output	4 - 20 mA DC into 500 Ohms load minimum
Power Supply	24 V DC from receiver inst.
Enclosure	Intrinsically Safe and Weather Proof to IP 65
Area Classification	Zone- 1 & 2, Gas group IIA , IIB , Temp class T6 as per IEC 60079
Electrical Connection	1/2" NPT(F)
Built in Indicator	Yes
Local Display	4 digits LCD Display, In Engg. units
Accuracy	± 0.075% of span or better including the effects of linearity, hysteresis & repeatability
Stability	+ 0.1% of upper range limit for 6 months / greater
Power (Hysteresis + repeatability + Linearity	+-0.1% of span
Turn Down Ratio	30 : 1
Drain/Vent	Required, plug of SS
Zero/Span	From front pad of instrument / By Hand-held terminal , non-interactive
Self-Diagnostic Facility	Required
Measuring Unit	
Service	Differential Pressure

General	Minimum Requirement
Element	Piezo resistive /Capacitance / Resonance
Operating. Temp Limits	- 2.2°C to 48.4°C
Body / Covers Material	Die cast Copper free aluminium
Element	SS 316L or better
Fill Fluid	Silicon
Process Connection	1/2" NPT(F)
ACCS	
5 - Valve manifold	Required of SS316
Mounting Accessories	Required
Zener Barrier	Required (MTL 7787 +) *bidder to specify
Cable Glands	Required : Weather-proof, double compression of brass, Ni coated 1/2" NPT
Other	
Protocol support other than HART	* Bidder to specify
Make	* Bidder to specify
Model No.	*Bidder to specify

5.6.1.1 Follow Sheet for Diff. Pressure Transmitters

Tag. No	Service	Vassal / Line No.	P&ID No.	Oper. Pr. Kg/cm2	Max. Working Pr. Kg/Cm^2 g	Oper.Temp.^{0} C	Design. Temp.^{0}C	Diff Range Kg/cm2	Remarks
DPT-301	DP across FWS #301	FWS-301	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-302	DP across FWS #302	FWS-302	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-303	DP across FWS #303	FWS-303	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-304	DP across FWS #304	FWS-304	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-305	DP across FWS #305	FWS-305	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-306	DP across FWS #306	FWS-306	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-307	DP across FWS #307	FWS-307	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-308	DP across FWS #308	FWS-308	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-309	DP across FWS #309	FWS-309	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	

Tag. No	Service	Vassal / Line No.	P&ID No.	Oper. Pr. Kg/cm2	Max. Working Pr. Kg/Cm^2 g	Oper.Temp.^{0} C	Design. Temp.^{0}C	Diff Range Kg/cm2	Remarks
DPT-310	DP across FWS #310	FWS-310	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-300A	DP across FWS #JKA	FWS-JKA	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-300B	DP across FWS #JKB	FWS-JKB	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-311	DP across FWS #311	FWS-311	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-312	DP across FWS #312	FWS-312	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-313	DP across FWS #313	FWS-313	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-314	DP across FWS #314	FWS-314	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-MF-11	DP across Filter-MF-11	ATF-0511-8-”A21A	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-MF-12	DP across Filter-MF-12	ATF-0512-8-”A21A	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-MF-13	DP across Filter-MF-13	ATF-0521-8-”A21A	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	
DPT-MF-14	DP across Filter-MF-14	ATF-0522-8-”A21A	322538-PIB-0005-01	5.0	8.75	- 2.2°C to 48.4°C	70	(0 to 2.0)	

5.6.2 Data Sheet for Pressure Transmitters

General	Minimum Requirement
Description	Electronic Indicating Transmitter (DP type)
Type	2 wire , Electronic (Smart) with HART Protocol)
Tag no.	Refer datasheet
P&ID No.	Refer datasheet
Line No	Refer datasheet
Range	Refer datasheet
Mounting	On 2" Pipe; Necessary Mounting Bracket and accessories by “Contractor”.
Case	Manufacturer’s Standard
Output	4 - 20 mA DC into 500 Ohms load minimum
Power Supply	24 V DC from receiver inst.
Housing type	Weather Proof to IP65
Area Classification	Zone- 1 & 2, Gas group IIA , IIB , Temp class T6 as per IEC 60079
Intrinsically Safe	Yes
Electrical Connection	1/2" NPT(f)
Built in Indicator	Yes
Local Display	4 digits LCD Display, In Engg. units
Accuracy	+ 0.75% of URL
Stability	+ 0.1% of upper range limit for 6 months / greater
Turn Down Ratio	30 : 1
Drain/Vent	Required, plug of SS 316
Zero/Span	From front pad of instrument / By Hand-held terminal , non-interactive
Self-Diagnostic Facility	Required
Measuring Unit	
Service	Gauge Pressure
Element	Piezo resistive /Capacitance / Resonance
Op. Temp Limits	-- 2.2°C to 48.4°C
Body / Covers Material	SS 316
Element	SS 316L or better
Fill Fluid	Silicon
Process Connection	1/2" NPT(f)
ACCS	
3 Valve manifold	Required of SS316
Mounting Accessories	Required of 2" pipe of CS, Zn plated / Polyester painted (Universal mounting)
Zener Barrier	Required (MTL 7787 +) *Bidder to specify
Cable Glands	Required : Weather-proof, double compression of brass, Ni coated 1/2" NPT
Others	
Protocol support other than HART	*bidder to specify
Make	*bidder to specify
Model No.	*bidder to specify

5.6.2.1 Follow Sheet for Pressure Transmitters

SN..	Tag. No	Service	Line No.	P & Id No.	Oper. Pr kg/Cm2	M.AW.P Kg/Cm^2 g	Oper. Temp.^{0}C	Design. Temp.^{0} C	Range kg/Cm2
1	PT-401	ATF main discharge header Pressure to T3	ATF-0440-24"-A21A	322538-PIA-0004-01	17.0	18.75	- 2.2°C to 48.4°C	70	(0 to 20)

5.6.3 Data Sheet for Level Transmitter (DP Type)

General	Minimum Requirement
Transmitter Type	Diff. Pressure Transmitter
Type	Electronic microprocessor based, HART
Tag no.	Refer Follow sheet
P&ID No.	Refer Follow sheet
Line No	Refer Follow sheet
Mounting	2" pipe, Field
Case	Die cast aluminium
Pressure Element	Diaphragm
Operating temperature limit	Ambient 0 to 70 0c
Wiring type	2 wire
Wetted parts	SS 316
Output	4-20mA DC
Power Supply	9 - 32V DC
Housing type	IP-67
Area classification	Safe
Build in Indicator	Required
Dial type	Digital
Accuracy	<±0.075% of span(with combined effect of Linearity, hysterisis,repeatability)
Transmitter Range	VTS
Calibration Range	VTS
CONNECTION	
Process	HP side :
	LP Side :
Electric for Cable Gland	1/2" NPT (F) wt cable gland
ACCS	
Three way valve manifold	SS 316 Required
Output Indicator	Yes, digital (Integral)
Filling fluid	Silicon oil –DC200

5.6.3.1 Follow Sheet for Level Transmitter (DP Type)

Tag. No	Service	Vassal / Line No.	P&ID No.	Oper. Pr. Kg/cm2	Max. Working Pr. Kg/Cm^2 g	Oper.Temp.^{0} C	Design. Temp.^{0}C	Diff Range Kg/cm2	Remarks
LT-01	Fire Water	FWT-T1	322538-RIA-0900-01	Full of Water	2.5	Amb.	60	0 to 2.5 Level Measurement of water	
LT-02	Fire Water	FWT-T1	322538-RIA-0900-01	Full of Water	2.5	Amb.	60	0 to 2.5 Level Measurement of water	

Tag. No	Service	Vassal / Line No.	P&ID No.	Oper. Pr. Kg/cm2	Max. Working Pr. Kg/Cm^2 g	Oper.Temp.^{0} C	Design. Temp.^{0}C	Diff Range Kg/cm2	Remarks
LT-03	Fire Water	FWT-T1	322538-RIA-0900-01	Full of Water	2.5	Amb.	60	0 to 2.5 Level Measurement of water	

5.6.4 Data Sheet of Guided Wave Radar

General	Minimum Requirement
Transmitter Type	Guided Wave Radar
Measuring Principle	TDR
Tag no.	Refer Follow sheet
P&ID No.	Refer Follow sheet
Line No	Refer Follow sheet
Mounting	2" pipe, Field
Case	Die cast aluminium
Transmitter Sensor	
Output Signal	4-20mA DC HART
Orientation	Vertical
Still Pipe/Probe	Probe
Pipe/Probe material	VTS
Probe Length	VTS
Indicator Integral	
Function	Indication
Supply Voltage	24V DC Loop wired
Power Consumption	VTS
Mounting	Direct
Cable Gland	SS,1/2"NPT(F)
Lightning Protection	VTS
Enclosure	IP-65 & Ex-proof
Certification	Required
Programming/ Calibration	VTS
Infrared Connector	VTS
Instrument range	VTS

5.6.4.1 Follow Sheet for Guided Wave Radar

Tag. No	Service	Vassal / Line No.	P&ID No.	Nozzle	Max. Working Pr. Kg/Cm^2 g	Oper.Temp.^{0}C	Viscosity	S.G	Tank Dimensio	Remarks
LT-HSD-1	High Speed Diesel	-	-	-	-	-	-	-	-	
LT-211	High Speed Diesel	-	-	-	-	-	-	-	-	
LT-212	High Speed Diesel	-	-	-	-	-	-	-	-	

Tag. No	Service	Vassal / Line No.	P&ID No.	Nozzle	Max. Working Pr. Kg/Cm^2 g	Oper.Temp.^{0}C	Viscosity	S.G	Tank Dimensio	Remarks
LT-213	High Speed Diesel	-	-	-	-	-	-	-	-	

Note: Size of Guided wave radar taken care by client

5.7 Data sheet for Limit Switch Box

Heading Left	Heading Right
Type	Proximity Limit Switch Box for Open and Close position
Make	Standard
Model	VTS
Temperature Range	'-2 to 65°C
Humidity Range	0-95% RH non-condensing
Mounting	On Top of Valve Body
Housing Material	Aluminium Die-cast with powder coated
Contact Type	Inductive
'Contact Form	Proximity, 2 wire
'Contact Rating	24V DC / 5Amp
'Cable Entry Size	1/2" NPT(F) with Double Compression Cable Gland
No of Entries	Two
Terminals	Anti-vibration Clip on Type
Area Classification	Hazardous Zone I, IIA / IIB
Enclosure Type	Ex-proof with weather proof IP65
Certification	CCOE/CMRI/PESO
Insulation Resistance	> 10 M Ohm at 500 VDC
Tag Plate	SS Tag plate
Output	PNP
Quantity	2 Nos.

Note :

1. Output selection may be change as per finalized automation System.
2. Local On/ Off indication should be provide.

5.8 Data sheet of Mass Flow Meter

Heading Left	Heading Right
Tag No.	Refer Follow sheet
P&ID No.	Refer Follow sheet
Line No. / Line Size	Refer Follow sheet

Heading Left	Heading Right
Area Classification	Refer Follow sheet
Fluid / Fluid State	Coriolis
Flow Rate	Refer Follow sheet
Pressure	Refer Follow sheet
Temp.	Refer Follow sheet
Spec. Gr.	Refer Follow sheet
Viscosity	Refer Follow sheet
Construction Type	Coriolis
Tube Geometry Straight / Other Shape	U-tube
Enclosure	Ex-proof & Weatherproof to IP66 or better
Process Connection	3" Flanged #150 RF RFS
Meter Body Size	VTS
Wetted Part Material	SS 316
Body Material	Dia cast Aluminium
Electronics Housing Material	Die Cast Aluminium
Cable Entry	1/2" NPT (F) with cable gland
Transmitter Mounting	Integral Type
Accuracy Flow | Density | Temp	0.05% of Total flow | 0.00050gm/cc | 0.1 Deg.C
Flow Range | Density Range	VTS | VTS
Power Supply	230V AC, 50Hz
Local Display	LCD display in Engineering Units
Input	From Sensor
Output | Frequency Output	4-20mA HART | Required
| Density Output	Required
Cable Entry	1/2" NPT (F) with cable gland
Certification	ATEX / CCOE (Note-5)

Note:

1) The mass flow meter shall be certified for use in “Custody Transfer of products” by a recognized Weights and Measures agency.
2) Supplier to submit Flow metre size calculation along with quotation.
3) The mass flowmeter shall be suitable for the area classification specified & necessary certificates shall be furnished.
4) Transmitter with Tag no. FT-501 is already procured by client.

Table 5.8: Follow Sheet For Mass Flow meter

Tag No.	P&ID NO.	Service	Flow (T/hr)	Pressure Kg/cm2	Temp. ^{0}c	Viscosity	S.G	Range
FT-501	322538-PIA-0005-01	Fuel	450	5-8	50	3.4	0.83	VTS

6 Technical Specification for Head Mounted Temperature Transmitter

6.1 Scope of Work

This specification together with the data & follow sheets attached herewith form the minimum requirement for design, materials, packing, supply, inspection, installation, testing, commissioning, guarantee, of Head Mounted Temperature Transmitters including accessories for the Modernization of Fuel Farm of DAFFPL, IGI Airport, New Delhi.

6.2 Construction Method

6.2.1 Technical Requirements

6.2.1.1 Resistance Temperature Detector (RTD)

a) RTD (Resistance Temperature Detector) shall be platinum element 3 wire, duplex type with 100 Ohms resistance at (-2.2 to 50)^0 C calibrated as per IEC 751/DIN 43760.
b) The element shall be spring loaded, mineral insulated and shall have SS 316 sheath as minimum.
c) The RTD shall have insulation resistance of more than 500 ohms at 500 V DC.
d) The RTD head shall be of Die Cast Aluminium, weather proof to IP 65 as per IS 2147. Terminals shall be brass screw type / Silver plated.
e) Design of RTD assembly with thermo-well shall allow online replacement of temperature element.
f) The head shall have two separate cable entries for the twin element sensors each of ½" NPT (f) size and provided with necessary weather-proof double compression cable glands of SS. One entry shall be provided with SS conduit plug.

6.2.1.2 Thermo-well

a) All temperature elements shall be provided with Thermo-well fabricated out of bar stock of minimum SS 316 and provided with hexagonal head. Thermo-well design shall be as per standard up to ANSI 600 # including for packages / sub-packages. For thermo-wells above ANSI 600 # rating, contractor may use their own proven design(s) recommended by various manufacturers suitable for Specified pressure-temperature conditions. Thermo-well design shall ensure no air gap between the tip of the element and Thermo-well to minimize measurement lag.
b) "Contractor's" shall carry out the vibration analysis of all Thermo-well as per PTC codes where line velocity exceeds 6 m/s for liquids and 120 m/s for vapours /gases. In case the thermo-well design fails vibration analysis, an alternate design may be used by the contractor. All such design along with calculations shall be submitted for "Owner / Owner Representative's" review.
c) Immersion length of thermo-wells shall be selected as follows:

Line Size	Immersion length
Up to 6"	280 mm
From 8" onwards	320mm
Vessels / columns	400 mm

a) This immersion length is based on thermo-well nozzle length of 200 mm. (Between flange face and inner wall of pipe). In special applications, where thermo-well nozzle sizes are larger or where temperature is to be measured at any specific location, "Contractor" shall decide the immersion length based on the actual requirements.

b) The thermo-well tip shall be at centre line of pipe but immersion length shall not exceed 400 mm for higher size pipes. Due care shall be taken of the aspects such as flow, pressure, temperature and fluid properties like corrosion etc.
c) The welding shall be done by professional welders, qualified for ASME unfired pressure vessels work. All welding shall be by TIG welding process. All the weld joints shall be tested to 100 kg/cm2 minimum. D.P Type Test shall be done for Thermo-well welding.
d) The process connection shall be 1 ½ "flanged to ANSI B16.5.

6.2.1.3 Transmitter

a) Transmitters shall be electronic, 2-wire SMART type with HART Protocol and capable of delivering 4-20 mA into at least 500 Ohms load when powered with 24V DC supply from receiver instrument. They shall be protected against short circuit and reverse voltage
b) Peak-to-peak ripple and total noise level in the electronic signal shall not exceed 0.25% of the maximum signal.
c) The instrument shall not be affected by radio frequency variations such as walkie-talkie, wireless paging system and other power and communication equipment.
d) The local indication shall be 4 digit LCD type in engineering units.
e) The calibrated range shall be selected in such a way that normal operation lies within 30-70% of the calibrated range.
f) Instrument cases shall be tropicalized and weatherproof to IP65 as per IEC529 as a minimum.
g) All transmitters shall have external span and zero adjustments from front face of instrument / by using a hand held configurator, non-interactive allowing easy range change at site.
h) All conduit connections shall be of ½" NPT (f) unless otherwise specified in the data sheets. If two entries are provided, one shall be supplied with an SS conduit plug.
i) The Head of the Transmitter should confirm to Zone – 1 & 2, Gas group IIA, IIB. Temp class T6.The instruments shall be intrinsically safe certified by statutory bodies like DGMS / CENELEC / BASEEFA / PTB / UL / FM / CSA / other international statutory authority for use in area classification mentioned in data sheets. Necessary copies of electrical compliance certificates shall be furnished to "Owner" /"Owner Representative" for review.
j) "Contractor" shall furnish a list of model nos. of Zener barriers of MTL / STAHL / Pepperl & Fuchs make that can be used with instruments and also furnish the allowable entity parameters.

6.3 Acceptance Criteria

The "Contractor" shall prepare a detailed shop "Quality Assurance Program" to meet the requirement of this specification for "Owner representative" approval. The supplier shall perform all tests and inspection necessary to ensure that the material and workmanship confirm to supplier's offer and submit the inter inspection/ test reports to "Owner / Owner representative at the time of intimating them for inspection.

Though the specification sheets indicate materials for various parts, it shall be the "Contractor" responsibility to select and recommend the correct materials for these parts to ensure compatibility with the process conditions specified in data sheets.

In the event of any conflict between specification, data sheets, standards and codes, etc, "Contractor's" shall refer to "Owner / Owner Representative" for clarification and proceed only after obtaining the clarification.

6.3.1.1 Tag Plate

Each instrument shall be provided with a Stainless Steel Tag plate permanently fastened to the superstructure at a visible place. The tag plate shall have following details:

a) Manufacturer's Name.
b) Tag Number.
c) Model No. and Serial No.
d) Range.
e) Year of Manufacture.

6.3.1.2 Other Requirements

Unless otherwise mentioned, end connections shall be as detailed below:

a) All threaded connections shall be to NPT as per ANSI B: 2.1.
b) All flanged end connections shall be as per ANSI B16.5.
c) Grooves of RTJ flanges shall be octagonal as per ANSI B16.20.
d) Flange face finish shall be serrated concentric to paragraph 6.3.4.1, 6.3.4.2 and 6.3.4.3 of ANSI B16.5.

6.3.1.3 Deviations and Rejection

All deviations to “Owner Representative” specifications shall be categorically stated. No deviation categorically stated shall be taken to be a complying case and, no deviation whatsoever shall be accepted at a later date. Hence, it is in the interest of the “Contractor’s” s that they highlight the deviations in a separate document titled "Deviations to Specification"

Any offer which does not highlight deviations and if deviations are detected during the course of evaluation is liable to be summarily rejected.

6.3.2 Contractor Quality Control

a) Unless accepted otherwise by the "Owner / Owner Representative”, “Contractor” shall employ a Quality Management System complying with the program described in ISO 9001-2008.
b) Work which, in the opinion of the "Owner / Owner Representative” is not in accordance with the Specifications shall be rejected. Any delay caused by such rejection shall not in any way relieve the “Contractor” of his obligations under the Contract

6.3.2.1 Guarantee

“Contractor’s” shall guarantee the performance of all equipment and system supplied under his scope in accordance with the approved design and specification and shall also guarantee material or design defects for the period of 12 months from the date of commissioning of the project or 18 months from the date of shipment of the entire system, whichever is earlier.

6.3.3 Documentation Schedule

“Contractor” shall strictly adhere to the documentation schedule attached with this specification and submit required no. of data sheets, catalogues, soft copies with prints.

“Contractor” shall submit 2 copies of the following along with the offer:

a) Technical data and specification / catalogues or leaflet information.

b) List of deviations to specification.

“Contractor” shall submit 1 copy of price list of spare parts required for commissioning and also 2 years trouble free operation along with price bid.

“Contractor’s” shall furnish 5 copies each of the following data/documents within 2 weeks after placement of order for “Owner / Owner Representative” review/approval.

c) Drawing showing overall drilling and mounting dimensions.

“Contractor’s” shall submit 4 copies and 1 soft copy of all the following documents in a folder to “Owner / owner Representative”.

a) Calibration certificates including functional test.
b) Material certificates of compliance.
c) Electrical certificates.
d) Installation, operation and maintenance manuals.
e) Priced list of tools and devices for maintenance.

“Contractor’s” shall strictly adhere to the documentation schedule attached with this specification and submit required no. of data sheets, catalogues, reproducible with prints.

6.4 Codes Reference

The related standards mentioned herein shall be of the latest revision prior to the date of enquiry.

a) ANSI B16.5
b) ANSI B16.20
c) ANSI B2.1
d) ASTM for materials.

6.5 Data Sheet for Head Mounted Temperature Transmitter

General	Minimum Requirements
Tag No.	Refer Follow Sheet
P & ID No.	Refer follow Sheet
Line No. / Service	Refer follow Sheet
Range	Refer follow Sheet
RTD	
Type	Platinum (Duplex), Pt-100
Resistance	100 ohms at 0° C
Base	Wound on Ceramic
Wiring	3 Wire DIN Standard 43760
Element Calibration	Confirming to IEC 751 Class B (+0.1 deg C) with alpha=0.00385
Insulation Resistance	More than 500 ohms at 500 V DC
Stability	0.05% after thermal cycling(ASTME 235)
Protect tube	OD : 8mm, Material : SS316 filling MgO2 (99.5 % purity)
Loading	Spring loaded to ensure positive contact with well
Head	
Type	Universal weather proof to IP65
Material	Die-Cast Aluminium
Terminal blocks	Brass screw type / Silver plated
Element Length	*Vendor to Advise

Thermo-well	
Construction	Bar Stock
Material	SS 316
Process connection	1 1/2" Flanged
Flange rating, facing and finish	150 #, RF, Serrated finish
Flange Material	SS 316
Bore dia	To suit element diameter.
Bore concentricity	within 10%
Thermo-well Internal thread	1/2" NPT (F)
SS chain	Required
Extension Length	150 mm Required
Extension Nipples	1/2" NPT (M) thermos-well connection in SS316
Transmitter	
Type	SMART 2 wire with HART protocol
Output	4 - 20 mA DC
Supply	24 V DC
Area Classification	Zone- 1 & 2, Gas group IIA , IIB , Temp class T6 as per IEC 60079
Intrinsically Safe	Yes
Enclosure	Weather proof to IP-65
Built in Indicator	Required Digital Display
Total Accuracy	+/- 0.1% of F.S or 0.1° C
Cable Connection	1/2" NPT (F)
Others	
Manufacturer	*Vendor to Advise
Model No.	*Vendor to Advise
Notes	
1) * Vendor To Advise	
2) Mounting details, Tests certificate to be provided.	
3) Inspection will be done by the “Owner Representative” or by authorised “Owner Representative”.	
4) Contractor to note that double compression type weather proof cable glands of SS are included in his scope for all electrical accessories.	
5) Spares required for commissioning & two years maintenance free operation to be submitted.	

6.5.1 Follow Sheet for Head Mounted Temperature Transmitter

Tag No.	Service	Line No.	P & ID No.	Oper. Pr. Kg/Cm2 g	Operating Temp. Deg C	Immersion Length mm	Range Deg C	Remarks
TT-2001	Jet A1 Fuel Hydrant Terminal T3 Pipe	ATF-313-24"-P3	322538-PIA-0004-01	17.0	(- 2.2 to 48.4)	*	(- 2.2 to 70)	

7 Technical Specification for Level Switches –Vibrating Fork Type

7.1 Scope of Work

This specification together with the data & follow sheets attached herewith form the minimum requirement for design, materials, packing, supply, inspection, installation, testing, commissioning, guarantee, of Level

Switches – Top Mounted Vibrating Fork type including accessories for the Modernization of Fuel Farm of DAFFPL, IGI Airport, New Delhi.

7.2 Construction Method

7.2.1 Technical Requirement's

a) All level switches shall, in general, be of internal Multi float operated type. Float length shall be selected to fully utilize the surge capacity of the vessel/ Tanks.
b) Top mounted level switches are used the vessel connection shall be 3" of required rating.
c) The head shall be rotatable with ½" NPT (f) conduit connections, dual, 1800 apart with one side supplied with SS conduit plug.
d) Gaskets, nuts and bolts on the rotatable head shall be suitable for the service conditions specified.
e) The design of the switches shall be such that inspection and calibration can be carried out easily. Wet calibration shall be carried for the level switches. The switching contact shall be of DPDT type with a contact rating of min 5A at 230VAC.
f) The switching enclosure shall be explosion proof to NEMA 7 suitable for installation in hazardous areas specified in data sheet. The quoted instruments shall be certified by international statutory certifying authority such as BASEEFA/PTB/UL/FM/CSA/CENELEC for installation in such areas.
g) The enclosure shall also be weather-proof to IP65 as a minimum.
h) All the switches shall perform satisfactorily when subjected to violent pulsations and severe mechanical vibrations.
i) Though the specification sheets indicate materials for various parts, it shall be the "Contractor's" responsibility to select and recommend the correct materials for these parts to ensure compatibility with the process conditions specified in data sheets.
j) "Contractor's" quote shall include a detailed specification sheet for each item, furnishing as a minimum the details meted out in "Owner representative" data sheets.
k) The bid shall be duly supported by product / technical catalogues, brochures, etc.
l) "Contractor" to ensure that all units referred to in his quote shall be to the same standards as those in Tender Specification / data sheet.
m) "Contractor" shall submit an item wise deviation list.
n) In the event of any conflict between specification, data sheets, standards and codes, etc. "Contractor" shall refer to "Owner / Owner Representative" for clarification and proceed only after obtaining the clarification.
o) Level switch should meet SIL2 and complies with IEC61508/11 requirements.

7.2.2 Level Switch – Vibrating Fork Type

a) The Level Switch shall be in accordance with this specification & the relevant latest National & International Standards

b) Supplier shall be fully responsible for the performance of the Level Switch & accessories offered for their suitability & performance complying the attached data sheet. The inspection requirements shall be as per the approved inspection plan.

c) Equipment shall be selected to suit the intended environment with due consideration of:

- Electrical area classification.
- Ambient temperature variations
- Thermal radiation.
- Humidity
- Dust.

- Vibration.
- Atmospheric pollutants

d) Level Switch type selection shall be as per process requirement and base on design condition. And Switch mechanism shall be designed to minimize the effect of vibration
e) The trim material of level switch shall be 316/316L stainless steel as a minimum and as per piping specification. However, depending on process fluid, other material like Hastelloy, Monel, 904 L etc. will be specified
f) Switches shall be hermetically sealed “single pole, double throw” (SPDT).Switches shall be rated for 24 VDC, 500 mA or 240VAC, 5 Amp with noble metal contact.
g) Cable entries shall be via isometric threaded entries ISO M20 x 1.5mm or ½” NPT female whichever mentioned in the datasheet.
h) The minimum degree of ingress protection for switch shall be IP65 and temperature class T6.
i) Float operated /Vibrating fork type level switch shall be side or top mounted as per requirement.
j) Direct acting level switches shall be external cage float type with magnetically operated (glandless) transmission of float movement to the switching element.
k) Switch shall be supplied with engraved labels stating tag number
l) Level switches shall be provided with a positive means of protection against process fluids entering the electrical housing in the event of element failure
m) Level switch shall comply with IEC 61508/IEC61511-1 if level switch used for safety integrated level (SIL) and mentioned in datasheet with minimum SIL-2 Certified.
n) Level switch shall have external test option using test magnet.
o) Electronic equipment located outdoors in field to be certified for installation in a hazardous area classified as per define in datasheet. Protection shall be preferably Ex “d” ex-proof if required
p) The selection of suitable instrument model to meet process condition is Supplier responsibility. At any point of time of execution of the job if the quoted instrument model is not suited to meet the application requirement, the same shall be replaced with suitable model without cost & time implication
q) Supplier shall be responsible for obtaining all statutory approvals, as applicable for all instruments and systems
r) In addition, equipments / instruments / systems located in the hazardous area shall be certified by the local statutory authorities for their use in the area of their installation. In general following certification shall be given.
s) For all intrinsically safe/explosion proof / flameproof equipment/instruments/systems or equipments with any other type of protection allowable as per this package which are manufactured abroad and certified by any statutory authority like ATEX,BASEEFA, FM, UL, PTB, LCIE, CENELEC etc, If required
t) Protection shall be preferably Ex‘d’ ex-proof, Temperature class T6, Ingress Protection IP65 minimum and intrinsically safe, If required
u) Vendor shall submit his QA plan covering various activities like design, engineering, material requirement, manufacturer inspection and testing, documentation and dispatch to site, erection and commissioning and maintenance of quality records for approval.

7.3 Acceptance Criteria

The “Contractor” shall prepare a detailed shop "Quality Assurance Programme" to meet the requirement of this specification for “Owner representative” approval. This document shall also contain the formats for test reports and maintenance of test records and specifications of test equipment and simulation devices.

7.3.1 Tag Plate

Each Level switch shall be provided with a Stainless Steel name plate permanently fastened to the superstructure at a visible place. The name plate shall have following details:

a) Manufacturer's Name.
b) Tag number as per “Owner representative” data sheet.
c) Model No. and Serial No.
d) Body / Cover material.
e) Process connections size & rating.
f) Year of Manufacture.

7.3.2 Deviations and Rejection

All deviation to “Owner representative” specification shall be categorically stated and the same shall be taken to be a complying case and no deviation whatsoever shall be accepted at a later date. Hence it is in the interest of the “Contractor’s” that they highlight the deviations in a separate document titled "Deviations to Specifications".

Any offer which does not highlight deviations and if deviations are detected during the course of evaluation is liable to be summarily rejected.

7.4 Contractor Quality Control

a) Unless accepted otherwise by the “Owner / Owner Representative”, “Contractor” shall employ a Quality Management System complying with the program described in ISO 9001-2008.
b) Work which, in the opinion of the “Owner / Owner Representative” is not in accordance with the Specifications shall be rejected. Any delay caused by such rejection shall not in any way relieve the “Contractor” of his obligations under the Contract.

7.4.1 Guarantee

“Contractor” shall guarantee the Performance of all equipment and system supplied under his scope in accordance with the approved design and specification and shall also guarantee the equipment and system against any manufacturing, material or design defects for the period of 12 months from the date of commissioning of the project or 18 months from the date of shipment of the entire system, whichever is earlier.

7.4.2 Documentation Schedule

“Contractor” shall strictly adhere to the documentation schedule and submit required no. of data sheets, catalogues, reproducible with prints.

“Contractor” shall submit 1 copy of the following along with the offer.

a) Technical data and specification / Catalogues or leaflet information.

b) List of deviations to specification.

“Contractor” shall submit 1 copy of price list of spare parts required for commissioning and also 2 years trouble free operation along with price bid.

"Contractor" shall furnish 5 copies each of the following data/documents within 2 weeks after placement of order for "Owner representative" review/approval.

a) Drawing showing overall drilling and mounting dimensions.
b) Wiring diagram and terminal arrangements.

"Contractor" shall submit 6 copies and 1 soft copy of all the following documents in a folder to "Owner representative".

a) Calibration certificates including functional test.
b) Material certificates of compliance.
c) Electrical certificates.
d) Installation, operation and maintenance manuals.
e) Priced list of tools and devices for maintenance.

7.5 Code Reference

Unless otherwise mentioned, end connections shall be as detailed below:

a) All threaded connections shall be to NPT as per ANSI B: 2.1.
b) All flanged end connections shall be as per ANSI B: 16.5.
c) Flange face finish shall be serrated concentric to paragraph 6.3.4.1, 6.3.4.2 and 6.3.4.3 of ANSI B16.5
d) Size & rating of flange shall be punched on flange.

7.5.1 Level Switch- Vibrating Fork Type-High-High Level Switch

General	Requirements
Tag No.	Refer Follow Sheet
PID No.	Refer Follow Sheet
Make	Vendor To Advise
Model No	Vendor To Advise
Service	ATF Storage Tank Level alarm- ESD- Tank overfill protection
Area Classification	Zone- 1 & 2, Gas group IIA , IIB , Temp class T4 as per IEC 60079
Basin/Chamber	
Material	SS 316
Process Connection Size & Rating	* ANSI 150# RF (Vender to confirm at site)
Process Connection Location	Top of the Tank
Type :Vibrating Fork Type	
Primary Sensor	Vibrating Fork (intrinsically safe)
Material:	SS-316
Dimensions	STS
Enclosure	Should be housed in weather proof (IP66) explosion proof housing as per locations.
Electrical Connection Size	1/2" NPT (F)
Cable Gland	Ex proof, Double compression required
Pressure data	
Fluid	JET A1 FUEL
Specific .Gravity (UPPER/LOWER)	0.775 to 0.84
Specific Gravity Min .Difference	
Operating Pressure	ATM
Operating Temperature	- 2.2° C to 48.4°C
Safe Feeling Height	As per process require.
Others	
Hydro test Pressure Chamber/Float Kg/cm2	N/A
Vaccum test	N/A

Approvals, if Any	Yes SIL-2 and complies with IEC61508/11 requirements- Approvals from TUV/ EXIDA
QTn.	6 Nos.
Supply	24V DC Namur Type
Contact Type	SPDT micro , 2A
Inputs required for overall SIL calculations	SFF, HFT, PFD

7.5.2 Follow Sheet for Level Switches-Vibrating Fork Type

Tag. No	Service description	P&Id No.	Vis.c P at -20° C	Design Pr kg/cm2(g) / temp °C	Vessel connect ion	Vessel MOC	Remarks
LS-VF-201	Top of ATF Storage Tank-201_ High/High Level	322538-PIA-0002-01	8.00	ATM / 70	1 1/2"	Carbon Steel	
LS-VF-202	Top of ATF Storage Tank-202_ High/High Level	322538-PIA-0002-01	8.00	ATM / 70	1 1/2"	Carbon Steel	
LS-VF-203	Top of ATF Storage Tank-203_High/High Level	322538-PIA-0002-01	8.00	ATM / 70	1 1/2"	Carbon Steel	
LS-VF-204	Top of ATF Storage Tank-204_ High/High Level	322538-PIA-0002-01	8.00	ATM / 70	1 1/2"	Carbon Steel	
LS-VF-205	Top of ATF Storage Tank-205_ High/High Level	322538-PIA-0002-01	8.00	ATM / 70	1 1/2"	Carbon Steel	
LS-VF-206	Top of ATF Storage Tank-206_ High/High Level	322538-PIA-0002-01	8.00	ATM / 70	1 1/2"	Carbon Steel	

8 Technical Specification for Pressure Gauges

8.1 Scope of Work

This specification together with the data & follow sheets attached herewith form the minimum requirement for design, materials, packing, supply, inspection, installation, testing, commissioning, guarantee of Pressure Gauges including accessories for the Modernization of Fuel Farm of DAFFPL, IGI Airport, New Delhi.

8.2 Construction Method

8.2.1 Technical Requirements

a) The pressure element shall be an elastic element as specified in the data sheets.

b) In case of Bourdon elements, it shall be directly connected to socket, without any capillary.
c) Pressure gauges shall have an accuracy of + 1% of FSD. These shall be weather-proof with dial size of 150 mm and shall have features like screwed bezels, externally adjustable zero, over-range protection and blow-out discs.
d) Where safety type cases are specified, they shall consist of a solid partition isolating the pressure element from the dial.
e) Pressure gauge sensing element shall be minimum of AISI SS 316 and movement of SS 304 with 1/2" NPT (M) process connection.
f) Primary elements shall withstand the specified overpressure for at least 30 minutes without having their elastic characteristics affected.
g) The gauge movement shall be adjustable for calibration purpose and the use of 'S' link for calibration of span is not permitted.
h) The design of the gauge shall be such that inspection and calibration can be carried out easily. The gauges having same or equivalent specifications shall give uniform performance from one to another and their component parts shall be interchangeable.
i) Fluid (glycerine) filled gauges to dampen effect of shock & vibration to be used. All gauges shall perform satisfactorily when subjected to violent pulsations and severe mechanical vibrations.
j) Each Pressure sensing element shall be processed for over pressure and stress relieved, heat-treated to guaranteed calibration stability. Ranges shall be selected so that the normal operating pressure will read approximately 1/2 full scale to 2/3 full scale.
k) Pointer shall be of Micro zero adjustment type made of Aluminium anodized black enamelled. Window shall be shatter proof toughened borosilicate glass with neoprene gasket.
l) Though the specification sheets indicate materials for various parts, it shall be the “Contractor’s” responsibility to select and recommend the correct materials for these parts to ensure compatibility with the process conditions specified in data sheets.
m) “Contractor” quote shall include a detailed specification sheet for each item furnishing as a minimum the details as meted out in this data sheets. The bid shall be duly, supported by product/technical catalogues, brochures etc.
n) “Contractor” to ensure that all units referred to in his quote shall be to the same standards as those in this tender & data sheet.
o) “Contractor” shall submit an item wise deviation list.
p) “Contractor” shall quote for spares for initial one year trouble free operation.

q) “Contractor” shall strictly adhere to the documentation schedule attached with this specification and submit required no. of data sheets. Catalogues, re-producible with prints.

8.3 Acceptance Criteria

The “Contractor” shall prepare a detailed shop "Quality Assurance Programme" to meet the requirement of this specification for “Owner representative” approval. This document shall also contain the formats for test reports and maintenance of test records and specifications of test equipment and simulation devices.

8.3.1 Tag Plate

Each Pressure gauge shall be provided with a Stainless Steel name plate permanently fastened to the back of the dial at a visible place. The name plate shall have following details:

a) Manufacturer's Name.
b) Tag number as per “Owner representative” data sheet.
c) Model no. and Serial No.
d) Sensor material.

e) Process connections size.
f) Size & rating of flange shall be punched on flange.
g) Year of Manufacture.

8.3.2 Deviation and Rejection

All deviation in the specification shall be categorically stated and the same shall be taken to be a complying case and no deviation whatsoever shall be accepted at a later date. Hence it is in the interest of the “Contractor’s” that they highlight the deviations in a separate document titled "Deviations to Specifications".

Any offer which does not highlight deviations and if deviations are detected during the course of evaluation is liable to be summarily rejected.

8.4 Contractor Quality Control

a) Unless accepted otherwise by the “Owner / Owner Representative”, “Contractor” shall employ a Quality Management System complying with the program described in ISO 9001-2008.

b) Work which, in the opinion of the “Owner / Owner Representative” is not in accordance with the Specifications shall be rejected. Any delay caused by such rejection shall not in any way relieve the “Contractor” of his obligations under the Contract

8.4.1 Guarantee

“Contractor” shall guarantee the Performance of all equipment and system supplied under his scope in accordance with the approved design and specification and shall also guarantee the equipment and system against any manufacturing, material or design defects for the period of 12 months from the date of commissioning of the project or 18 months from the date of despatch of the entire system, whichever is earlier.

8.4.2 Documentation Schedule

a) “Contractor” shall strictly adhere to the documentation schedule and submit required numbers of data sheets, catalogues, softcopies.

b) “Contractor” shall submit 2 copies of the following along with the offer.
c) Technical data and specification / Catalogues or leaflet information.
d) List of deviations to specification.
e) “Contractor” shall submit 1 copy of price list of spare parts required for commissioning and also 2 years trouble free operation along with price bid.
f) “Contractor” shall furnish 5 copies each of the following data/documents within 2 weeks after placement of order for “Owner representative” review / approval.
g) Drawing showing overall drilling and mounting dimensions.

“Contractor” shall submit 6 copies and 1 softcopy of all the following documents in a folder to “Owner representative”.

a) Calibration certificates including functional test.
b) Material certificates of compliance.
c) Installation, operation and maintenance manuals.
d) Priced list of tools and devices for maintenance.

8.5 Codes Reference

Unless otherwise mentioned, end connections shall be as detailed below:

a) All threaded connections shall be to NPT as per ANSI B: 2.1.
b) All flanged end connections shall be as per ANSI B: 16.5.
c) Flange face finish shall be serrated concentric to paragraph 6.3.4.1, 6.3.4.2 and 6.3.4.3 of ANSI B16.5.

8.6 Data Sheet for Pressure Gauge

General	Requirements
Type	Direct Reading
Mounting	Local
Enclosure	Weather Proof to IP 65 as a minimum
Tag No.	Refer Follow Sheet
Range	Refer Follow Sheet
Gauge	
Dial	White with Black markings
Dial Size	150 mm
Case and Bezel	Die Cast Aluminium enamelled black with screwed type inter bezel
Case	Glycerine filled case
Pressure Element	Bourdon
Element Material	SS 316
Socket Material	SS 316
Movement Material	SS304
Window Material	Shatter Proof Borosilicate glass of Klinger / Maxos / equivalent make
Zero Adjustment	Internal micro adjustable pointer
Process Connection	1/2 NPT M
Location	Bottom
Nominal Accuracy Required	± 0.5% of FSR or Better
Resolution	0.2 kg/cm2
Blow out Protection	Disc (Material : Neoprene)
Over range Protection	130% of Range
Options	
Snubber	Refer Follow Sheet
Snubber Material	SS316
Connection	1/2" NPT(F) X 1/2" NPT(M)
Others	
Manufacturer	* Vendor To Advise
Model No.	* Vendor To Advise

Notes:

1) * "Contractor" to specify
2) Mounting details, Tests certificate, Operation and Maintenance manual to be provided.
3) Inspection will be done by the authorised “Owner / Owner Representative”
4) Spares required for commissioning & two years maintenance free operation to be submitted

8.7 Follow sheet for Pressure Gauges

Tag. No	Service NO.	Line No.	P&Id No.	Oper. Pr. Kg/Cm^2 g	Design. Pr. Kg/Cm^2 g	Oper.Tem p.^{0}C	Range Kg/Cm^2 g	Remarks
PG-spare 101 to 106	ATF transfer Pump suction	ATF-147-10”-P3	322538-PIA-0004-01	2.0	5	Amb.	(0 to 6)	6nos Qty
Spare 201 to 206	ATF transfer Pump discharge	ATF-149-10”-P3	322538-PIA-0004-01	17.0	20.0	Amb.	(0 to 25)	6 nos Qty.
PG-PF-214	ATF transfer Pump discharge	DAFT-0304-A21A-3”	322538-PIC-0003-01	2.0	5	Amb.	(0 to 6)	1 Nos,

9 Specification for Thermal Safety Valves

9.1 Scope of Work

This specification together with the data & follow sheets attached herewith form the minimum requirement for design, materials, packing, supply, inspection, installation, testing, commissioning, guarantee of Thermal Safety Relief valves including accessories for the Modernization of Fuel Farm of DAFFPL, IGI Airport, New Delhi.

9.2 Construction Method

9.2.1 Technical Requirements

a) In case, ASME Section I valves are supplied, it shall have the certificate from ASME laboratories.
b) Thermal Relief valve shall be semi nozzle and reduced lift.
c) The percentage accumulation in case of Thermal Relief Valves/safety valves shall be as follows:
   i. Gas, Vapour or liquid except in (c) & (d) below - 10%
   ii. Liquid for Thermal Relief - 25%
   iii. Fire exposure on unfired vessels - 21%
d) 3/4"x 1" flanged type valves with typically 0.38 cm² orifice size shall be specified for thermal relief.
e) The body material shall as a minimum, be as per piping Specifications. Nozzle and disc material shall be SS 316 as a minimum with machined stainless steel guide and spindle. Whenever semi nozzle designs are unavoidable, body material shall be at least same as nozzle material.
f) The spring material of Thermal Relief valves shall be as follows unless otherwise necessary because of process conditions:
   i. - 29°C to 250°C : Stainless Steel 316
   ii. Above 250°C : Tungsten Alloy Steel.
   iii. Below - 29°C : Stainless Steel 316
g) Flanged connection shall be for standard sizes 1" or larger. Flange rating shall be 150 # ANSI.
h) Where permissible, threaded connections shall be used on sizes 3/4" and below
i) Pilot operated-Thermal relief valves shall have remote sensing facility for pilot valve. Internal sensing for pilot shall be avoided as far as possible.
j) The Thermal relief valves shall be type tested for capacity with 5 % blow down as per ASME sec VIII UG-131 and the actual blow down of individual valves shall meet the process requirement. Contractor shall furnish the type test certificate for the same.
k) "Contractor" quote shall include a detailed specification sheet for each item furnishing as a minimum the details as meted out in "Owner Representative "data sheets. The bid shall be duly supported by product/ technical catalogues, brochures etc.
l) "Contractor" to ensure that all units referred to in his quote shall be to the same standards as those in "Owner representative" data sheet.
m) "Contractor" shall submit an item wise deviation list. "Contractor" shall quote for spares for initial one year trouble-free operation.
n) "Contractor" shall strictly adhere to the documentation schedule attached with this specification and submit required no. of data sheets. Catalogues, re-producible with prints. In the event of any conflict between specification, data sheets, standards and codes etc. "Contractor" shall refer to "Owner representative" for clarification and proceed only after obtaining the clarification.
o) Size & rating of flange shall be punched on flange as per enclosed data sheet.

9.3 Acceptance Criteria

a) The "Contractor" shall prepare a detailed shop "Quality Assurance Program" to meet the requirement of this specification for "Owner Representative" approval. This document shall also contain the formats for test reports and maintenance of test records and specifications of test requirement and simulation devices.
b) Testing for tightness shall be in accordance with EI (API) RP527.
c) Inspection shall be done by "Owner/Owner Representative.

9.3.1 Tag Plate

Each Valve shall be provided with a stainless steel name plate permanently at a visible place. The name plate shall have following details:

a) Manufacturer's Name
b) Tag number as per "Owner representative" data sheet.
c) Model no. and Serial No.
d) Orifice Designation.
e) Size.
f) Year of Manufacture.

9.3.2 Deviation and Rejection

a) All deviation to "Owner representative" specification shall be categorically stated and this shall be taken to be a complying case and no deviation whatsoever shall be accepted at a later date. Hence it is in the interest of the "Contractor's" that they highlight the deviations in a separate document titled "Deviations to Specifications".
b) Any offer which does not highlight deviations and if deviations are detected during the course of evaluation is liable to be summarily rejected.

9.4 Contractor Quality Control

a) Unless accepted otherwise by the "Owner / Owner Representative", "Contractor" shall employ a Quality Management System complying with the program described in ISO 9001-2008.
b) Work which, in the opinion of the "Owner / Owner Representative" is not in accordance with the Specifications shall be rejected. Any delay caused by such rejection shall not in any way relieve the "Sub-Contractor" of his obligations under the Contract

9.4.1 Guarantee

"Contractor" shall guarantee performance of all items supplied under his scope in accordance with approved design & specification & shall also guarantee the items against any manufacturing, material or design defects for the period of 12 months from the date of commissioning of the project or 18 months from the date of shipment of all the items whichever is earlier.

9.4.2 Painting

All the items shall be suitable for use in humid and tropical land climate. These shall be furnished with all necessary weather and anti-corrosion protection to prevent damage from saline and corrosive process atmosphere.

All the items shall be fully de-rusted and then two coats of primer and two coats of baked epoxy paint shall be applied.

The painting shall be as per follows:

a) Carbon Steel - Light Grey
b) Alloy Steel - Canary Yellow
c) Stainless Steel - Natural

9.4.3 Documentation Schedule

a) "Contractor" shall strictly adhere to the documentation schedule and submit required no. of data sheets, catalogues & soft copies with prints.
b) "Contractor" shall submit 3 copies of the following along with the offer.
   i. Sizing calculations
   ii. Technical data and specifications / catalogues or leaflet information.
   i. List of deviations.
c) Spare list for initial 1 year operation.
d) "Contractor" shall furnish 5 copies each of the following data / documents within 2 weeks after placement of order to "Owner representative" review / approval.
e) Drawings and Technical data sheets.
f) "Contractor" shall submit 6 copies and 1 softcopy of all the following documents in a folder to "Owner representative".
   i. Calibration Certificates including functional test.
   ii. Material certificates of compliance.
   iii. Installation, operation and maintenance manuals.
   iv. Priced list of tools and devices for maintenance.

9.5 Codes Reference

The design, manufacturing and performance of the pressure safety valves shall confirm to the latest edition of the following standards and codes of practice.

a) ASME - "Power Boiler code" & "Code for Unfired pressure Vessels"
b) EI (API) - RP 520 ,526 & 527
c) ANSI - B 2.1 & B16.5

All safety valves shall be marked & certified in accordance with ASME Boiler & Pressure Vessels Code.

Unless otherwise mentioned, end connections shall be as detailed below:

a) All threaded connections shall be to NPT as per ANSI B: 2.1.
b) All flanged end connections shall be as per ANSI B16.5.
c) Flange face finish shall be serrated concentric to paragraph 6.3.4.1, 6.3.4.2 and 6.3.4.3 of ANSI B16.5

9.6 Data Sheet for Thermal Safety Valve

General	Requirements
Tag No.	Refer Follow Sheet
Equipment No.	Refer Follow Sheet
Process data	
Fluid	Aviation Turbine fuel
Required Capacity	Nominal LPM
Operating Pressure Kg/Sq.cm	Refer Follow Sheet
Set Pressure	Refer Follow Sheet
% of Allowable over pressure	0.1
Back Pressure Kg/Sq.cm	Discharge is connected to process line back pressure is assumed as I Kg/cm2. (g)
Operating Temperature	- 2.2° C to 48.4° C
IBR Certificate in Form IIIC	Not Required
Calculated Area sq.cm	STS
Sel. Area sq. cm	0.38 cm²
Orifice Designation	-
Reliving Capacity in Kg/hr	*Vendor To Advise
Valve	
Type	Thermal Relief
Full Nozzle / Semi Nozzle	Semi Nozzle, Reduced Lift
Valve type/ Bonnet type	Conventional / Closed Bonnet
Inlet Connection : Size & Rating	3/4" Flanged
Inlet Connection : Facing / Finish	300 #, RF, Serrated
Outlet Connection : Size & Rating	1" Flanged
Outlet Connection : Facing / Finish	150 #, RF, Serrated
Cap over Adj. Bolt / Screwed	Cap over Adj. Bolt
Lever	Not Required
Test Gag	Required
Material	
Body	ASTM A216 Gr WCB
Seat	SS 316
Guide	SS 316
Spring	Stainless Steel
Basis	
Code	EI (API) 520/527
Others	
IBR Certificate in Form IIIC	NO
Manufacturer	* Vendor To Advise
Model No.	* Vendor To Advise
Hydro test Pressure	* Vendor To Advise

9.6.1 Follow sheet for thermal Safety Valves

Tag No.	Service Description	Line No./Eqpt. No.	P&ID No.	Fluid	Opera. Pressure Kg/Cm²	Set Pressure Kg/Cm²	Back Pressure kg/cm 2	Remark
TSV-PF-214	Aviation Fuel	DATF-0304-A21A-3"	322538-PIC-0003-01	ATF	2.0	15.0	--	
TRV-201A	Aviation Fuel	ATF-0210-20"-A21A	322538-PIA-0002-01	ATF	0.9	3.5	1.5	

Tag No.	Service Description	Line No./Eqpt. No.	P&ID No.	Fluid	Opera. Pressure Kg/Cm^2	Set Pressure Kg/Cm^2	Back Pressure kg/cm 2	Remark
TRV-201B	Aviation Fuel	ATF-0206-10”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-202A	Aviation Fuel	ATF-0217-20”-A21A	322538-PIA-0002-01	ATF	0.9	3.5	1.5	
TRV-202B	Aviation Fuel	ATF-0221-10”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-203A	Aviation Fuel	ATF-0232-20”-A21A	322538-PIA-0002-01	ATF	0.9	3.5	1.5	
TRV-203B	Aviation Fuel	ATF-0230-10”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-204A	Aviation Fuel	ATF-0242-20”-A21A	322538-PIA-0002-01	ATF	0.9	3.5	1.5	
TRV-204B	Aviation Fuel	ATF-0240-10”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-204C	Aviation Fuel	ATF-0239-6”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-205A	Aviation Fuel	ATF-0253-20”-A21A	322538-PIA-0002-01	ATF	0.9	3.5	1.5	
TRV-205B	Aviation Fuel	ATF-0251-10”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-205C	Aviation Fuel	ATF-0250-6”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-206A	Aviation Fuel	ATF-0261-20”-A21A	322538-PIA-0002-01	ATF	0.9	3.5	1.5	
TRV-206B	Aviation Fuel	ATF-0263-10”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	
TRV-206C	Aviation Fuel	ATF-0265-6”-A21A	322538-PIA-0002-01	ATF	4.5	15.0	1.5	

This can be firmed up after finalization of P&ID.

Hydro carbon Gas Detector

9.7 General

a) This specification together with the data sheets attached herewith form the minimum requirement for design, materials, packing, supply, inspection, installation, testing, commissioning, guarantee of Hydro Carbon gas Detector including accessories for the Modernization of Fuel Farm of DAFFPL, IGI Airport, New Delhi.

b) Combustible Gas (HC & H2) Detectors shall be able to perform to the temperature, humidity, air velocity and vibration specification prescribed in ISA 12.13.01.

c) The detectors shall be calibrated at their mean operating temperature. All components, including the sensor, shall be designed for operation within the ambient temperature range for the location of the installation. The sensor shall be installed away from sources of steam, which may be released during freezing temperatures, causing condensation and freezing which may, in turn, plug the detector. Where high temperatures are unavoidable, high temperature rated detectors with remote sensing heads shall be employed.

d) The detector housing shall be suitable for corrosive environment.

e) Sensors shall be located away from prevailing winds, heating and cooling system. Air circulation patterns and effects of other equipment that affect circulation shall be taken into consideration while finalizing the location of the detectors. Where widely varying wind direction changes are expected, multiple detectors shall be installed to provide the required cover.

f) Sensors shall be located away from vibration prone areas. If this is not possible, the sensors shall be mounted on flexible mounts or flexible conduit.

g) Combustible sensors shall be located in accordance with the protection area limitations of the detector manufacturer.

h) Sensors shall be typically located approximately 1 m from the expected emission point, and preferably in the direction of ignition sources and / or populated areas.

i) Special consideration shall be given to the properties of the process gas (refer Process Design Criteria for properties of process fluids), specifically its vapour density and predominant component. For lighter-than-air gases, the detectors shall be placed above the release point. For heavier-than-air gases, the detectors shall be placed 300-450 mm above the grade.

j) Detector locations shall take into account the possible flow pattern of the leaking gas or vapour and ventilation system airflow.

k) The number of detectors shall be based on the number of potential release sources.

l) Perimeter detection of releases shall be considered in areas containing large amounts of light hydrocarbons (e. g. process areas or pressure storage areas) to alert operations to initiate a manual response or to actuate an automatic response (e. g. unit shutdown or firewater spray system). These detectors shall be installed along a unit boundary adjacent to an ignition source.

m) Indoor or partially enclosed installations that may require gas detection shall be protected with open path or point detection system.

9.8 Fixed HC Detectors

a) Fixed Hydrocarbon (HC) Gas Detectors shall be based on Infrared Absorption Technology.

b) The detecting unit included in the sensor head shall provide adequate sensitivity and stability, under all conditions, with ±5% accuracy (For Range of 100% LEL).

The fixed HC gas detectors shall be powered from 24 VDC -ve earthed supply, with a 4-20 mA signal loop to cover the calibrated range. Detector faults shall be signalled by 4 mA signal.

c) Explosion proof junction boxes shall be provided with the detectors for cable termination.

d) Detector system shall initiate responses at two different concentrations: for warning alarms and for initiation of executive action. Typical values of these set-points are: "20% and 60% LEL for general process areas"; “15% and 40% LEL for HVAC air intakes"; “5% and 10% LEL for turbine engine air intakes”.

e) The alarm condition shall not be resettable until the specific detector reading has dropped below the warning alarm level as applicable.

f) Operator response shall be required to clear the audible and visual alarms.

g) HC Detectors shall be calibrated 0-100% LEL (Lower Explosive Limit) of Methane in air. A single point detector may be used for more than one release point, with due consideration to the manufacturer's specification of the sensing area.

h) Measuring radius of Gas detector shall be min.60 meter or better.

9.9 Fixed H2 Detectors

a) Fixed catalytic H2 Detectors shall be provided in the battery room, which may see release of H2 gas.

b) The fixed H2 gas detectors shall be powered from 24 VDC -ve earthed supply, with a 4-20 mA signal loop to cover the calibrated range. Detector faults shall be signalled by 4 mA signal.

c) The H2 detectors shall be capable of detecting 0 - 100% LEL of H2 and shall have an accuracy of ±5% over the entire detection range.

9.10 Data sheet for Gas Detector

Detection Gas Type		COMBUSTIBLE
1	Model No.	Supplier to Specify
2	Function	Local Display with Magnetic key
3	Type	Diffusion / Diffusion remote type sensor with 5 mtr cable.
4	Quantity	2 'Nos.
5	Enclosure	Ex d IIC T6 IP65
6	Detectable Gas	Hydrocarbon- CH4/C3H8
7	Measuring Method	IR
8	Measuring Range	0-100%LEL
9	Response Time (90% of F.S)	7 to10 Sec.(or Better)
10	Accuracy	± 3% / F.S
11	Repeatability	± 3% / F.S
12	Linearity	± 3% / F.S
13	Measuring Signal Output	4-20mA.DC
14	Conduct Connection	PF 3/4"
15	Signal Cable Connection	1.5mm* 3 wires
16	Cable Gland	Double Compression type
17	Mounting type for Display module	2" Pipe & Wall
18	Power Supply	18-31V.DC
19	Sensor life Time	Supplier to Specify
20	Model No.	Supplier to Specify
21	Type	Beacon & Sounder
22	Sounder Volume	95dB

23	Display	Green/Red LED
24	Power Supply (Sounder/Lamp)	DC 24V/ DC 5V
25	Enclosure certification	Ex d IIC T6 IP65
26	Material of Construction	SS
27	Adapter for calibration	Yes
28	Calibration Kit	Yes
29	Mounting Bracket	Yes
30	Press (Kg/Cm^2)	Ambient ±10%
31	Humidity (% RH)	5 to 90% RH
32	Temperature (℃)	-20 to 65℃
33	Area Classification	hazardous

10 Specification of Servo Gauge Level Transmitter

10.1 General

1. New TFMS requirement is described in the attached System Architecture Dwg. for the two types of TFMS measurement system enumerated below.

2. Primary TFMS Measurement system-

    a. Primary TFMS Measurement system will consist of Radar Type Level Tx. (SIL2) along with Multi-Spot Temperature cum Water Bottom Sensor as field instrumentation for individual product storage tanks.

    b. The product level, temperature, water level (as measured by field instrumentation referred vide Pt.2a above), will be interfaced primarily with control Room located Redundant Communication Interface Unit (CIU) which in turn will be interfaced with TFMS computer (hardware + software).

    c. The Communication Interface Units will be interfaced with Conventional PLC over Serial Communication i.e. MODBUS RTU. This also included in the bidder scope of supply.

    d. The hardwired outputs i.e. 4-20 mA signal (level), Hi-Hi Level trip Alarm and Lo-Lo Level Trip Alarm of level tx. will be interfaced with PLC.

    e. Control Room Instrumentation (i.e. CIU and TFMS software / computer) shall be capable of interfacing min. 20 level tx. to take care of future TFMS requirement.

    f. In order to have open connectivity, the TFMS computer (Hardware + Software) is required to communicate with other makes of CIUs (to be supplied by other OEMs along with their level tx. in future) over MODBUS RTU Serial Communication specified.

    g. Tender includes the requirements of Primary TFMS measurement system referred above.

3. Secondary TFMS Measurement will be done by Servo Type Level Tx.

    a. Secondary TFMS Measurement systems consist of Servo Type Level Tx. as field instrumentation for individual product storage tanks provided by the bidder.

    b. The product level and Average density measured by field instrumentation (i.e. Servo Type Level Tx.), will be interfaced primarily with control room located Non-Redundant Communication Interface Unit (CIU)

c. The Communication Interface Unit will be interfaced with Safety PLC over Serial Communication i.e. MODBUS RTU.

d. The hardwired outputs i.e. 4-20 mA signal (level), Hi-Hi Level trip Alarm and Lo-Lo Level Trip Alarm of level tx. will be interfaced with PLC.

e. The OEM of Servo Level Tx. will provide its 'Software-serial interface driver' in Engineering station in included in the tender package which will ensure following at Operator station/ Engg. Station computers:

- Viewing of Product Level
- Execution of Density measurement command which will provide viewing of Product Spot Density as well as Product Density Profile.

This includes the requirements of Secondary TFMS measurement system referred above.

a) The servo device shall use a minimum of moving parts (drum, shaft, stepper motor).

b) The device shall be able to constantly measure level, interface layers and density profiles (optional).

c) The servo ATG accuracy of the measurement shall not be influenced by any product characteristics (vapor, heavy turbulence and / or foam).

d) The servo ATG shall be suitable for installation through a 4-inch or bigger inch nozzle or still pipe.

e) The Servo ATG can diagnose itself to check for possible defects (of gauge and displacer) which would result in a non-valid level reading and report these issues within 30 seconds.

f) The Servo ATG must be easy to handle by one person and have a weight equal or less than 26 kg (57 lb) (in order to avoid the need of extra equipment for placement/handling).

g) The Servo must have at least a measuring range of 0 to 27 meters (0 to 88 ft) & optionally up to 37 meters (121 ft). The servo must be able to operate in Cavern applications of up to 220 meter depth with measuring range up to 37 meter.

h) The servo ATG must be able to detect the water level in the tank as well as interface layers

i) For the interface layers the servo ATG must be capable of producing an accuracy equal or less than 2 mm (0.08 inch) (based on the condition that the differences between product densities are at least 100 kg/m3 (6.25 100 lb/ft3).

j) The servo ATG shall be suitable for connection of an optional density measurement for online density measurement

k) There shall be no wearing parts, such as contact brushes or slip-rings.

l) The displacer shall have a submersion of less than 10 mm in order to minimize the density sensitivity.

m) It shall be possible to password protect the gauge against configuration changes.

n) It shall be possible to make each password unique.

o) The Servo sub parts (displacer, transmitter boards, housing etc.) shall be designed such that they can be freely exchanged between gauges.

p) The vendor shall provide calculations proving MTBF figures based on installed operational units in the field. The servo ATG MTBF shall at least be 20 years.

q) The Servo ATG is required to have a SIL 2 it shall have been certified by an external accredited laboratory such as TUV.

r) The SIL certificate shall be a real certification and include the assessment report describing the limitations.

s) The SIL certificate shall cover the all relevant components.

t) By mean of Periodic Automatic commands The Servo ATG mechanics shall be automatically tested and an alarm shall be reported if the mechanics don't work correctly which is required to improves the safety of a facility and reduces the risk of an overfill accident even further.

u) Accuracy of Servo ATG should be +/- 0.4 mm at ref conditions.

v) Periodic density measurement command scheduling shall be possible from the TFMS software.

w) Design should be such that with a single screw cap all electronic boards can be accessed.

x) Servo ATG should have programmable wave integration time with three set points.

y) The servo ATG shall be able to operate on stilling wells of 4" and larger, using flanges of 2" and larger.

z) For Servo ATG maintenance supply of Calibration chamber is mandatory and integral calibration chamber is not acceptable

aa) Servo ATG shall have motor high and motor low limits to restrict displacer travel within measurement ranges.

bb) Servo ATG shall have wire rupture detection mechanism, which prevents wire breakage, while displacer is lifted beyond measurement ranges and also to avoid mandatory presence of technician on tank top, while displacer is being pulled up

cc) The servo shall be able to measure the spot density and the average density and the density profile

dd) The servo ATG accuracy for density measurement shall be equal to or better than 5 kg/m3 (0,31 lb/ft3) or 3 kg/m3 (0.19 lb/ft3) under reference conditions.

10.2 Data sheet for Servo gauge

Sr No	Description							
	Service							
1	Tag Nos.			Qty. Nos.	LIT-201A, 202A, 203A, 204A, 205A & 206A			6
2	Service				Aviation Turbine Fuel storage tanks			
3	Tank Nos.				VF-201, 202,203, 204,205 & 206			
4	P&ID No.				322538-PIA-0002-01			
	Process Data							
5	Fluid				**AVIATION TURBINE FUEL (ATF)**			
6	Temperature	Min	Norm	Max	15°C		40°C	50°C
7	Pressure	Min	Norm	Max	ATM		ATM+FOL	
8	Specific Gravity@Op Temp		Density (kg/m³)		0.8		800	
9	Viscosity@Min op.Temp (cP)				2.56			
10	Design Pressure				ATM + FOL			
11	Design Temperature		Min / Max		15°C / 65°C			
	Transmitter							
12	Type				Indicating Transmitter			

13	Tank type			Conceal roof Vertical Tank		
14	Tank Height			20000 mm		
15	Location			Tank Overhead		
16	Area Classification	Enclosure		Zone 1, Gr IIA/IIB, T3	Flameproof	
17	Process Connection			*Existing Vendor to visit at site		
18	Vent Connection			VTS		
19	Stilling well	Size	Material	Required	VTS	VTS
20	Transmitter Mounting Orientation			Tank Overhead		
21	Flange Size	Rating as per ANSI B 16.5		VTS	150#	
22	Servo Housing Material			Cast aluminium		
23	Drum compartment Material			SS 316 or better		
24	Measuring drum, drum shaft			SS 316 or better		
25	Measuring Wire Material	Instrument Range		SS 316 or better	VTS	
26	Calibration Chamber			Required		
27	Measuring Range			0 - 20000 mm		
28	Accuracy	Repeatability		± 1 mm	0.1 mm	
29	Output	Transmission Protocol		VTS	VTS	
30	Electrical Power supply			230 V AC , 50 Hz		
31	Power Consumption			VTS		
32	Ingress Protection	Lightning Protection		IP 65	Yes	
33	Certification			ATEX/CENELEC/FM		
34	Cable Entries	Cable entry size		At least 4 nos	1/2" NPT (F)	
35	Output Signal			4-20mA, 2nos Alarm Contact		
36	Signal Compatibility			Honeywell-Enraf / SAAB / E & H (Refer note 10)		
37	Tag Plate			SS 316 with engraved letters		
38	Function			Measurement of Level		
39	Level Alarms	Remote Alarm Indication		2, Programmable	Required	
40	Alarm Relay Outputs	Contact Rating		2 x SPDT Galvanically Isolated	24 VDC, 3 Amp.	
	Options					
41	Local Display			LCD type Required with Density indication		
42	Portable Communication Terminal/Device		Model	Required - VTS (One common for all Servo Gauges)		
43	Tank side Indicator			LCD type with backlit, Required		
44	Manufacturer			As Per Approved Vendor's List		
45	Model			VTS		
	Temperature Sensor			N.A		
46	Tag Number			N.A		
47	Type	Quantity		N.A	N.A	
48	Element Spacing			N.A		
49	Measuring Range	Accuracy		N.A	N.A	
50	Mounting	Sheath		N.A	N.A	
51	Electrical Connection	Wiring Connection		N.A	N.A	

52	Output	Connection	N.A	N.A
53	Installation	Material	N.A	N.A
55	Manufacturer	Model	N.A	N.A

Notes

1. Perforated still pipe shall be provided as per instrument requirement for installation of the gauge.
2. Cable gland (double compression type) shall be provided.
3. All equipment's and accessories shall be Ex-Proof and shall have PESO/CCOE approval.
4. Recommended still well drawings to be provided after PO
5. Documentation - All necessary manuals like installation, maintenance, operational with calibration certificates. Master instrument calibration certificate photocopy for NIST traceability
6. VTA = Vendor To Advice, N.A = Not Applicable
7. Vendor shall demonstrate proper functioning/ calibration of the instrument an d its communication with tank farm system software (software will be provided by others)
8. For additional vendors, refer the approved vendor list.
9. Nozzle length from shell shall be Vendor to check
10. Vendor to add all necessary spares required for commissioning of instrument & quote recommended spares required for 2 years of operation.

11 Technical Specification for Instrumentation Cables, Jn. Box & Push Button

11.1 Scope

This specification together with the data are attached herewith form the minimum requirement for design, materials, packing, supply, inspection, installation, testing, commissioning, guarantee of Instrumentation Signal, Communication, Control cables.

11.2 Introduction

This specification covers the minimum requirements for the design, manufacture, assembly, Inspection, testing, certification and delivery of Instrument Cables, for Delhi Aviation Fuel Farm Project, White oil terminal of Delhi Airport.

This specification shall be read in conjunction with tender documents. The requirements which have not been explicitly identified, but required for the completion and efficient performance of the entire system are in Bidder's scope.

11.3 Reference Codes & Standards

All cables to be supplied under this specification shall conform to the latest editions of following Codes & Standards.

EN 50288-7 (BS 5308 Part 2)	2004	Instrumentation Cables. Specification for PVC Insulated cables.
BS 2782	2004	Methods of testing plastics. Thermal properties. Determination of flammability temperature of materials
BS 6387	1994	Performance requirement for cables required to maintain circuit Integrity under fire conditions.
BS 6425 Part 2	1999	Tests on gases evolved during the combustion of materials from cables.
BS 6724	1997	Thermosetting insulated, armoured cables for voltages of 600/1000 having low emission of smoke and corrosive gases when affected by fire
BS 7211	1998	Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire
IEC 60331	2002	Fire Resisting Characteristic of Electric cables.
IEC 60332	2004	Tests on Electric Cables under fire Conditions.
IEC 60754 Part 1	1994	Tests on gasses evolved during combustion of electric cables.
ASTM-D-2863	2008	Oxygen Index and Temperature Index Test

ASTM-D-2843	2004	Smoke Density Test
IS-1554 Part 1	1998	PVC Insulated (heavy duty) electric cables
IS-5831	1984	PVC insulation and sheath of electric cables
IS-3975	1988	Specification for mild steel galvanized armour wires and strip
IS-694	1990	PVC insulated cables for working voltages up to & including 1100V
IS-7098	1985	XLPE insulated & PVC sheathed cables for working voltages up to & including 1100V
IS-6380	1984	Elastomeric insulation and sheath of electric cable
IS-6474	1984	Polyethelene Insulation & sheath of electric cable
IS-10810	Latest Edition	Method of test of cable

11.4 Construction & Electrical Characteristics

11.4.1 General

1. All construction of all instrumentation cables shall conform to EN 50288-7 (previously BS 5308 Part 2, Type 2) and as detailed below in clause 15.5
2. Each Conductor shall be made from annealed electrolytic grade high conductivity pure copper stranded.
3. The conductors shall be insulated with high quality dielectric grade PVC.
4. Colour-coding for identification of cores / pairs in single pair/core and multi pair/core cable shall be as specified in this specification.
5. The pairs or triads of insulated conductors shall be uniformly twisted together with a suitable right hand lay. The lay length of twisted pairs shall not exceed 80 mm.
6. Armouring shall be provided over the inner sheath. Armouring shall be generally of Galvanised steel wires as per IS 1554 Part-I.
7. Overall / Individual shielding of pair/triads by aluminium backed Mylar/polyester tape bonded together with the metallic side down helically applied with either side 25% overlap and 100% coverage. Minimum shield thickness shall be 0.05 mm. A copper drain wire will be in continuous contact with the aluminium side of the shield. The drain wire shall be 0.5 sq mm multi-strand bare tinned annealed copper conductor.
8. Inner and outer sheath shall be of extruded tough PVC. The outer sheath shall be chemical resistant, corrosion resistant and moisture resistant. Both inner and outer sheath shall be extruded flame retardant PVC to IS 5831-Type ST2.
9. Running length of the cable shall be printed or embossed at least at every 5 meter interval on the outer sheath. The marking shall be legible and permanent.
10. Tolerance in overall diameter of cable shall be within ± 2 mm over offered value for cables with OD less than 30 mm and ± 3 mm for cables with OD more than 30 mm.
11. Maximum DC resistance of the conductor of the completed cable shall not exceed 12.3 ohms/km at 20 °C for cables with 1.5 sq. mm conductor, 39.7 ohms/km at 20 °C for cables with 0.5 sq. mm

conductor and 7.41 ohms/km at 20 °C for cables with 2.5 sq mm conductor.

12. L/R ratio of adjacent core shall not exceed 40 micro henry / ohm for cable with 1.5 sq. mm
13. Conductor and 25 micro henry / ohm for cables with 0.5 sq. mm conductor.
14. The drain wire resistance including shield shall not exceed 30 ohms / km.
15. Electrostatic noise rejection ratio shall be over 76 dB.
16. All cables are required to be low smoke ,zero halogen type and either Flame retardant or Fire resistant as per IEC 332 and IEC 331 as mentioned.
17. All power cables above 2.5 sq.mm size, shall be 1.1kV grade, XLPE insulated, multi standard conductor, single/multi core, steel armoured, Extruded PVC inner sheathed & extruded FRLS PVC outer sheathed. Cable of size 6 sqmm and below shall be of copper conductor. Cable of size 10 sq. mm and above shall be aluminum conductor conforming to IS 7098 (Part -1).
18. The length of cables in each drum shall be as specified in purchaser's data sheet. Tolerance in cable length in a drum shall be ± 1 %.
19. Fire Resistance cables shall be supplied as per requirements given in attached summary sheet. Fire Resistance cables shall be as per IEC-60331.
20. All equipment's & accessories shall be Ex-Proof and shall have PESO / CCOE approval.

11.5 Type of cables

Following cables types are required as a minimum,

a.	Single pair shielded cable.	Type-1
b.	Single triad cable.	Type-2
c.	Multi-pair with individual &overall shield.	Type-3
d.	Multi-triad with only overall shield.	Type-4
e.	Power supply cables.	Type-5
f.	Ethernet cable	Type-6
g.	Modbus cable	Type-7
h.	Multi-core with only overall shield.	Type-8
i.	Multi-pair with only overall shield.	Type-9

Type 1: Single pair shielded FRLS cable

Type of cable	Single pair shielded copper cable
Construction	600 V grade, Multi strand annealed electrolytic copper
Conductor	Electrolytic annealed copper ,1.5 sqmm, min. 7, 0.53mm, as per IS 5831
Insulation	Extruded PVC type C as per IS 5831/84, 0.6mm thick
Pair twist	10~15 twists / mtr uniformly
Individual Pair Shield	Al mylar tape, helical, thickness, 0.05mm, thick, overlap / coverage : 25 % / 100 %
Overall shield	Al mylar tape, 0.05mm thick , overlap / coverage : 25% / 100%
Inner sheath	Extruded PVC type ST2 of IS 5831 / 84 Thickness : 0.8mm Rip cord required, Non metallic type below inner sheath
Outer sheath	Extruded PVC type ST2 of IS 5831/84 Thickness : Min 1.4mm Colour : Blue for IS cable, Black for Non IS cable
Armour	Armour over inner jacket shall be of Galvanised steel wire. Size : 1.4 mm
Drain wire	Shall be provided, Annealed tinned copper in a continuous contact with Aluminium side of the shield size, drain wire resistance : 0.5mm, 30 ohm / km
Core colour	Black & white in pair cable.
Oxygen Index of PVC	Over 30%
Temperature index	Over 250degc
Mutual capacitance @1 KHz between adjacent core	250 pF/mtr
Max. Capacitance between any core & screen @ 1 KHz	400pF/Mtr
L/R ratio	Not more than 40 microH/ohm
Noise rejection ratio	76 dB
Maximum resistance of the conductor of complete cable at 20 deg.C	Shall not exceed 12.3 ohms/km

Note: Single pair cable without shielding of 2.5 sq.mm size, shall be used for Fire Alarm initiating circuits

Type 2: Single triad FRLS cable

Type of cable	Single triad shielded copper cable
Construction	600 V grade, Multi strand annealed electrolytic copper
Conductor	Electrolytic annealed copper ,1.5 sqmm, min. 7, 0.53mm, as per IS 5831
Insulation	Extruded PVC type C as per IS 5831/84, 0.5mm thick
Triad twist	12~20 twists / mtr uniformly

Individual triad Shield	Al mylar tape, helical, thickness, 0.05mm, thick, overlap / coverage : 25 % / 100 %.
Overall shield	Al mylar tape, 0.05mm thick , overlap / coverage : 25% / 100%
Inner sheath	Extruded PVC type ST2 of IS 5831 / 84 Thickness : 0.8 mm Rip cord : Required, Nonmetallic type below inner sheath
Outer sheath	Extruded PVC type ST2 of IS 5831/84 Thickness : Min 1.4mm , colour : Black
Armour	Armour over inner jacket shall be of Galvanised steel wire. Size : 1.4 mm
Drain wire	10 strands of 0.25 mm ATC in a continuous contact with Aluminum side of the shield size, drain wire resistance : 0.5mm, 30 ohm / km.
Core colour	Red, white & light red
Oxygen Index of PVC	Over 30%
Temperature index	Over 250 deg.C
Mutual capacitance	Between cores with shield grounded shall not more than 150 pF/mtr
Capacitance	Between one conductor & other conductor connected to shield shall not more than 250 pF/mtr
L/R ratio	Not more than 40 microH/ohm
Noise rejection ratio	76 dB
Maximum resistance of the conductor of complete cable at 20 deg.C	Shall not exceed 12.3 ohms/km

Type 3 Multi-pair shielded cable with individual & overall shield-FRLS

Type of cable	multipair shielded copper cable
Construction	600V grade, Multi strand annealed electrolytic copper
Conductor	Electrolytic annealed copper, 1.5 sqmm, min. 7 strand 0.3mm, as per IS 5831
Insulation	Extruded PVC type C as per IS 5831/84, 0.6mm thick
Pair twist	10~15 twists / mtr per pair uniformly
Individual Pair Shield	Al mylar tape, helical, thickness, 0.05mm,thick ,Overlap / Coverage : 25 % / 100 %.
Overall shield	Al mylar tape, 0.05mm thick , overlap / coverage : 25% / 100%.
Drain wire	Annealed tinned copper in continuous contact with
	aluminium side of shield, size : 0.5 mm, resistance : 30 ohm/km
Inner sheath	Extruded PVC type ST2 of IS 5831 / 84 Thickness : 0.7mm Rip cord : Required, Non metallic type below inner sheath
Outer sheath	Extruded PVC type ST2 of IS 5831/84 Thickness : Min 1.4mm Colour : Blue for IS cable, Black for Non IS cable
Armour	Armour over inner jacket shall be of Galvanised steel wire, Size : 1.4 mm
Core colour	Black & white in pair cable, each pair shall have serial no. at regular interval of 100 mm.
No. of pairs	2, 3, 6 or 12 pairs
Oxygen Index of PVC	Over 30%
Temperature index	Over 250degc
Communication wire	0.5 sqmm , multi-strand copper conductor with PVC insulation.
Mutual capacitance @1 Khz between adjacent cores	250 pF/mtr
Max. Capacitance between any core & screen @ 1 KHz	400pF/Mtr
L/R ratio	Not more than 25 microH/ohm
Noise rejection ratio	76 dB
Maximum resistance of the conductor of complete cable at 20 deg.C	Shall not exceed 39.7 ohms/km

Type 4 Multi-triad shielded cable overall shield-FRLS

Type of cable	Multi-triad shielded copper cable
Construction	600V grade, Multi strand annealed electrolytic copper
Conductor	Electrolytic annealed copper ,1 sqmm, min. 7 strand, 0.3mm, as per IS 5831
Insulation	Extruded PVC type C as per IS 5831/84, 0.5mm thick
Pair twist	10~15 twists / mtr uniformly
Overall shield	Al mylar tape, 0.075mm thick ,overlap / coverage : 25% / 100%
Drain wire	Annealed tinned copper in continuous contact with aluminium side of shield, size : 0.5 mm, resistance : 30 ohm/km
Inner sheath	Extruded PVC type ST2 of IS 5831 / 84 Thickness : 0.8 mm Rip cord : Required, Non metallic type below inner sheath
Outer sheath	Extruded PVC type ST2 of IS 5831/84 Thickness : Min 1.4mm , colour : Black
Armour	Armour over inner jacket shall be of Galvanised steel wire, size : 1.4 mm.
Core colour	Red, white, light red, each triad shall have serial no. at regular interval of 100 mm.
Oxygen Index of PVC	Over 30%
Temperature index	Over 250 deg.C
Communication wire	0.5 sqmm , multi-strand copper conductor with PVC
	Insulation.
No. of Triads	12 triads
Mutual capacitance	Between cores with shield grounded shall not more than 150 pF/mtr
Capacitance	Between one conductor & other conductor connected to shield shall not more than 250pF/mtr
L/R ratio	Not more than 25 micro H/ohm
Noise rejection ratio	76 dB
Maximum resistance of the conductor of complete cable at 20 deg.C	Shall not exceed 39.7 ohms/km

Type 5: Power supply cable

Construction	1100 VAC grade, XLPE insulated, PVC inner & outer sheath
Conductor	Multi-stranded Electrolytic annealed copper, 2.5 sqmm, Min 7, 0.67mm,as per IS 5831
Insulation	Extruded PVC type C as per IS 5831/84, 0.7mm thick
Inner & outer sheath	Extruded FRLS 90 deg.C PVC type ST2 of IS 5831 / 84. Inner sheath of 0.3 mm thickness and Outer sheath of 1.4 mm thickness with oxygen index of 29 @ 27 deg.C
Armour	Armour over inner jacket shall be of Galvanised steel wire, as per IS 1554 Part 1 Size : 1.4 mm
Core colour	Black & Red for 2 core cable, Black, Red & Green for 3 core cable. Multi-core cable shall be identified by core numbers marked at regular interval of 100mm
Temperature index	Over 250degc
Outer sheath colour	Grey
Maximum resistance of the conductor of complete cable at 20 deg.C	Shall not exceed 7 ohm/km
Minimum volume resistivity	1 x 10^{13} @ 27 deg.C 1 x 10^{10} @ 70 deg.C
High voltage test	2 KV rms for 1 min.

Note: Power cables for Fire Alarm system notification circuits and ESDV solenoids valves shall be Fire resistant as per IEC 331 and other power cables shall be flame retardant. Based on power requirement, other size of conductors should be used, as applicable.

Type 6 Ethernet cable (Cat 6)

Construction	23 AWG, 4 pair, stranded, (7 x32), bare copper conductor, twisted pair, polyolefin insulation, oil resistant, black PVC jacket, unarmoured cable.
Core colour coding	Pair 1 : white/blue stripes and blue Pair 2 : white/orange stripes and orange Pair 3 : white/green stripes and green Pair 4 : white/brown stripes and brown

Type 7 Modus cable - FRLS

Construction	24 AWG (7 X 32 AWG), 300V, 2 pair, stranded, tinned copper conductor, twisted pair, Polyethylene insulation, FRLS, Shielded, armoured cable.
Pair twist	12 twists / ft uniformly
Core colour coding	Pair 1 : white/blue Pair 2 :
Outer sheath colour	Black

Type 8 Multi-core cable overall shield-FRLS

Type of cable	Multi-triad shielded copper cable
Construction	600V grade, Multi strand annealed electrolytic copper
Conductor	Electrolytic annealed copper ,1.5 sqmm, min. 7 strand, 0.3mm, as per IS 5831
Insulation	Extruded PVC type C as per IS 5831/84, 0.5mm thick
Pair twist	No twist
Overall shield	Al mylar tape, 0.075mm thick ,overlap / coverage : 25% / 100%
Drain wire	Annealed tinned copper in continuous contact with aluminium side of shield, size : 0.5 mm, resistance : 30 ohm/km
Inner sheath	Extruded PVC type ST2 of IS 5831 / 84 Thickness : 0.8 mm Rip cord : Required, Non metallic type below inner sheath
Outer sheath	Extruded PVC type ST2 of IS 5831/84 Thickness : Min 1.4mm , colour : Black
Armour	Armour over inner jacket shall be of Galvanised steel wire, size : 1.4 mm.
Core colour	Red, white, light red, each triad shall have serial no. at regular interval of 100 mm.
Oxygen Index of PVC	Over 30%
Temperature index	Over 250 deg.C
Communication wire	0.5 sqmm , multi-strand copper conductor with PVC insulation.
No. of Triads	12 core, 24 core, 36 core.
Mutual capacitance	Between cores with shield grounded shall not more than 150 pF/mtr
Capacitance	Between one conductor & other conductor connected to shield shall not more than 250pF/mtr
L/R ratio	Not more than 25 microH/ohm
Noise rejection ratio	76 dB
Maximum resistance of the conductor of complete cable at 20 deg.C	Shall not exceed 39.7 ohms/km

Type 9 Multi-pair cable overall shield-FRLS

Type of cable	Multi-triad shielded copper cable
Construction	600V grade, Multi strand annealed electrolytic copper
Conductor	Electrolytic annealed copper ,1.5 sqmm, min. 7 strand, 0.3mm, as per IS 5831
Insulation	Extruded PVC type C as per IS 5831/84, 0.5mm thick
Pair twist	No Twist
Overall shield	Al mylar tape, 0.075mm thick ,overlap / coverage : 25% / 100%
Drain wire	Annealed tinned copper in continuous contact with aluminium side of shield, size : 0.5 mm, resistance : 30 ohm/km

Inner sheath	Extruded PVC type ST2 of IS 5831 / 84 Thickness : 0.8 mm Rip cord : Required, Non metallic type below inner sheath
Outer sheath	Extruded PVC type ST2 of IS 5831/84 Thickness : Min 1.4mm , colour : Black
Armour	Armour over inner jacket shall be of Galvanised steel wire, size : 1.4 mm.
Core colour	Red, white, light red, each triad shall have serial no. at regular interval of 100 mm.
Oxygen Index of PVC	Over 30%
Temperature index	Over 250 deg.C
Communication wire	0.5 sqmm , multi-strand copper conductor with PVC insulation.
No. of Triads	12 pair & 24 pair
Mutual capacitance	Between cores with shield grounded shall not more than 150 pF/mtr
Capacitance	Between one conductor & other conductor connected to shield shall not more than 250pF/mtr
L/R ratio	Not more than 25 microH/ohm
Noise rejection ratio	76 dB
Maximum resistance of the conductor of complete cable at 20 deg.C	Shall not exceed 39.7 ohms/km

11.5.1 Fire Resistance cables

Fire Resistance cables shall be supplied as per requirements.

1. Each Conductor shall be made from annealed electrolytic tinned copper conductor of size 1.0 sq mm / 1.5 sq mm / 2.5 sq mm made up of 7 strands as per IS2982/8130 with pair/triad twisted.
2. Insulation shall be of mica-glass/EPR or silicon.
3. The inner sheath shall be applied with a low smoke fire resisting compound.
4. Outer sheath shall be made up of low smoke, heat & oil resistant, flame retardant.
5. Circuit integrity of cable shall be maintained for a minimum period of 3 hrs as per IEC60331.
6. Core Colour shall be as follows:
   - Black & Blue for a pair
   - Black, Blue & Brown in a triad.

11.6 Documentation with offer

Bidder shall submit datasheet /specification for each type of cable offered, number of pair/core, length, cable diameter, cross section drawings for all types of cables etc. for evaluation.

11.7 Documentation after LOI/PO and final documentation

Within 2 weeks of placement of LOI/PO, the Bidder shall submit datasheet /specification for each type of cable indicating the type of cable, number of pair/core, length, cable diameter etc. for review. The Bidder shall also submit the manufacturing, quality control procedures and production schedule.

1. Bidder shall precede manufacturing of cables after getting approval from consultant on documents/specification/datasheets.
2. Bidder shall provide test certificates for all the tests indicated in clause 6.0 of this specification.

3. All the above documents shall also be part of Final documentation.
4. In addition, Bidder shall provide the "Manufacturer's certificate of Conformity" to the specification after LOI/PO.

11.8 Inspections and Tests

11.8.1 General

1. Bidder shall perform all tests and inspection necessary to ensure that the material and workmanship conform to the tender and documents approved by the owner/ consultant & such tests shall be adequate to demonstrate that the material will comply with the requirements of this specification and the guarantee furnished by the Bidder.

2. **Vendor shall submit inspection/ test reports for Owner/ client approval.**

3. The bidder shall arrange at the time of inspection, necessary equipment and testing instruments, drawings and personnel etc. required for inspecting the material.

4. The testing instrument calibration certificate shall be produced during inspection from reputed testing Institutions.

5. Inspection and testing shall be carried out as per relevant standards unless otherwise indicated in the document. Supplier shall be responsible for quality control, inspection and tests required to complete all the work conforming to this specification and shall meet the guarantees.

6. All cables shall be subjected to routine tests at manufacturer's works in accordance with BS, IS and IEC standards. Certification of the routine tests shall be provided in a complied data book to be made available during final inspection.

7. Cables shall be subjected to following dimensional checks as a minimum:
   - Core Insulation thickness
   - Inner sheath / Bedding jacket thickness
   - Cable diameter over Armour
   - Outer sheath thickness
   - Overall Cable diameter

8. Cables shall be subjected to following Electrical tests as a minimum :
   - Voltage grade test
   - Measurement of Insulation resistance
   - Continuity check
   - Measurement of Conductor loop resistance
   - Measurement of capacitances : Core to Core , Core to Armour , Core to Screen
   - Determination of L/R ratio
   - Measurement of Mutual capacitance
   - Measurement of Armour resistance

9. Type test certification shall be provided to ensure that Flame retardant cables are meeting the test requirements as per IEC 60332.

10. Fire resistant cable shall be capable of operating when exposed to a source of heat as detailed in IEC 60331 and sustaining a degree of mechanical impact a detailed in BS 6387.

11. Fire resistant cables shall be capable of operating when exposed to a water spray during a fire as detailed in BS 6387. Cable ends are to be sealed to prevent ingress of moisture during the test.

12. All tests are to be carried out on the same piece of cable.

13. A sample of each constituent component of the insulation, bedding and sheathing of the cable shall be tested in accordance with IEC 754 part 1. The manufacturer shall state the total mass of acidic product released in the data sheet and provide an analysis of the gas in compliance with BS 6425 pt 2. The cable shall also comply with low smoke emission and acid evolution requirements of BS 6724 & 7211. All non-metallic material components of the cable shall be tested for oxygen index according to the requirements of a national standard such as BS 2782 Pt 0, Method 141. The manufacturer shall state the value achieved and if applicable the equivalent standard used.

11.9 Identification

1. All cable drums shall have their identification reference clearly stenciled on the outside of both flanges. Drum identification labels shall be attached on the outside and inside of the drum flange. Labels shall be robust and non-fading and give the following information
   - Drum identification number
   - Voltage grade
   - Cable construction (eg XLPE/LC/PVC, PVC/SWA/PVC).
   - Number of cores and cross sectional area
   - Cable Length.
   - Order number and item number.
   - Total weight of cable and drum
   - LOI/PO number
   - Direction of rotation

Cables shall be drummed in maximum and continuous lengths on non-returnable cable drums with cable ends sealed and fixed to the drums. Cable drums shall be fitted with battens, fixed around the entire periphery of the drum.

11.10 Technical Specifications of ESD PB Station SIL 2 certified

Product	Flameproof – Weatherproof Enclosure of Indicating lamp with Stop push button station with separate cable terminal box wired upto the terminal.
Flameproof	Zone – 1 & , Gas groups – IIA & IIB as per IS:2148/1981, Temp. Class – T6
Weatherproof	IP 65 Degree of protection as per IS:13947 (Part-1) 1993. IP certificate for the same to be submitted.
Material	Cast Aluminium Alloy LM6
Finish	Inside & Outside light grey epoxy powder coated to shade 631 as per IS:5
Earthing	1 No. inside & 2 No
Hardware	Stainless Steel
Gasket	'O' Ring endless Neoprene rubber gasket.
Terminals	8 Nos. for 1.5/2.5 sqmm clip-on Terminals
Cable Entries	2 Nos ¾" ET cable entries from bottom side. SS plugs to be provided on cable

	entries.
Indicating Lamp.	1 No. 24V DC . 5 Watt LED type Indication Lamp (RED COLOUR)
Element	2 Nos. 5A, 230 VAC (1NO + 1NC Contact elements)
Actuator	'Stop' push button of red mushroom head press to Stop & Reverse turn to release with pad locking arrangement in stop position.
Mounting	Surface Mounting Type (Mounting Accessories / Canopy to be provided)
Approvals	PESO, CMRI. Certificate for the same to be submitted for approval before procurement of the same. SIL 2 certification by TUV
Makes	Baliga / FCG/ Flexpro/ Ex-protecta/ CEAG/ Sudhir Switchgears or equivalent
Qty.	3 Nos.
Location	1 Nos. @ Control Room, 1 Nos. each side of dyke wall(Total Nos.2)

11.11 DATA SHEET FOR EXPLOSION PROOF / WEATHER PROOF JUNCTION BOX

S.No.	Item Description	Requirement
1	Body & Cover	Cast Al. Alloy (LM6); Minimum 5mm thick
2	Gasket	Neoprene rubber
3	Terminals	Clip on type, block locked at both ends suitable for up to 2.5 sqmm conductor. Make - Elmex, Phoenix
4	Tag Nameplate	To be provided
5	Paint	Anti Corrosive epoxy paint, shade light gray
6	JB Type	Suitable for area classified as IEC Zone 1&2, Gr. IIA & IIB T6; as per IS:2148
7	Protection Class	IP-65 as per IS:2147
8	Other	• Explosion proof junction boxes shall have detachable cover, which is fixed, to the box by means of cadmium plated hexagonal head screws. Terminal shall be spring loaded, vibration proof, clip on type, mounted on nickel plated steel rails completed with end cover and clamps for

		each row. • Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines: – 50 to 60 mm between terminals and sides of box parallel to terminals strip for up to 50 terminals and additional 25 mm for each additional 25 terminals. – 100 to 120 mm between terminals for up to 50 terminals and additional 25 mm for each additional 25 terminals. • All junction boxes shall be provided with 20% spare cable entries and terminals. • All cable glands and plugs shall be nickel plated brass material. • Double compression type cable glands shall be used for armoured cable.
9	Approvals	CMRI & CCOE/PESO approval is required for Flameproof and Weather proof enclosures.
10	Accessories required	a) Flame Proof Double compression Aluminium Cable Glands / Plugs for all the cable entries are in Vendor's scope. b) Mounting Accessories for JB's are in vendor's scope.

12 Level Switch Top Mounted (Float Type)

12.1 Scope

1. The scope covers design, supply, manufacturing, inspection/testing, packing, forwarding, and providing performance guarantee. The scope also covers commissioning assistance at site.

2. The specification is to be read in conjunction with data sheets, standards and all attached annexure.

3. It is not the intent to completely specify all the details of design and construction, nevertheless, the equipment shall conform in all respects to high standards of engineering, design, workmanship and shall be able to meet all statutory requirements, perform continuous commercial operation up to vendor's guarantee manner acceptable to purchaser who will interpret drawings and specification and shall have the power to reject the work or material which is not in accordance with the specifications.

4. Compliance to this specification shall not relieve the vendor from the responsibility of supplying the equipment and auxiliaries of proper design, material and workmanship to meet the operating requirements specified in the datasheet / design basis. In case of requirements of additional instruments, controls, safety devices and any other auxiliaries for safe, smooth & trouble free operation of the equipment, the vendor / bidder shall include the same in his scope of supply.

5. The vendor shall be responsible for the co-ordination of all sub-suppliers and for the overall guarantee of equipment offered. It is the specific responsibility of the manufacturer to invoke all applicable referenced specifications to each sub-supplier Purchase Order.

6. The offered equipment/supplies shall be sourced from a regular and established manufacturer and having requisite design, engineering, manufacturing and testing facility.

7. The offered model shall be from the regular manufacturing range of the supplier and the design shall have a minimum of two years successful field operation with the same model having the same design and materials of constructions. Relevant information of the offered equipment like catalogues

12.2 General Technical Requirement

Level Switch shall be selected to suit the intended environment with due consideration of:

a) Electrical area classification
b) Ambient temperature variations
c) Thermal radiation
d) Humidity
e) Dust
f) Vibration
g) Atmospheric pollutants

The switches shall be normally closed type & open to alarm.

There shall be a minimum of bounce during making or breaking of switch contacts.

Switch mechanism shall be designed to minimize the effect of vibration.

The selection of suitable instrument model to meet process condition is vendor‘s responsibility. At any point of time of execution of the job if the quoted instrument model is not suited to meet the application requirement, the same shall be replaced with suitable model without cost & time implication.

12.3 Statuary Approval

1. Vendor shall be responsible for obtaining all statutory approvals, as applicable for all instruments and systems.

2. In addition, equipments / instruments / systems located in the hazardous area shall be certified by the local statutory authorities for their use in the area of their installation. In general following certification shall be given.

3. For all intrinsically safe/explosion proof / flameproof equipment/instruments/systems or equipments with any other type of protection allowable as per this package which are manufactured abroad and certified by any statutory authority like BASEEFA, FM, UL, PTB, LCIE, CENELEC etc. should also have the approval of Chief Controller of Explosives (CCE), Nagpur.

4. For all flame proof equipments manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like CMRI/ERTL etc. The equipment shall in addition bear the valid approval from Chief Controller of Explosives, Nagpur and a valid BIS license.

5. For all intrinsically safe equipment manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like CMRI/ERTL etc. The equipment shall in addition bear the valid approval from Chief Controller of Explosives, Nagpur.

6. Approvals other than above shall neither be offered nor will these be acceptable.

12.4 Q.A. Planning

Bidder shall submit his QA plan covering various activities like design, engineering, material requirement, manufacturer inspection and testing, documentation, dispatch to site, erection and commissioning and maintenance of quality records for approval within two weeks from receipt of LOI/PO.

QA involvement shall commence at the initiation of the requisition and follow through to completion and acceptance, thus ensuring total conformity to the purchaser's requirements. Bidder shall submit the Quality records to Inspection Engineer of third party inspection agency.

12.5 Data sheet for Level Switch Magnetic (Float Type)

Tag No. Location	LS-0701 / UG-215
PID No.	322538-PIC-0007-01
Make / Model	*Bidder to specify
Service	Level Switching
Area Classification	Hazardous Hazardous,Zone1,Gas Group IIA,IIB
Qty.	One
Material Housing	Die cast Aluminum
Process Connection size & Rating	2" Flanged ,SORF ANSI B 16.5 150#
Process connection Location	Top of the Tank
No of Float	Two
Material / Dimension	SS / Vendor to specify
Actuation Level	Multipoint set Level
Tank Nozzle Projection (mm)	250

Type of Switch / Qty.	Micro switch / 1no. (2NO & 2NC)
Power / rating	230V, AC, 5A
Diff. Fixed / Adjust	10-15mm
Contact-Open On Low Level / Close on High Level	Open Close
Enclosure	Ex. Proof Zone1, Gr.IIA, IIB
Electrical connection Size	½" NPT
Cable Gland - Required	SS 304 double compression required
Fluid / specific gravity	ATF mixed with water / 0.8-1

13 Scope of the Automation Erection Work

13.1 Erection Scope of Works

The works to be done by “Contractor” described in this document have to be carried out inside the Delhi Aviation Fuel Farm Facility at IGI Airport, at New Delhi

The Contract is referred to the instrumentation supply, erection works including installation, testing, calibration, pre-commissioning, commissioning and supply of installation material.

“Contractor” shall execute the works Not Limited to the following:

h) Flow Measuring instruments installation.
i) Tank Farm Management System. .
j) Level Measuring Instruments Installation.
k) Pressure Indication Instruments Installation.
l) Temperature Indication Instruments Installation.
m) Supervision of On-line Instruments Installation.
n) Works in Control Rooms.
o) Instrument Cables, Junction Boxes and Local Panels Installation.
p) Pre-commissioning and Assistance to Commissioning.
q) Any other work necessary to have the plant completion from the instrumentation point of view.
r) Carrying out FAT & SAT & commissioning, training and handing over the complete Fuel farm Automation system.

The works above listed shall be carried out in accordance with the document

s) Automation will be performed by PLC systems.
t) Instrument such as transmitters will be mainly electronic smart type. Cables will be armored connected by Flame Proof Double Compression glands. Junction boxes will be weather proof & Flame proof both main cables routing and secondary cables lying will be above ground in trays.
u) Pneumatic positioners with I/P converters will be mainly used for control valves.
v) The installation and the electrical connections of instrument power supply cables from relevant UPS system to Field instrument/local panel is part of Instruments Installation works.
w) The Consoles and Cabinets installation, the Control Room interconnections, the grounding connections and the termination in the Control/Rack Room relevant to TFMS/PLC Systems will be executed by “Contractor”..
x) The cable ducts / Tray with Galvanized Perforated Type sheets that will be supplied installed and fixed by Contractor.
y) “Contractor” shall take into account, during the support prefabrication, the possible presence of fire proofed structures.
z) Grounding of shield cables to respective instrument earth bus provided in the control room / local panel / field instruments etc.
aa) Supply of all type of consumables required for the erection of the complete Instruments work.
bb) All instrument secondary cables shall be segregated to avoid intrinsically safe wiring running in some tray of not intrinsically safe one or power supply one.

13.2 “Contractor’s” Duties

a) The supply of all tools, equipment, manpower and managerial staff, materials to be incorporated in the plant, consumables and whatever else may be necessary, in time, quality, type and quantity required for completing the works.

b) The protection, safety and maintenance (in warehouse and/or in field, after erection), of the material supplied by the “Owner Representative” and taken delivery of the supply of materials necessary for the said protection and/or maintenance shall be at Contractor's charge if any.
c) All unloading transport and unloading at storage park, loading and transport to construction site and/or to own workshops and then to site, of all instrumentation materials including supports included in the scope of work of the works.
d) All loading, transport to Storage Park, loading and transport to site of all instrument cable, tube/multicore cable drums of any weight and size.
e) To co-ordinate with other contractors at the work site so as to allow other Contractors, performing works in the same area to use any scaffolding erected by Contractor for his own purposes, so long as this does not interfere with Contractor's activities and/or delay the removal of the said scaffolding.
f) The instruments installation activity shall be carried out up to commissioning of the project on site, which means that the instrumentation shall be installed, connected to the process, electrically wired and tested and commissioning as applicable.
g) The sealing with compound of all conduit tubes entering control rooms, local panels and building, to avoid the infiltration of water.
h) The installation shall be fully in accordance with the engineering documentation and drawings.
i) The installation shall be done in compliance with the applicable local laws, regulations and safety rules as well as with the international standards and codes mentioned on the document.

13.3 “Contractor’s” Duties

The works listed hereinafter have to be, therefore, considered excluded from the scope of the present specification, but included in the scope of erection of other disciplines:

a) Orifice flanges including block valves, mechanical installation. Anyhow the instrument’s “Contractor” is responsible to supervise the correct installation.
b) Rota meters (without transmitters and/or contacts except purging ones), orifice plates, restriction orifices flow nozzles, venturies, in line flow meters (mass flow, vortex, etc.), control valves, safety valves, rupture discs mechanical installation .
c) Anyhow “Contractor” is responsible to supervise correct installation and to perform all tests for the above equipment.
d) Instruments air main header mechanical installation up to the inlet of air distribution pot.

13.4 “Contractor’s” Duties

“Contractor” shall follow the following rules during erection:

a) Weekly program of detailed activities must be proposed by “Contractor”, approved and then authorized by “Owner representative”. The programs should take in consideration the overall schedule and availability of materials. The installation activities in the existing plant area are subject to the issue of permits to work.
b) No instrument installation can be done, if it is not previously calibrated.
c) Any exception must be specifically approved by “Owner representative”.
d) Contractor” shall issue daily report on forms that will be fixed by “Owner representative” of all activities 1 month before the beginning of works.
e) Dedicated people such as supervisors, foremen and technicians with relevant equipment and tools shall be especially assigned as a task for following activity:

i. Assistance to “Contractor” specialists for calibration and setting of special instruments;
ii. Test of alarm and interlock system;
iii. Test with “Contractor” specialist of Automation Systems.

13.5 "Contractor's" Duties

"Contractor" shall handle the materials as follow before the erection:

a) Grouping of instruments with relevant piping, bulk / Packaging materials for each unit of plant.
b) Grouping of each unit of the plant of "in line" instruments (such as TW, TE, TG, PG) and checking of relevant dimension against specifications.
c) Carrying out the inspection of materials.
d) Protection of all materials while in storage and when installed as per good practice and manufacturer's instructions.
e) Temporary labeling and identifications of all materials in storage.
f) "Contractor" is responsible for the correct use and destination of all materials supplied. At this purpose "Contractor" will keep update situation of used material and forecast any possible deficiency of material in order to avoid "bottle neck" for construction progress.
g) "Contractor" shall install junction boxes, cable trays and cables as per engineering drawings. The cabling and wirings activity will be maximized as far as possible. Stranded conductor ends shall be fitted with a suitable crimped thimble (boot lace ferrule type) of correct type and length according to the core size. All spare wires shall terminate to the spare terminals.
h) During the pre-commissioning, "Contractor" will clearly describe and certify on "Owner representative" forms the portion of work activity not yet completed, scheduling these activities in due time in order to respect the completion date.
i) During and after instrument or equipment installation, each instrument or equipment will be protected following the indications given by "Owner representative" to avoid any damage. Special consideration shall be given to instrument preservation after mechanical completion.
j) It is clarified that "Contractor" shall install instrument air distribution system starting from the air distribution pot in accordance with relevant hook-up drawings.
k) "Contractor" shall sand-blast, apply two coats of primer and final coat on raw materials supplied (e.g., supports, protections). Painting materials shall be supplied by instrument "Contractor". Painting cycle shall be as per relevant painting specification.

   Due consideration for dissimilar metals shall be taken. A Teflon insulation system shall be provided by "Contractor" to prevent galvanic contact between metals with potential differences.
l) Any straight nipples shall be fabricated from base pipe. All nuts, bolts and washers shall be cadmium steel plated as minimum considering corrosion.
m) Lock washers or equivalent shall be used on all fixing to prevent loosening by vibration.

13.6 "Contractor's" Duties

The "Contractor" shall give consideration to the following when establishing the final location of the instruments:

a) Ensure operability and serviceability.
b) Minimize vibration.
c) Protection from damage, dropped object, drainage of water and process fluids.
d) No instrument shall be installed in such a way that it depends on the impulse tubing for support.
e) Site condition.
f) Good practice and engineering aspects.
g) Instrument tubes below 25 mm OD shall be run in field trays with clamp support every 600 mm. For 25 mm tubes, field trays can be excluded. Support each 1.5 m distance. Tubing clamps shall be made of non-corrosive material, stainless steel AISI 316 or flame retardant plastic. Galvanic corrosion between tubing and tubing support system shall be avoided.
h) Parallel runs of tubing on the same support shall be arranged such that it is possible to have access to every connection point. Installation into or through panels shall be by use of bulkhead unions or multi-cable transits. All tubing, fittings which are not directly connected shall be sealed

by use of end-plug/cap. All tubing shall be blown through with clean, dry air before final installation. All tubing in hydraulic systems shall be flushed and cleaned. Suitable sealing compound shall be selected by the “Contractor” in accordance with recommendations given by “Owner representative”.

i) Tubing shall be cut, bent and deburred using only the correct tools. Special attention shall be paid to protection of tubing & capillaries. Tubing joints shall be made by means of compression fittings.

j) Impulse line routing shall avoid passing over rotating machinery, other vibrating equipment or main cable trays.

k) Capillaries of filled systems shall be run separately from other lines and shall be continuously supported. Spare capillary shall be neatly formed and secured.

l) Tightness of instrument tubing shall be tested as follow:

a) **Air Tubing:** Leakage rate less than 0.1 bar per 10 min (when normal supply air pressure is applied).

b) **Signal Tubing:** No leaks to be detected by e.g. soap test when there is applied normal instrument operating air pressure.

c) **Process Impulse Tubing:** No visible reduction of pressure when 1.5x max. Working pressure is applied to the tubing for = 30 min.

d) **Hydraulic Tubing:** No oil leakages detected when 1.5 x maximum working pressure is applied for a duration of 30 minutes.

b) Wherever necessary in accordance with safety rules, “Contractor” shall erect scaffolding to access working locations. Scaffolding price is included in contractual unit price for completion of all the contractual obligations..

c) All instruments will be supported by 2" pipe.

d) Pressure gauges shall be installed at the end of works to avoid damaging.

14 Technical Standards for Instruments Installation in Field and Control Room

14.1 Field - Process Connection Piping

a) Connections to process lines shall be made using material in accordance with the instrument classes. Process connections up to and including the first block valve will be installed by the Piping Contractor.

b) Where line classification requires welded fittings, the welding electrodes utilized shall be of suitable material and in all cases shall be approved before hand by “Owner Representative”. Contractor shall submit welders to qualification tests as per the appropriate procedures.

c) Seal welding may be required for threaded fittings for special services and dangerous liquids. In such a case the connections shall be dry-installed, i.e., without sealing compounds, and threaded surfaces shall be free of all traces of grease.

d) Process connections shall be routed to prevent formation of gas pockets within liquid service pipes and liquid pockets in gas service pipes, even if not specified on hook-up erection drawings. As a general rule, 25 mm. of slope shall be provided for every 300 mm of horizontal run of pipe.

e) Valves shall be located and oriented to guarantee easy reach and operation.

f) Instruments, (level instruments in particular) shall be positioned and oriented in such a manner as to guarantee easy reading and, where controllers and recorders are involved, easy access to internal mechanism.

g) All local repeaters on signals from transmitters shall be installed and solidly bracketed in proximity to the by-pass of the control valve for the relative loop.

14.2 Electrical connections

a) The “Contractor” shall make a preliminary study of instruments layouts and possible routes for connection cables between instruments and junction boxes.

b) Connections between control room and units shall be made with multicore cables, single pair, serial communication installed above or underground, as specified in detail engineering.

c) Cables for electronic signals, thermocouple extension, and alarm shall be installed at a distance of at least 30 centimeters from power supply and remote control cables.

d) Junction boxes for multicore cables shall be installed in accordance with drawings furnished by “Contractor Representative”.

e) Cable glands shall be installed on junction boxes for incoming cables, when not supplied already assembled. Connections within boxes shall be aligned and arranged to permit easy access to all conductors; each conductor shall be equipped with an identification tag.

f) Conductors and terminals shall be duly marked at each end, transmitter side and junction box side, in accordance with “Contractor Representative” / “Contractor” drawings. The numbering system shall be submitted to “Owner representative” for approval.

14.3 Instrument Supports

a) Instrument Supports - Pneumatic and Electronic.

b) Instrument supports of 2" steel pipe shall be constructed at site by Contractor, and shall be painted with primer. These shall be made to meet the relative service. Auxiliary supports for pneumatic and electronic routings shall be made of hot-galvanized steel section.

c) Machined parts shall be protected by cold-galvanizing. All pipe supports shall have corrosion protection not less than Class 2 to BS 4678: Part 1.

d) Supports shall be welded, bolted, or fixed with expansion nails.

e) Typology, dimensions and fixing shall be studied by “Contractor” and agreed with “Owner representative” Supervision.

f) Particular care shall be given to supports on routes to be subsequently hot or cold-insulated and protected with fire-proofing.

14.4 Temperature Instrument Installation

a) Temperature gauges shall be mounted at the end of works to avoid damaging. During the erection time, wells only will be installed.
b) Thermo-well shall be installed in such a manner that the temperature element can be installed and removed from the well for maintenance purposes.
c) For calibrations below ambient temperature, “Contractor” has to provide the necessary tools to perform the work.
d) Continuity test of transmission line from RTD element head to the junction box terminals. After execution of works, RTD element heads shall be adequately protected and the threaded parts shall be greased.

14.5 Level Gauges Installation

The activity includes the following operations:

a) Collection of instruments from warehouse, Transport to the site, after a visual check on the integrity of materials and conformity to the technical specifications Connection of level gauges to equipment flanges.
b) Fabrication and installation of drain line, including:

- Study by Contractor of the shortest pipe routing from the bottom of level gauge and sewer.
- Installation of draining accessories on the level gauge;
- Prefabrication of drain line and relevant supports;
- Supports and drain line installation from instrument up to the sewer.
- Tight test for levels.

14.6 Electronic Level Instruments Installation (diff. pressure type)

The activity includes the following operations:

a) Supports fabrication for local indicators and transmitters. Treatment with "primer" and transport to the site. The supports shall be fixed on the structures by means of welding or with galvanized bolts. "Primer" restore operation shall be foreseen where necessary. Minor civil works shall be executed for supports fixing.
b) Collection of instrument (transmitters and local indicators) from warehouse. Transport to the site. Calibration activity according to the technical specification of each instrument. Installation of instrument on the supports.
a) Manifold fabrication, on the basis of hook-up drawings provided by “Owner Representative”. Transport to site. Manifold shall be in rigid pipe material or tubing according to project standards.
b) Manifold connection to the process line and to instrument. Manifold clamping and installation of spacing support on the manifold leads.
c) Hydraulic test of connection lines to the process.
d) Signal cable installation for connection of transmitter up to the junction box. This activity includes:
   i. “Contractor” shall study all routings for the signal cables starting from local junction boxes. The Contractor shall be responsible for selecting the shortest and straightest routings. Taking into account the possibility of eventual interferences.
   ii. Therefore the “Contractor” shall coordinate his work with other “Contractor” in order to solve eventual problems prior to installation of cable trays (conduits) and of cables.
   iii. Support preparation and cable trays (conduits) installation from single instrument to the relevant junction box, in accordance with the agreements reached with “Owner representative” Continuity test of transmission line from transmitters to the local indicators and junction box terminals.

14.7 Float / Servo Type Level Indicators on Tanks

The activity includes the following operations:

a) Support fabrication for positioning of steel cable-guide pipes from the tank roof up to the base. The supports shall be generally of collar type, welded to the tank and bolted to the pipe. Anchoring supports prefabrication for the internal part of tanks (roof and bottom). Type of supports, distance from tank and materials shall be submitted for approval to “Owner representative” Supports shall be treated with "primer" and moved to the site.
b) Supports installation and "primer" restore.
c) Collection of materials and accessories from warehouse. Visual check of quantity and "status" of material & Transport to the site.
d) Installation of float guides.
e) Installation of float, steel cable-guide, and steel cables at the internal and external part of tanks.
f) Installation of local indicator at the base of tank.
g) Functional test of all system.
h) Inspection with ““Owner / Owner Representative”

14.8 Electronic Pressure Transmitters - Direct Pressure Switches

The activity includes the following operations:

a) Supports fabrication for local indicator and transmitters. Treatment with "primer" and transport to the site. The supports shall be fixed on the structures by means of welding or with galvanized bolts. "Primer" restore operation shall be foreseen where necessary. Minor civil works shall be executed for supports fixing.
b) Collection of instruments (transmitters and local indicators) from warehouse. Transport to the site. Calibration activity, according to the technical specification of each instrument. Installation of instruments on the supports.
c) Manifold fabrication, on the basis of hook-up drawings provided by “Owner representative”. Transport to the site. Manifold shall be in rigid pipe material or tubing according to the project standards.
d) Manifold connection to the process line and to instrument, manifold clamping and installation.
e) Hydraulic test of connection lines to the process.
f) Signal cable installation for connection of transmitter up to the junction box, and for connection of pressure switch to the junction box.

14.9 Local Pressure Gauges

The activity includes the following operations:

a) Collection of instruments from warehouse. Transport to the site, after a visual check on the integrity of instruments and conformity to the technical specifications. Calibration activity shall be foreseen for all pressure gauges.
b) Manifold fabrication, on the basis of hook-up drawings provided by “Owner representative” Transport to the site. Manifold shall be in rigid pipe material for direct installation of line.
c) Fabrication and installation of supports for pressure gauges not directly connected on line (capillary type or remote connected with tubing). Supports shall be fabricated in field and fixed to the structures by welding or bolts.
d) Manifold connection to the process and to the instruments, including accessories (separators, pulsation dampeners, pig tails syphon, snubber etc.).
e) Hydraulic test of connection lines to the process.

14.10 Thermal Relief valve

a) Nozzle and disc seating areas shall be such that several maintenance lapping operations can be carried out.
b) Back pressure shall not exceed the pressure rating of the discharge flange
c) Bonnets for balanced valves shall be vented to atmosphere
d) The selection of suitable instrument model to meet process condition is supplier responsibility. At any point of time of execution of the job if the quoted instrument model is not suited to meet the application requirement, the same shall be replaced with suitable model without cost & time implication.
e) Supply and Installation of TSV in scope of Instrumentation contractor where's Nozzle connection in existing pipe line with necessary pipe flange and valve shall be in scope of piping contractor.

14.11 In Line instrument

a) In general "Contractor" will install and connect all equipment that for any reason are supplied not assembled with other equipment.
b) All in-line instruments shall be installed in accordance with Manufacturer recommendations.
c) Prior and during the installation of control valves and other in-line instruments, the "Contractor" shall ensure that:
   i. All process lines have been hydrostatically tested.
   ii. All process lines have been properly flushed clean.
   iii. Instruments are correctly located with reference to flow and direction.
   iv. Instruments are properly supported to avoid stress-forces being exerted through flanges.

14.12 MOV's and On-Off Valves Installation

The activity includes the following operations:

a) Check that valves are correctly installed on-line. Actuator to be rotated where necessary.
b) Check activity on correct flow direction and on valves data, corresponding to technical specifications.
c) Air supply/ electrical power supply installation to the valves or positioners /actuators.
d) This activity includes:
e) "Contractor" shall study all routings for the branch headers, starting from instrument air main header. The "Contractor" shall be responsible for selecting the shortest and straightest routings, taking into account the possibility of eventual interferences. Therefore the "Contractor" shall coordinate his work with other Contractors in order to solve eventual problems prior to installation of pipes.
f) Supports preparation and installation for the branch header system. The supports shall be obtained in field from galvanized steel, suitable to bear 1", ¾", and ½" inch pipes according to the standard drawings "Owner representative" Supervision.
g) Branch pipe from Main header up to the valve or actuator.
h) Installation and pneumatic connection of the air-set to the terminal of header.
i) Single SS tubing connection from pneumatic positioner or actuator to the relevant junction box, to local controller, to I/P converter or to solenoid valve.
j) Installation of two-core cable for connection of:
i. Electro/pneumatic positioner to junction box.
ii. Solenoid valve (installed on valve) to junction box.
iii. Limit switches on valve to junction box.

k) Contractor shall study all routings for signal cables starting from local junction boxes. Contractor shall be responsible for selecting shortest & straightest routings, taking into account possibility of eventual interferences. “Contractor” shall coordinate his work with other Contractors in order to solve eventual problems prior to installation of cable trays (conduits) and of cables.

i. Supports preparation and cable trays (conduits) installation from electro-pneumatic positioner, limit switches or solenoid valves.

ii. Laying or pulling of signal cable.

l) Execution of pneumatic connections, Continuity and pressure test of pneumatic lines. Execution of electrical connections.

m) Continuity and pressure test of air branch header, from user up to main header shut-off valve.

n) Loop alignments with local pneumatic controllers and I/P converters. Test activity on control valve with close local loop. Simulation and alignment.

o) Disconnecting activity of pneumatic and electronic connections for flushing activities in line. Restore of connections.

p) MOV’s Push button installation shall be in Contractor scope with including laying & termination & gland of cable including supply.

14.13 Emergency shutdown System

This item includes the following field devices:

a) Break glass push buttons.

b) Manual shutdown stations.

c) Local audible and visible warning panels.

Display panels are to be installed in the control room.

14.14 Works in Control Room

The work will include the installation of equipment in Control Room following main reference drawings i.e. Control Room Layout, Wiring diagrams, Loop Schematic Drawings and System “Contractor” Drawings. The “Contractor will ensure that:

a) Equipment shall be installed with care and only after HVAC system is in operation. Any damage of external paint work shall be properly touched-up by “Contractor”.

b) Control room equipment includes all kind of cabinets and panels such as marshalling, power supply distribution, barrier, PLC, relay, other auxiliaries, etc.

c) Supply of metal base frames is out of “Contractor” scope of work.

d) Instruments panel and cabinets will be, in principle, supplied with internal wiring completed and tested at Manufacturer shop. However, “Contractor” shall be responsible to carry out on site all the internal interconnections not completed by panel supplier and restore those parts of internal wiring that could result incomplete or missing for shipping purposes (e.g. inter panels wiring, power supplies, etc.)

e) “Contractor” shall also install all instruments that arrive separated from panel board (e.g. to be site installed in existing panels).

f) Install boards, loose instruments and accessories with necessary wiring connections;

g) Dismount and/or reinstall instruments, supplied by the “Contractor” already installed on equipment, to avoid damages during installation of equipment;

h) Test, calibrate and pre-commissioning all the instruments supplied with equipment, either installed or loose.

i) All kind of operating devices such as workstations and printers, PC’s, alarm annunciators, CRT’s, etc.

j) “Contractor” shall perform execute all the works necessary to allow the cables and multicore cables installation.

k) Supply of the steel structures and frame-works necessary to support and rise at the same level of false floor the equipment in Central Control Room and Receiving Area Control Rooms is included in the "Contractor" scope of work.

l) The "Contractor" shall carry out all cutting and finishing - where necessary - of the false floor supplied by others. The "Contractor" is responsible for making any slots in the false floor for the passage of cables inside the equipment.

m) Minor masonry works for anchoring the structure base to the cement floor of the cables area are also included. The "Contractor" shall adjust the false flooring so that the outer parameter of work stations, cabinets, panels, etc., coincides perfectly with the floor itself.

n) The "Contractor" shall, before installation, inspect all equipment to ascertain any damage suffered during shipment.

o) Once ascertained that there is no damage, "Contractor" shall transport equipment items from warehouse to Control Room, where they shall be installed on the supports already arranged.

p) "Contractor" shall execute placing, anchoring and aligning the equipment on their scaffolding including the assembly and alignment of equipment items delivered in several parts.

q) In case of occurrence to install the equipment without having the false floor in place, "Contractor" shall prepare all the facilities in order to perform such installation.

r) "Contractor" shall execute grounding of equipment and signals (both instruments and electrical ground).Earth shall be connected by cable and terminated by "Contractor" on earth bars. Earthing system is separate for intrinsically safe (I.S.) and structural safety earths. All connections to earth bars and equipment earth terminals shall be by crimped type cable lugs.

s) "Contractor" shall execute multicore cables and cables wiring connections including identification and labeling at terminal points and immediately after the entrance in local instrument/Control room. "Contractor" shall execute multicore cables and cables supporting, with routing identification. "Contractor" shall execute test and wiring check from J. Box to marshalling cabinets and shall execute multicore cables and cables megger test.

t) Automation "Contractor" (PLC) specialist will manage, implement and troubleshoot inspection, testing, energization activities and loop checking limited to automation system (hardware and software part) only. "Contractor"shall take care of remaining part and shall assist "Contractor" specialist providing any installation services required. Costs for such services are included in the prices of items.

u) "Contractor" shall verify correct voltage level of equipment.

v) "Contractor" shall execute engraving of tag numbers and service on trifoliate sheet for annunciator panels and control room equipment wherever required.

w) "Contractor" shall clean the control room every day as follows:

i. Removing of all scraps.

ii. Dust elimination, twice per day, from pavement (below and on false floor), panel and cabinet surfaces, and other equipment surfaces.

iii. Dust elimination shall be done by wet system also, once per day, from false floor and equipment surfaces, from walls and roof when necessary.

iv. Keeping always closed the Control Room doors and windows.

v. All armour of incoming cables should be removed by "Contractor" inside each Control Cabinet.

vi. If necessary, "Contractor" will remove armour of cables which are to be used in Control Room.

vii. Also clamping of cables under false flooring (below panel entry) shall be made in case of possible tension and stress on panel terminations. Clamps shall be supplied and installed by "Contractor".

x) Loop tests after completion of above activities, "Contractor" shall execute the final test of all loops, to and from the field, with direct simulation from field of all process variables to be controlled. Alarms, interlocks, sequences, shall be tested.

14.15 Cable Tray (Perforated)

a) The Cable tray shall be made of FRP (Fibre Reinforced Plastic) Cable Tray. The Perforated cable tray shall be made out of min 4 mm thickness.
b) Cable tray shall be supplied with necessary mounting accessories like Coupler Plates, Bolts and Clamps.
c) An additive material shall be mixed with the matrix polyester to make the material Ultraviolet resistant.
d) The minimum glass content in FRP material shall be 45%.
e) All FRP cable trays shall be manufactured using the PULTRUSION process.
f) Perforated type cable Bearers 50mm width is to be provided in 4.0 mm thickness.
g) The Composite FRP Cable Bearers shall be supplied in Drilled/Perforated channels. Drilling/Perforation should be of 8 mm Dia. Holes Perforations/holes should be staggered @ 150 mm lengthwise and minimum 25 mm crosswise.
h) The Cable Bearers shall be supplied in lengths of 2 meter.
i) The construction of cable bearers shall be such as to facilitate easy handing and to ensure easy laying of cables without causing the damage to cables. The inside surface shall be free from sharp edges, burrs or projection. Only machine moulding is acceptable in both the side.
j) The cable bearers shall have holes on each end for fixing of coupler plates to join individual cable bearer sections.
k) The coupling plate shall also be manufactured of the same material & using the same process-Pultrusion. The minimum thickness shall for cable tray be 6 mm for tray with 300 mm width & above and minimum width should be as per width of the joining face of the cable tray.
l) Tow coupler plates are to be provided for each length. The couplings between two sections of bearing lengths or associated connections shall be done by SS 316 Bolting only. Site assembly and erection should be made very easy for the contractor.
m) The inside depth of the cable trays shall be as follows :

1. 25mm for 50mm wide tray
2. 50mm for 100mm, 200mm and 300mm wide trays
3. 75mm for 450mm and 600mm wide trays

n) Tolerance on width and length shall be +/- 6mm and height +/- 2mm. Tolerance on width specified is applicable for cable trays of 150mm and above. For lower size cable trays vendor shall maintain a minimum tolerance. The inside depth of the cable bearer should not be more than 100 mm.
o) The selection of suitable model to meet the requirement is Supplier responsibility. At any point of time of execution of the job if the quoted model is not suited to meet the application requirement, the same shall be replaced with suitable model without cost & time implication.
p) Edge of FRP cable tray shall be gel coated.
q) Nuts shall be nylon grip type
r) Bends and crossovers shall be factory made. same shall not be fabricated at site.
s) Standard length of cable tray shall be of 2.5 m.
t) Cable tray supply with cable tray cover wherever required.

14.16 Installation of Cable Network

a) Cable network shall include power, control, instrumentation and lighting cables which shall be laid in underground trenches, Hume pipes, cable trays, through GI pipes or on building structure surfaces as shown in the relevant drawings, single line diagrams or as per the Engineer-in-Charge's instructions. Supply and installation of cable trays, GI pipes / conduits, cable glands and sockets of ends, isolators, junction boxes, push button stations, etc. shall be under the scope of the contractor.

b) While laying cables in ducts / trenches or burying them, care shall be taken to ensure that low signal cables are separated from other power supply cables.

14.16.1 General Requirements for Handling of Cables

a) Before laying cables, these shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 volt Megger.

b) The cable shall be supplied at site, wound on wooden drum as for as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case, the cable will be rolled on, as it produces kinds which may damage the conductor.

c) Sharp bending and kinking of cables shall be avoided. The bending radius for PVC insulated and sheath armoured cable shall not be less than 10 D where 'D' is overall diameter of the cable.

d) While drawing cables through GI pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with cotton / bituminous compound.

e) LV voltage (230V and above) and other control and instrumentation cables shall be separated from each other by adequate spacing or running through independent pipes/trays.

f) Armoured cables shall never be concealed in walls/floors/roads without GI pipes, conduits or RCC pipes.

g) Joints in the cable throughout its length of laying shall be avoided as for as possible and if unavoidable, prior approval of Engineer-in-Charge shall be taken. If allowed, proper straight through epoxy resin type joint shall be made, without any additional cost.

h) A minimum loop of 5M shall be provided on both ends of the cables, or after every 150 M or unjointed length of cable, and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future.

i) Cable shall be neatly arranged in the trenches/trays in such manner so that crisscrossing is avoided and final take off to the motor / Switchgear is facilitated. Arrangement of cables within the trenches / trays shall be the responsibility of the "Contractor".

j) All cable routes shall be carefully measured and cable cut to required lengths and undue wastage to be avoided. The routes indicated in drawings are indicative only and the same may be rechecked with Engineer-in-Charge before cutting of cables. While selecting cable routes, interference with structures, foundation, pipeline, future expansion of building etc. to be avoided.

k) All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes, Use of friction type or other fabric type tape is not permitted.

l) Wherever cable rises from underground / concrete / masonry trenches to motors / switchgears / push buttons these shall be taken in GI pipes of suitable size, for mechanical protection up to 300 mm distance of concerned cable gland or as instructed by the Engineer-in-Charge.

m) Where cables pass through foundation/walls of other underground structures, the necessary ducts or opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.

14.16.2 Laying of Cables (Underground System)

a) Cables shall be so laid in ground that these will not interfere with other underground structures. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidity in places under the ground them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the Engineer-in-Charge.

b) Cables shall be laid at minimum depth of 750 mm in case of LV and 900 mm in case of MV, below finished ground level. Excavation will be generally in ordinary alluvial soil. The width of the trench shall be sufficient for laying of required number of cables.

c) Sand bedding 75 mm thick shall be made below and above the cables, A layer of bricks (full size) shall be laid and a flat brick to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However, the relative location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respect to the surrounded ground and to entire satisfaction of the Engineer-in-Charge.

d) Route markers should be used for underground cables as per guideline Not Limited to following:.

i. Separate route markers should be used for LV, MV cables.

ii. Route markers should be grounded in ground with 1:2:4 cement concrete pedestal of size not less than 200x200x575 mm.

iii. Cable markers should be installed at an interval not exceeding 50 Meter along the straight routes of cables at a distance of 0.5 M away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable.. Cable markers should be used to identify change in direction of cable route and for location of every joint in underground cable.

e) RCC Hume pipe for crossing road in cable laying shall be provided by Contractor. RCC Hume pipe at the ends shall be sealed by bituminous compound after laying and testing for cable by Electrical contractor without any extra charge.

14.16.3 Laying of Cable Under Floors

a) If required GI class A pipe shall be used for laying of outgoing cables from distribution boards to motors, insulators/junction boxes of motors, starter of motors and push button stations. Preferably one cable shall be drawn through one pipe. Size of pipe shall be such that after drawing of cable 40% area is free. If length of pipe is more than 30 M free area may be increased to 50%.

b) Use of elbows is not allowed at all. Pipe bending machine shall be used for making long smooth bends at site. Ends of pipe shall be sealed temporarily while laying with cotton/jute/rubber stopper etc. to avoid entry of building material.

c) Location of equipment/motor/isolator/push button etc. shall be ascertained prior to laying of pipe.

14.16.4 Laying of Cable in Masonry Trenches

Masonry/Concrete trenches for laying of cable shall be provided by contractor if required. Cable shall be clamped to the support with aluminium saddles/clamps and galvanized bolts. However, steel members such as angles/flats etc. shall be provided and grouted by the Contractor to support the cables. Minimum size of angles shall be 50x50x6mm and flats 50x6mm.

14.16.5 Laying of Cables in Cable Trays

a) The erection of cables trays shall include providing, cutting, welding, fixing, etc. of steel members such as MS angles/channels/flats, GI fasteners etc.

b) Cables shall be fixed in cable trays in single tier formation and cables shall be clamped with aluminium flat clamps and galvanized bolts/nuts.

c) Earthing flat/wire can also be laid in cable tray along with cables. After laying of cables minimum 20% areas shall be spare.

14.16.6 Laying of Cables on Building Surface/Structure

a) As far as possible, such type of cable laying shall be avoided and will be allowed only for temporary connections.

b) Cables shall be rigidly supported on structural steel/masonry using individual cast/ malleable iron galvanized saddles and these supports shall be approximately 400-500 mm for cables upto 25

mm diameter and maximum 1000 mm for cables larger than 25 mm. Unsightly sagging of cables shall be prevented. Only aluminium/GI clamps with GI bolts/nuts shall be used.

c) If drilling of steel structure must be resorted to approval must be secured from the Engineer-in-Charge and steel must be drilled where the minimum weakening of the structures will result.

14.16.7 Termination and Jointing of Cables

a) All PVC cables up to 1.1 KV grade, armoured or unarmoured shall be terminated at the equipment /junction box/isolators/push buttons/control accessories etc. by means of suitable size compression type cable glands. Armour of cable shall be connected to earth point at both ends and screen, if any. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type.

b) In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, close fit holes should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes after installation if bottom plate and cables with gland. It shall be sealed with cold sealing compound.

14.16.8 Use of Lugs/Sockets

a) All cable leads shall be terminated at equipment terminals by means of crimped type solder-less connectors unless terminals at the equipment ends are suitable for direct jointing without lugs / sockets.

b) The following is the recommended procedure for crimped joints and the same shall be followed:-

i. Strip off the insulation of the cable and with every precaution, not to severe or damage any strand. All insulation to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.

ii. The cable should be kept clean as far as possible before assembling it with the terminal/socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be filled with corrosion inhibiting compound. This compound should also be applied over stripped portion of conductor and palm surface of socket.

iii. Correct size and type of socket/ferrule/lug should be selected depending on size of conductor, and type of connection to be made.

iv. Make the crimped joint by suitable crimping tool.

v. After crimping the conductor in socket/lug, no portion of the conductor to should remain without insulation.

14.16.9 Dressing of Cable inside the Equipment

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

14.16.10 Identification of Cables/Wires/Cores

a) Power cables shall be identified with Red, Yellow, Blue for phase and Black for Neutral PVC tapes. For trip circuit's identification, additional red ferrules shall be used only in particular cores of control cable at the termination points in the Switchgear/control panels and control switches.

b) In case of control cables all cores shall be identified at both ends by their wire numbers by means of PVC ferrules indicating with coordinates of extremities. Wire numbers shall be as per schematic connection drawing. For power circuit also, wire number shall be provided if required as per the drawings of Switchgear manufacturer/supplier.

14.17 Earthing Network

a) The entire Earthing installation shall be done in accordance with the Earthing drawings, specifications and instruction of the Engineer-in-Charge.
b) Entire Earthing system shall fully comply with IEC & BS Electricity Act and & Rules.
c) Contractor shall carry out any change desired by Electrical Inspector or "Owner Representative" in order to make the installation conform to the Indian Electricity Rules, at no extra cost.
d) The exact location of the earth pits, earth electrodes and conductor and earthing points of the equipment's shall be determined at site. Any change in the methods, routing, size of conductor etc. shall be subject to approval of the "Owner / Owner Representative" before execution.

14.18 Earthing Pit with Electrode

Plate or pipe type earth electrode with earth pit shall be provided for this work unless otherwise advised by the Engineer-in-Charge due to typical site conditions. Earthing electrode and pit shall be as per existing earthing Pit & electrode. All earth electrodes shall preferably be driven to a sufficient depth to reach permanent moist soil.

Earth pit centre shall be at a minimum distance of 2 M away from nearest building, unless otherwise advised. Minimum 3 M distance shall be maintained between centres of 2 earth pits.

14.19 General Specification for Painting

14.19.1 Scope of Specification

This specification defines the requirements for surface preparation, selection and application of primer and finish paints for Instrument piping supports & steel structures, equipment etc.

Notwithstanding whatsoever may or may not be indicated herein below, the Contractor shall be bound to use the best available quality of materials, workmanship and methods of application, approved, and as per standard practice, it being understood that the specifications are largely indicative and not intended to be exhaustive.

14.19.2 Extent of Work

The following surfaces and materials shall require painting:
a) All structural steel work including steel supports, etc. as provided by the Contractor.
b) All above ground carbon steel piping and fittings. (Including painting of identification marks.)

14.19.3 Tools and Tackles

All tools, brushes, rollers, spray guns, blast materials, hand/power tools for cleaning and all equipment, scaffolding material, shot/sand blasting equipment, and air compressor etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantities.

All paints and primers shall be brought to the site in sealed containers which shall be opened in order of their manufacturing dates in the presence of the Engineer-in-Charge or his authorized representative. Time expired paints/primer shall not be used in the work.

14.19.4 Surface Preparation

In order to achieve maximum durability, one or more of the following methods of surface preparation shall be followed, depending on conditions of steel surface and as instructed by Engineer-in-Charge / Specification. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes more to the success of the paint protective system.

a) Manual or hand tools cleaning.
b) Mechanical or power tools cleaning.
c) Solvent cleaning.
d) Sand blasting.

Mill scale, rust, scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. Remove all other contaminants, oil, grease etc. by use of an aromatic solvent prior to surface cleaning.

14.19.5 Primer Application

After surface preparation, the primer should be applied by brush, also to cover the corners, sharp edges, etc. in the presence of an inspector nominated by the “Owner Representative”.

The shades of successive coats should be slightly different in colour in order to ensure application of individual coats. The thickness of each coat and complete coverage should be checked as per provisions of this Specification. This should be approved by “Owner / Owner Representative” before application of successive coats.

14.19.6 Type and Application of Paint

- Prepared surfaces shall not be left exposed to weather over-night and also to moist atmosphere before applying primer coat.
- Do not apply paint when the temperature falls below 10 degrees Centigrade.
- Do not apply paint when the relative humidity is above 90% or during fog, rain or mist.
- Primed surface should be over coated after the re-coat ability time specified in the datasheet given by concerned manufacturer.
- All the Primers and Finishes are supplied in brushing consistency. Thinner should be added only if viscosity increases during the application due to higher ambient temperature. Normally, addition of thinner is restricted up to 5-10% by volume in case of brush application. In case of spray application, only recommended thinner should be used to bring the paints to spraying consistency.
- Blast cleaned surfaces shall be coated with the primer within a maximum period of 3-4 hours. If relative humidity is over 75%, this period should be reduced to 1-2 hours, for better performance.
- All two pack primers and paints shall be used up within the pot life mentioned in the data sheets, given by the concerned manufacturer.
- Application of paints is recommended at ambient temperature. The substrata should also be at ambient temperature.
- Paint Material and Painting Systems shall be as per attached table.
- Primer Paint DFT shall be 50, MIO paint DFT shall be 75 and final paint DFT shall be 70.

Paint material and painting systems

Application	Environment	Painting system		
		Surface treatment	Primer	Finish paint

Steel structure	Highly humid	Sand blasting to SA-21/2. Wherever not possible, mechanical cleaning to SA-2	Two coats of Epoxy Zinc Rich Primer	One coat of High build MIO paint
	Highly corrosive	Sand blasting to SA-21/2. Wherever not possible, mechanical cleaning to SA-2	Zinc phosphate. High build zinc phosphate primer where sand blasting is not possible	Chlorinated rubber paint

NOTE:

All primers and finish coats shall be cold cured and air-dried unless otherwise specified.

- Technical data sheets for all paints shall be supplied at the time of submission of quotation.
- All paints shall be applied in accordance with manufacturer's instruction for surface preparation and application.
- The paints and primers shall conform to the specifications given above and be of first class quality in their product range, of any of the following manufacturers.
  - Asian Paints
  - Shalimar Paints
  - Goodlass Nerolac Paints
  - Bombay Paints
  - Berger Paints
  - Jenson & Nicholson Paints
  -

- **Storage**

All paints and painting material shall be stored only in rooms to be provided by the contractor and approved by the Engineer in Charge for the purpose. All necessary precautions shall be taken to prevent fire. The main storage building shall preferably be separate from the adjacent buildings. A sign-board bearing the words "PAINT STORAGE NO NAKED LIGHT HIGHLY INFLAMMABLE" shall be clearly displayed outside. Fire extinguishers shall be installed in the paint store.

- Colour Code

The scheme of identifying the materials contained in the equipments and carried in the pipeline shall generally follow the procedure mentioned in IS: 2379, code for the identification of pipelines.

The code scheme is intended for identification of the individual group of the pipeline. The system of -coding consists of a ground and bands super imposed on it as per BIS standards.

Colour code for equipment

Instruments	Light grey
Electrical items cable trays	Dark grey
Structural steel work and pipe supports	Dark grey

14.20 Junction Boxes Installation

a) Junction boxes will be 6, 12, or 24 entries type (excluding multi-cables entries).

b) **Supports Pre-fabrication for Junction Boxes:** The supports shall be fabricated in field and fixed on structures by means of welding or with galvanized bolts. Galvanizing restore operation shall be foreseen where necessary. Minor civil works shall be executed for supports fixing.

c) **Cable Gland and Sealing Installation on Junction Boxes:** In case junction boxes are delivered separated from cable glands, “Contractor” shall provide materials assembling, and take care to seal (with plugs or spare cable glands) the holes not used.

d) Junction box supports shall be fixed on structures as indicated on Instrument installation drawing. On concrete structure, “Contractor” shall utilize expansion bolts (bolts supplied by “Contractor”). Stand-alone supports are not allowed.

e) “Contractor” shall take into consideration that skid mounted equipment will have the relevant junction boxes installed.. These junction boxes are fully wired with the exception of some junction boxes that are partially wired because some instruments are not relevant to the skid. “Contractor” shall complete the above installations.

14.21 Local Panel Installation

a) The work will consist of the activities described on document in the relevant paragraphs and will include the installation, supporting and wiring and tubing for the following, but not limited to:

i. In same case holes or nuts shall be executed.

ii. “Contractor” shall take into consideration that the local panel relevant to alternative compressors will be installed by “Contractor”. These local panels are fully wired. “Contractor” shall install and wire interconnecting multicore cables between local panel and the main control room. Connection activity at local panels.

14.22 Safety Valve Test

a) This item includes the activities described in Price List to be carried out for each item during mechanical completion, pre commissioning and start-up.

b) The activities shall be carried out in accordance with local law and regulations and in case a third party approval and/or witnessing is required, it shall be “Contractor” duty aid cost.

c) Maximum set pressure is 20 bar and maximum size is 8” x 10” both spring operated and pilot operated safety valves.

d) It is “Contractor” duty to perform the seat lapping in case of leakage.

14.23 Material Supply Matrix

Material and equipment shall be supplied in accordance with following table, which will overcome any other requirement specified in the document “Description of Price List items Instrument Installation”.

SN.	Material Description	By “Contractor	By “Owner	Notes
1	Main control panel and local panel	X		
2	Operator console and control room equipment	X		
3	Field instruments	X		
4	Motor Operated / Control Valves		X	
5	Bulk material for mechanical hook-up	X		
6	Bulk material for pneumatic hook-up	X		
7	Junction boxes and cable glands	X		
8	Multicore cables and single Pair/triad cables	X		
9	Earthing materials	X		
10	Main cable trays, cover and accessories.	X		
11	Conduits and conduits accessories	X		
12	Secondary cable trays and accessories (from main routing to junction box/local panel)	X		
13	Secondary cable trays and accessories (from Junction boxes to single instruments)	X		
14	Auxiliary support for instruments, Jn. Box. Tray.	X		
15	Auxiliary support for pneumatic mechanical hook-up and electronic routing	X		
16	Bolts, screws, expansion bolts for fixing any kind of	X		

SN.	Material Description	By "Contractor	By "Owner	Notes
	support			
17	Special electrodes for the welding of grounding into plates	X		
18	Electrodes for the welding of various supports	X		
19	Painting for cold galvanizing	X		
20	Primer	X		
21	Material for cable and conductor identifications	X		
22	Clamps or stop collars for conduit fixing	X		
23	Bands for fixing the cable on cable tray	X		
24	Nails and expansion bolts in galvanized steel	X		
25	Insulation tapes and self-astringent lugs for terminal cable executions	X		
26	Copper compression lugs for cable connection	X		
27	Sealing compound for cables in cable glands or where necessary.	X		
28	Cable trays for pneumatic signal tubing	X		
29	Material for sealing of cable terminals awaiting for connection	X		
30	Grease and paraffin	X		
31	Teflon for tight on threaded parts	X		
32	Soldering paste and accessories material	X		
33	Plastic foils or equivalent to protect instrument and local panels from elements	X		
34	Material for sealing cable entrance in control room / MCC room.	X		
35	Instruments Testing Kit for testing of various type of instruments	X		
36	Auxiliary support for boards, panels and racks	X		
37	Cable belts for fixing cable inside panels	X		
38	Material for panels and racks insulation from panel supports	X		

14.24 Material reconciliation

All the materials given to the "Contractor" as Free Issue or for the material supplied by the "Owner", for which "Owner" has made payments against supply, shall be reconciled on the basis of `As Executed Drawings'. All the pipe/ tube material will be reconciled on linear measurement basis for the pipe/ tube length more than 0.5 meter. All the pipe/ tube length less than 0.5 meter will be treated as a scrap and reconciliation shall be done on weight basis.

a) 0.02% of the total pipe/ tube length consumed, will be allowed as wastage during cutting and bevelling operation.

b) All the instrument, fittings, valves, items etc. shall be reconciled on quantity (number) basis.

c) No separate payment against supply shall be made for items such as gaskets, fasteners, pipe anchor, clamps, hanger, U bolts, primer, material for painting, insulation, cladding, structural steel support etc. The payment for such items/ material shall be included in item rates of various items and hence the conditions of reconciliation shall not be applicable to such items.

15 Field Inspection, Testing, Pre-Commissioning and Handing Over

"Contractor" shall carry out the inspections, calibrations, tests, energization and loop checks of all instruments installed including those pre-installed on skids and packages including any addition, integration, clarification and exception stated in this specification.

"Contractor" shall also issue relevant certificates and documentation in order to complete the plant according to the definitions given in the listed documents:

a) Mechanical Completion Manual.
b) Quality Control Plan for Instrument Installation (including package ones).
c) Sequential loop check shall be done for all systems (not only interlock and emergency ones).

"Contractor" shall carry out inspections, calibrations, tests, energization and loop checks also for all instruments supplied with equipment, packages, or supplied installed on panels and cabinets.

"Contractor" is responsible for inspecting all aspects of the construction work to ensure conformity to project standard and specifications.

15.1 Functional Tests

a) The scope of the said tests is to demonstrate the simultaneous total operation of all field instruments, the PLC and the other auxiliary equipment/items.
b) All functional tests shall be performed by the "Contractor" under supervision of "Owner representative", utilizing "Contractor's" own specialized manpower that shall, in turn, operate in close collaboration with the field Supervisors.
c) The functional tests shall simulate process variables, using connections to the transmitter terminal (or primary element such as pressure switch, level switch, etc.).
d) The correct action of the TFMS/PLC, MOV's control valve and corresponding actions of other systems connected to it, shall be verified for each loop.
e) The functional test for the Control Loops shall also include a functional test of all equipment connected to the PLC (e.g. alarms, interlocks, mV/mA converters, monitor switches, MCC, electrical panels, MOV, on Off Valves, Dumper etc.).
f) For the implementation of the said functional tests, the "Contractor" shall provide qualified personnel (electricians, instrument specialists), capable, of working beside the "Contractor" specialist for the various equipment items and of carrying out any directives given by the latter.
g) The "Contractor" shall depute personnel (electricians and instrument specialists) with previous experience in the erection and start-up of similar type of PLC systems.
h) In the case of defects in Field/Control Room connections, the "Contractor", with the co-operation of the field Supervisors, shall perform troubleshooting and take the necessary corrective action.

15.2 Loop Testing

a) The procedure to be adopted for loop tests is indicated in detail below. A definition of the meaning of the "Loop Test" will first be given: the term "Loop" shall be considered in widest sense, as a single system including all associated instrumentation. During the Loop Test, the calibration of field and control room instruments shall be tested.
b) Loop Testing is usually an operation involving at least Two "Contractor" specialists per Loop, of which: one in the field (at the instrument or pertinent J.B.), one at the PLC work station.
c) For particularly complex Loops, the said arrangement of personnel may be increased by 1 of 2 persons in the Control Room and 1 in MCC Room.

d) "Contractor" shall provide their own personnel with suitable radio communication systems, previously approved by "Owner Representative". On completion of the test, all parties involved shall sign the test certificate: "Contractor", and "Owner or Owner Representatives".

15.3 Loop Test Procedure

Activities Not Limited to the following are included in "Contractor's" scope of work:

a) Visual inspection of the loop including but not limited to flow direction.
b) Feed for the various components (240VAC//24VDC, nitrogen, or instrument air), according to the specifications for each instrument.
c) Checking the polarity of extension cables for RTD, analogue and DC signals.
d) Simulating the process variable directly in the process connection on primary field sensors, signal values are checked from 0% to 100% and vice versa of the scale as per field quality control forms. In Control rooms, MCC and in field, simultaneous response of said signals will be checked (in accordance with reference documents) on all loop components, including control and on/off valves, operator stations, PLC's, local panels and other auxiliary equipment. This shall apply to all kind of loops and signals (monitoring, controls, alarms, status, commands, interlocks, etc.)
e) Thermo- resistance elements shall be removed from pockets and checked for physical integrity.
f) Elements shall be reconnected checking their proper polarity.
g) Set values shall be checked for trips and associated alarms.
h) Control and on/off valves action and controller action shall also be checked.
i) Fail-safe and Burn-out actions shall also be checked, where applicable.

15.4 Check List for Completeness

The following activities shall be included in the scope of work of the "Contractor" and they shall be executed within the contractual terms:

a) Conduct any non-operating checks to ensure instrument operability, i.e. remove all shipping stops; check pointer travels; and verify instrument capability to measure, operate, and stroke in the direction and manner required by the process application.
b) As dictated by "Owner Representative" practice, and manufacturer's instructions, bench or field calibrate instruments with standard test equipment and make all required adjustments and control point settings.
c) Clean all transmission and control tubing by blowing with cooled and filtered clean air before connecting to instrument components.
d) Clean all air supply headers by blowing with clean air and check them for tightness.
e) Install and connect all system components and verify their conformance to specifications and design criteria for function and range using dummy transmission signals, as needed.
f) Check all electrical signals and alarm wiring for continuity, correct source of power, and polarity.
g) Check thermocouples / RTD for proper joining of wires, position of elements in wells, proper polarity, and continuity of receiving instruments.
h) Identify orifice plates by tagging.
i) Install any sealing fluids, as required.
j) During loop checks fully pressurize and energize the transmitting of control signal system(s) by opening instrument process connections at primary sensors and final regulators and by making control mode setting for automatic operation of equipment.
k) Provide a schedule of recorder charts (if applicable).
l) Operate equipment and make vibration, trip, governor and safety device checks and operating test and adjustment, as required.
m) Supply all necessary equipment and devices to perform required test and pressure test on instruments and on instrument take-off piping and tubing. Perform, any other test, required on instrument installation, by project specification and or applicable codes.

n) Remove all in line components (e.g. control and on/off valves, flow transmitters, etc.) before piping testing and/or flushing and reinstall after completion of this operation.
o) Schedule safety valve testing with “Owner representative” agreement.
p) Provide test facilities for safety valves and carry out first and final setting and tagging.
q) Witness tests of instrument tagging.
r) Paint and/or tag all safety valves and safety equipment in color designated by “Owner representative” Safety valves shall be calibrated and tested during:
i. Mechanical completion.
ii. Pre commissioning.
iii. Start-up.
s) Provide “Owner Representative” with a record chart of all test and work completed

15.4.1 Operations at “Contractor’s” Obligation

Besides the duties as per the paragraph "Contractor Duties", the following shall also be included in the unit prices for the single items:

a) Manpower, consumables, personal tools, light lifting equipment (hoists, jacks, etc.), clothing including safety tackle, test equipment and instruments.
b) Equipment, operators, drivers, fuel, lubricants, maintenance, spare parts, electric panels and cables for welders (motor welding sets, including costs of installation and operation), grinders, drills, etc. The rates shall be applied to the effective number of hours worked for both personnel and equipment, without taking into account time required for preparation, handling, transfer and transport from and to site.
c) Both normal working hours and overtime are as defined by local laws and union rules and/or as conventionally established by Contract.

15.5 Basis of Payment - Price List

Instrument installation will be paid according to the unit prices listed in the document “BOQ for Instrument Installation”. Part Payment will be released after installation of the item.

Each unit price listed in the document “BOQ for Instrument Installation” includes each and all the activities and materials of whatsoever nature described in the corresponding article of the “Description of BOQ list items” as modified and/or clarified, as well as all the applicable duties, liabilities, obligations etc., also if not specifically mentioned in the unit price description but which are required to complete the corresponding Contractor scope of work.

16 Technical Documentation

16.1 Documentation Supplied Along with Tender Document

The documentation supplied along with tender by “Owner / Owner Representative” will be mainly:

a) Instrument Data Sheets / Specification.
b) Technical specification for Instrument installation.
c) Bulk Material Take-off.
d) System Architecture.
e) Control Room layout
f) Input / Output list
g) Earthing pit.

16.2 Documentation Supplied by “Owner”

Documentation supply by “Owner” to successful “Contractor” will be mainly:

a) Instrument List.
b) Instrument Hook-up Drawings (mechanical, pneumatic, electrical/support).
c) Control Room Layouts.
d) Instrument Main Cable Routing layout and Sections.
e) Junction Boxes Drawings.
f) Instrument layouts.
g) P&ID’s.
h) Typical installation drawing.
i) Jn. Box number or page of the applicable J.B. where the instrument is connected.
j) Loop Schematic diagram.

16.2.1 Instrument Main Cable Routing and Section

This main cable routing shows approximate position of:

a) Field junction boxes.
b) Local panels.
c) Field equipment (for equipment directly connected to the control room without use of intermediate junction box).
d) Main cable way, with elevation, size and sections.

16.3 Instrument List (Excel)

This document is a list of instruments (shown on P&ID’s) including all pertaining components.

The instrument list will indicate, for each instrument, the following basic information:

a) Tag number.
b) Fluid.
c) Description.
d) Location.
e) P&ID’s number.
f) Instrument data sheet no.
g) Instrument installation no.

16.3.1 Cable List (Field and Control Room)

The associated cable schedule will report the following information:

a) Cable identification number.
b) Junction box or field equipment terminating point.
c) Types of cables.
d) Cable length (Approximately)

16.4 Documents Supplied and Training Provided by "Contractor"

The supply of the following documents shall be considered integral part of the scope of work of "Contractor":

a) Cable routing sections in field, other than main cable routing, and inside the control room.
b) Control rooms / MCC room metal base frames and auxiliary supports.
c) Cable trays routing starting from main cable tray up to the junction boxes or other users and, from, these to the single instruments.
d) Erection procedures.
e) Material certificates and other documentation for material supplied by "Contractor".
f) Field sketches if requested by "Owner representative".
g) Marked-up "As Built" of all "Owner Representative" / "Contractor's" drawings and documentation showing all the modifications carried out during the erection.
h) Marked-up copies will be handed over to "Owner / Owner representative" for approval / comments within 10 days after mechanical completion of each system.

16.5 Safety

a) "Contractor "to strictly follow the safety work procedures and safety regulations of "Owner / Owner Representative" and as mentioned elsewhere in the bid document.
b) Entire "Contractor"work force team shall be well aware of job safety requirements and they must have under gone the safety training and refresher training periodically.
c) "Contractor "shall provide complete range of PPE to his workforce team and all PPEs shall be as per International Code of Practice.
d) The "Contractor" shall be responsible for all arrangements with respect to work men's compensation insurance and any other local regulations covering the labour employed.
e) The "Contractor" shall also make available all sort of medical aid , first aid facilities and all personal protective equipment for his workers at site.
f) Particular attention is drawn to the following:
i. In case of accident, the "Owner / Owner Representative" shall be informed in writing forthwith. The "Contractor" shall strictly follow regulations laid down by Factory Inspector, Government and Local Authorities in this regard. The "Contractor" shall report immediately in triplicate to the "Owner / Owner Representative" any accident at site. Each such report shall include the information as required by the regulations.
ii. Compliance with statutory requirements for inspection and testing of all lifting appliance such as cranes, gantries, etc. and auxiliary lifting gear.

16.6 Quality Assurance

a) The "Contractor "shall maintain an effective quality system. A concise description of the vendors system and its proposed application to the scope of work, including references where applicable to a quality manual or similar authorised company document, is required with the quotation.
b) A List of documents, in dossier form, shall be retained as evidence or proof that the product or service supplied complies with specific requirements.
c) A quality plan, indicating the verification activities that will be applied in order to achieve the required quality will be required to be submitted for approval

16.7 Functional Design Specification (FDS)

a) The “Contractor” shall prepare (after PO/LOI receipt) a FDS for approval. The FDS shall be submitted for review as one complete document. The FDS shall be revised by the “Contractor” in accordance with the “Owner Representative” comments and submit for approval.

b) The “Contractor” shall discuss the requirements with the “Owner / Owner Representative” and obtain all information necessary to perform the Work.

c) The approved FDS shall act as a working document for the detailed engineering and implementation of the “Modernization of DAFFPL’s Fuel Farm at IGI Airport, New Delhi” Automation.

d) The FDS shall contain the following information as a minimum:

i. The system objectives.
ii. Each party’s responsibilities.
iii. Services offered.
iv. Specifications and equipment quantities for all deliverables including systems.
v. Equipment items, giving type, manufacturer, model etc.
vi. The documentation to be delivered.
vii. All spare parts, tools, test equipment and installation materials.

e) Overall system specification including:

i. Dimension, weight, power consumption, heat dissipation, position requirements for all equipment units and the complete system.
ii. System schematics and equipment layout drawings
iii. Analysis of spare capacities and the ability to meet the performance criteria e.g. response times, availability etc.
iv. Analysis of system and communications network load.

f) Drawings including:

i. Network cabling, system cabling and hook-up drawings.
ii. Electrical single line and earthing diagrams.

g) Interface Specifications including:

i. Systems I/O interface specifications.
ii. Communications network specifications and definition of transmitted data.
iii. Communications RS-232/485 for third party devices.

h) For all software to be developed, including application programs:

i. A block diagram of software structure and program schedule.
ii. A software specification including flow charts, detailed descriptions, memory and timing requirements.

i) Guidelines for configuration in line with and consultation with the Owner/Consultant documenting philosophies developed in.

j) Following guidelines are to be used by the “Contractor” during the implementation phase of the project.

i. A guideline for configuration of the “Modernization of DAFFPL’s Fuel Farm” operator interface including operational procedures, commands, display presentations, hard copy print-outs and reports.
ii. A guideline for configuration of all data base requirements.

k) Definition of FAT, SAT and Final acceptance test

16.8 System Manuals

16.8.1 Operator's Handbook

This shall describe (in a step-by-step manner) all hardware, software, keyboard functions, display presentation and printer output available to and required by the operator to achieve day-to-day operation and to restart in the event of a system failure. This shall also detail the configuration of the operator interface facilities including all displays, reports, calculations, trends, alarm/event handling etc. It shall include description of the hierarchy, reference codes, memory utilization and capacity.

16.8.2 Operator's Ready – Reference Guide

This shall contain a summary of the keyboard functions and associated keying sequences, acting as an aide-memoir. The format and content shall facilitate ease of use and be printed on a material resistant to water and tearing.

16.8.3 Engineer's Handbook

This shall describe the hardware, software, keyboard functions, display presentation, printer outputs, equipment procedures available to the maintenance engineer. These shall include all configurations, off-line and on-line programming facilities.

16.8.4 Equipment Handbook

This shall describe in detail specifications of all hardware units which comprise the "Modernization of DAFFPL's Fuel Farm at IGI Airport, New Delhi". All layout drawings, printed circuit card descriptions, theory of operation, logic drawings and hook-up details shall be included together with description of the total equipment operation, input/output facilities. A bill of material listing all hardware supplied along with manufacturer part number, name plate data, overall dimensions shall be provided.

16.8.5 Maintenance and Testing Handbook

This shall describe the maintenance schedule, preventive maintenance, test procedures and corrective maintenance procedure including failure analysis. This handbook shall also include descriptions for the use of all diagnostics and test equipment supplied, together with detailed lists of spare parts as supplied. The maintenance handbook shall cover all the items supplied as a part of this contract including printers.

The procedures for returning of faulty equipment to the "Contractor", both during and beyond warranty, shall be documented; together with a description of the modification/upgrade procedures used for the supplied equipment. An appendix to this Handbook shall list all equipment items supplied, to printed circuit card level, and shall detail the original equipment suppliers, type numbers, modifications, quantities and serial numbers.

16.8.6 Software Handbook

This should detail the software provided within the various units comprising the "Modernization of DAFFPL's Fuel Farm at IGI Airport, New Delhi". It shall include operational descriptions/functions of the individual programs and the overall system. A comprehensive program schedule together with individual descriptions and flow charts for all application programs with complete source listings shall be provided. The Handbook shall consists of configuration, graphics builder information, system initialization guide etc.

16.8.7 Database Handbook

This shall detail the complete database provided within the “Modernization of DAFFPL’s Fuel Farm at IGI Airport, New Delhi”. It shall include descriptions of the database structure, referencing codes, third party interface mapping, capacity, utilization and storage. Detailed lists describing the complete database contents as supplied shall also be attached.

16.9 Installation Manuals

The “Contractor” shall provide a manual for the installation of each item of equipment and cabling etc. which is to be installed on site. The document shall incorporate all necessary instructions, precautions and checks for satisfactory installation. Drawings necessary for the installation of the equipment e.g. layout, fixing arrangement, termination details, etc. shall be included.

16.10 Training To Owner’s Personnel

The “Contractor” will provide training to **DAFFPL** personnel: one group consisting of operators, and other group consisting of hardware/software maintenance engineers. The “Contractor’s” obligations will be Not Limited to the following:

a) “Contractor” shall be responsible for furnishing details of course outlines, manuals of training, equipment necessary to conduct the training, exercises to evaluate trainees’ progress. “Contractor” shall also be responsible for any other requirements necessary to train the engineers deputed by owner within a time limit so that they acquire the necessary expertise to operate and maintain the programs and the equipment supplied.

b) Each instructor-designate shall have the following minimum qualifications for his area of instructions
   i. Six months of formal class-room instructor experience.
   ii. Complete and thorough technical knowledge of the equipment and system supplied under the contract and skilled experience in their programming, maintenance and operation.
   iii. Complete and thorough knowledge of the test and laboratory equipment and software, hand book and guides and their actual use as aids and tools in maintaining, diagnosing, programming, operating and trouble-shooting the hardware software system.

c) In order that the selected trainees shall have time to participate in the course, sufficient advance notice of minimum 8 weeks shall be given by the “Contractor”. The course outlines shall be submitted 10 weeks ahead for review. The training exercise shall be designed to be objective in nature and shall include trouble shooting exercises on similar equipment.

d) The engineer training shall cover as a minimum following topics:
   i. General system familiarisation including design.
   ii. System operation.
   iii. System/peripheral maintenance.
   iv. Subsystem operation and maintenance.
   v. Measuring techniques and maintenance procedures.
   vi. Diagnostics/Troubleshooting.
   vii. Preventive maintenance requirements.
   viii. Debugging/writing application and system software.

e) “Contractor” shall consider training during warranty period. It shall be similar to training to be conducted during handing over of the system. Minimum two trainings shall be held every year. Each training module shall be of 2 days.

f) “Modernization of DAFFPL’s Fuel Farm at IGI Airport, New Delhi”, “Contractor” shall demonstrate & assist DAFFPL for training to all crew for its operation & to guide for the safe, effective & smooth operation of loading. Frequency of training shall be same as above during stabilization & warranty period.

16.11 Contractor's Field Organisation and Equipment

The "Contractor" will ensure to provide Not Limited to the following facilities at site of work:

a) **Contractor's Project-in-Charge**: The "Contractor" shall constantly keep on his work during its progress one or more qualified (minimum 15 years of experience in similar capacity for similar projects) and competent Contractor's Project-in-Charge, who will be responsible for carrying out of the works to the true meaning of the Drawings, Specifications and Schedule of Quantities, Consultant's instructions and directions to the satisfaction of the Consultant and the Owner. Any directions or instructions given to the Contractor's Project-in-Charge by the "Owner / Owner Representative" shall be deemed to have been issued to the Contractor. Such Contractor's Project-in-Charge shall be available at site till successful completion of the project.
Such Contractor's Project-in-Charge shall also keep the Consultant/Contractor informed about their absence from site for any reason. Attention is called to the importance of requesting instructions from the Consultant before undertaking any work where "Owner / Owner Representative" directions or instructions are required. Any such work done in advance of such instructions will be liable to be removed at the "Contractor's" cost and expense.

b) **Equipment:** The "Contractor" shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, plants, all transport for labour materials and plant necessary for the proper carrying on execution & completion of the work to the satisfaction of the "Owner / Owner Representative".

c) **Site Office:** The "Contractor" shall provide erect and maintain where directed, simple watertight separate offices for the "Owner Representative". This office shall be well lighted and ventilated and provided with windows, doors with a lock, office furniture and a telephone. Each office shall be a minimum of 250 Sq. ft. (23.22 sq. meter) and shall have a desk, chair and drawers for keeping drawings and tack board for displaying drawings. The office is to be demolished/ removed when directed by the "Owner / Owner Representative".

d) **Watchman:** The "Contractor" shall make his own security arrangements to guard the Site and premises at all times, at his own expense. The security arrangements shall be adequate to maintain strict control on the movement of material and labour. The "Contractor" shall extend the security arrangements to guard the material stored and/or fixed on the premises by the Contractors.

e) **Storage of Materials**: The "Contractor" shall provide, erect and maintain proper sheds for the storage and production of the materials etc., and also for the execution of work which may be prepared on the Site.

f) **Sanitary Conveniences:** The "Contractor" shall provide and erect all necessary sanitary convenience for the Site-staff and the workmen maintain in a clean orderly condition and clean and de-odorize the ground after removal.

g) **Telephone:** The "Contractor" shall pay all charges in connection with the telephone provided at site office during the execution of the contract.

h) **Water & Electricity** - Water & Electricity to be provided by Owner at one point on chargeable basis and further distribution shall be arranged by the Contractor at his costs,

i) **Scaffolding, staging, Guardrails**: The "Contractor" shall provide scaffolding, staging, guardrails, temporary stairs which shall be required during construction. The support for the scaffolding, staging, guard rails and temporary stairs shall be strong and adequate for the particular situation. Temporary access to the various parts of the Building under construction shall be rigid and strong enough to avoid any chance of mishaps. The arrangement proposed shall be subject to the approval of the "Owner / Owner Representative".

16.12 Preservation and Storage

16.12.1 General

These instructions, Not Limited to the following, are applicable for complete project cycle from engineering, design, test, supply, installation, commissioning and giving satisfactory acceptance test. Hence all the equipment and materials covered in this tender, shall be carefully preserved, stored and handled by the "Contractor" at his works, during transportation as well as at "Owner / Owner Representative" site till the successful completion of project.

a) At site, "Contractor" shall arrange by themselves, the facility for proper storage of all equipment and material supplied as part of the system. Manual and mechanised handling shall be also carried out by "Contractor".

b) The equipment shall only be packed for shipment, once major deficiencies, if any, have been corrected. "Contractor" shall be solely responsible for the adequacy of the preparation for shipment provisions with respect to materials and application, and to provide equipment at the destination in ex-works condition when handled by commercial carriers.

c) Separate, loose, and spare parts shall be completely boxed. Pieces of equipment and spare parts shall be identified by item number and service, marked with "Contractor's" order number, tag number, and weight, both inside and outside of each individual package or container. A bill of material shall be enclosed in each package or container of parts.

d) One complete set of installation, operation, and maintenance instructions shall be packed in the boxes or crates with equipment. Packing list with all details shall be pasted on each crate or box.

16.12.2 Site Management

For efficient management, the "Contractor" shall deploy at site Not Limited to the following:

a) The "Contractor" shall keep on site during all working hours a responsible person, thoroughly familiar with the class and nature of the work to be performed as per tender. This responsible person will be deemed to have full authority to receive and to pass onto the "Contractor's" other employees all instructions relating to the work under the terms of the contract.

b) The "Contractor" shall arrange skilled, semi-skilled and unskilled labour, Supervisory staff, Engineer, Stores personnel and other safety, security and clerical staff required to complete all the work as specified in this tender. All technical personnel assigned to the site by the "Contractor" shall be fully conversant with the supplied system and software package. Their qualification and experience detail shall be submitted along with offer and for approval by "Owner" after award of tender.

c) Any instructions given by the ("Owner / Owner Representative") to the responsible person shall be deemed to have been given to the "Contractor".

d) The "Contractor" shall carry out the work in accordance with the standards listed herein and in accordance with any local statutory regulations.

e) All tools and tackles including welding sets, gas cutting sets, ladders, scaffolding etc. in required quantities for carrying out the work uninterrupted shall be provided by the "Contractor", to meet the target completion date. Also consumables as necessary and listed below but Not Limited to, shall be provided by "Contractor":

a) All industrial gases like oxygen, acetylene or inert gases, compressed air and all types of electrodes, brazing rods, flux etc. for welding purposes, with necessary facilities for testing welded joints.

b) Teflon tape and other pipe jointing compounds for threads and material for sealing of cable entries to control room, local panels, insulation tapes, sealing compounds for explosion proof conduit fittings.

c) Structural steel, MS plates, GI plates, Flats, pipe etc required for fabrication of supports (instruments, tray etc.)
d) Bolts and nuts for supports, U-bolts with nuts, clamps for SS tubes, expansion bolts (pinch anchor / Rawl bolts) for various sizes for fixing to concrete structures.
e) Paints, primers and solvents.
f) All accessories for electrical wiring like cable lugs, ferrules for identification, cable ties, aluminium clamps with nuts and bolts etc.
g) Spool pieces and blinds for testing, wherever required.
h) All materials for civil works like grouting etc. required for Automation system.
f) The “Contractor” shall also include and provide at his cost, for vehicles including automobiles for personnel transportation, pick-up trucks, cranes, welding machines, ropes, winches, ‘D’ shackles etc. at his own cost. Security of “Contractor’s” equipment and materials is his own responsibility.
g) It shall be entirely “Contractor’s” responsibility to also provide all types of erection aids, machines, testing/ checking equipment, cranes, scaffoldings, etc. necessary to perform the work in, safe and efficient manner and complete the job as per time schedule indicated. “Contractor” shall submit appropriate test and calibration certificates for the above as required by “Owner Representative”
h) All work must be done to the satisfaction of the “Owner / Owner Representative” who should be consulted on any point requiring clarifications. The “Contractor” is free to suggest to the "Engineer In-charge" alternative methods for execution of the work where this would result in improvement.
i) “Contractor” shall not allow rubbish & scrap materials from his operations to lay at site. Rubbish & scrap shall be collected daily & be deposited at a place approved by "Engineer In-charge".
j) Upon completion of the work, the “Contractor” shall promptly remove his equipment and return to the relevant place and any unused free issue materials supplied by the "Owner".
k) The “Contractor” shall submit before commencement of the actual work, a comprehensive list of tools, tackles, and test equipment which will be employed by him for carrying out the installation.
l) In the event of the “Contractor” is unable to maintain the target completion dates, he shall increase the strength of any of the above category of personnel, tools, tackles and equipment as advised by “Owner / Owner Representative” When asked by “Owner / Owner Representative”, “Contractor” shall work in shifts or round the clock at no extra cost. For such increase of manpower and resources the “Contractor” shall not claim any additional charges.
m) The “Contractor” to submit the man power loading per month along offer. Manpower deployment details to “Owner Representative” on daily and summary on weekly basis.

16.12.3 Post Warranty Maintenance Contract (Annual Maintenance Contract)

“Contractor” shall quote separately for Post Warranty Maintenance Contract / Annual Maintenance Contract (AMC) after warranty period for **FIVE** years based on lump sum amount including the supply of spares, consumable and services required for total operation and maintenance of the system. A resident engineer shall be continuously posted and available at the site to handle the predictive maintenance, preventive maintenance, system health check, any non-performance, calibration etc. The personnel deployed shall have thorough knowledge of the system and at least two years of experience on the maintenance of similar system.

a) The AMC shall include software upgrades to the Terminal Automation System.
b) Periodic (quarterly) training should also to be included as a part of AMC.
c) The lump sum price of the Post Warranty Maintenance contract shall be furnished as per scope of quantity (SOQ) line items. AMC scope shall include all future expansions and future upgrades.
d) The annual calibration of instruments for five years is in the scope of “Contractor”. The master instruments required for calibration shall be arranged by the “Contractor” at their cost.
e) “Contractor” shall undertake pest control of entire Administration building (which includes the control room) in the AMC period.
f) During AMC period, supply of all possible spares for replacement of faulty parts and consumables like oil, grease for maintenance of equipment are included in “Contractor’s” scope.

16.13 Method of Measurement

Item shall be measured as running meter. The unit rate shall be inclusive of rates for supply, transport, delivery, installation and guarantee of the item.

16.14 Basis of Payment

Payment shall be done as per successful delivery and installation as per approved drawing at site. The supply and installation of item shall fulfil all the requirement / methods specified above in the specification document/standards.

16.15 Item Rate Contract

The “Contractor” shall quote for “Item Rate Contract” with due consideration to Not Limited to following aspects:

a) The “Contractor”shall quote his Price on Item Rate Basis inclusive of all the cost of material (as per specifications), labour, tools, tackles, equipment, lifts, leads, loads required in connection with the completion of the Works.

b) Quoted prices shall be inclusive of packing, freight, insurance and all duties and taxes payable at any stage of work and applicable as per State Government or other entitled Statutory Authority.

c) The quantities set out in the Schedule of Quantities are estimated quantities of the work and based on preliminary design and are meant primarily to form a common basis for Tender analysis. They are not to be taken as per the actual /final quantities of the work to be executed by the contractor in fulfillment of his obligation under the Contract. Actual quantities may vary significantly from the quantities given in the Schedule of Quantities and no extra claim from the “Contractor”shall be entertained on this account.

d) The “Contractor” shall be responsible to complete the work in all respects and provide/supply all facilities which may not be covered in the Tender Documents but are nevertheless required to complete the Works, with the only exception of such items as they have been specifically excluded from the Contractor’s scope.

16.16 Price Escalation Clause

While quoting the rates for individual items in the Schedule of Rates, the “Contractor” is deemed to have taken into account the possibility of rise in price of labour or materials due to commercial exigencies. Irrespective of any rise or fall in the price of any labour or materials, the rate for each item shall remain the same (firm) till completion of work and its Final Acceptance by the Owner. The “Owner / Owner Representative” shall not be required to pay any additional amounts due to fluctuation in prices. It is clearly understood by the tenderer that there is No Price Escalation Clause Applicable in this Contract Priced.

16.17 General Notes to Contractor

Contractor to specify:

a) Though the specification sheets indicate materials for various parts, it shall be the “Contractor’s” responsibility to select and recommend the correct materials for these parts to ensure compatibility with the process conditions specified.

b) “Contractor’s” quote shall include a detailed specification sheet for each item, furnishing as a minimum the details as meted out in “Owner” data sheets.

c) The bid shall be duly supported by product / technical catalogues, brochures, etc. Contractor to ensure that all units referred to in his quote shall be to the same standards as those in “Owner’s” data sheets.

d) "Contractor" to note that double compression type weather proof cable glands of nickel plated brass are included in his scope.
e) Contractor shall quote for spares for commissioning and initial one year trouble free operation.
f) Contractor shall indicate the make and the model no. of all bought-out items along with catalogues and literature in his offer.

16.18 Deviation Table

Any deviation to the tender document shall be submitted by the "Contractor" along with the offer, duly justifying the reasons for deviation. "Owner / Owner Representative" may accept or reject the deviation and inform all the vendors accordingly. Deviation shall be submitted in the format below.

SN.	Page No.	Clause No	Query	Reply

17 Environment, Health and Safety Protection

17.1 Introduction

We consider Environment, Health and Safety Protection (EHS) as an integral part of “Owner / Owner Representative” business. We are committed to protect environment, in which we operate and to ensure the health and safety of all our employees, contractors, visitors and community.

In addition to relevant statutory requirements, “Owner Representative” has adopted these safety guidelines for contractors and their workmen in order to maintain the desired standard of safety at work. The guideline given in this booklet forms an important part of the contract. It is the responsibility of the “Contractor” to ensure that the workmen of contractors and any subcontractors are fully informed of the guidelines and that they follow it in their work.

In addition to the guidelines listed herein, “Owner” from relevant departments may give special instructions to contractors, if the circumstances so demand. These special instructions also form the part of the contract.

It is to be understood that the purpose of these guidelines is not to sum up what is safe or not safe. It only contains a number of important general safety procedures and instructions, which are applicable to all “Contractor”. In case the contractor considers that for some reason, the working method has become unsafe; he should immediately discontinue the work and inform the concerned person to get further instructions.

17.2 General Safety Rules

General Safety Rules Not Limited to the following shall be strictly adhered at site of work:

a) The personnel employed by the “Contractor” have to adhere to the Rules & Regulations of the Factory Act and must maintain discipline at all times.
b) Smoking within the factory premises other than the designated areas is strictly prohibited.
c) The contractor’s employees must not report to work in an intoxicated condition.
d) “Contractor's” employees must not work under the influence of medicine or drugs or in a noticeably fatigued state.
e) “Contractor's” employees must not commit criminal activities such as theft on the project premises or against the “Owner / Owner representative” employees or representatives.
f) “Contractor's” employees may not use devices such as cameras and video recorders inside the project premises.
g) “Contractor's” employees must not bring unauthorized persons or animals inside the project premises.
h) Employees of the “Contractor” should eat food only at designated places.
i) “Contractor” shall engage experienced supervisor/s to oversee the safety of the job and the workers. One such person shall be designated as Safety Coordinator and his name is to be communicated to “Owner / Owner Representative”. Safety coordinator should be present at the work site throughout the work. In his absence he is expected to nominate other person and inform “Owner / Owner Representative” at site accordingly.
j) The “Contractor” must report to “Owner / Owner Representative” daily before starting work, in order to (a) Establish the scope of the day’s work (b) To obtain the necessary work permits.
k) Any work, beyond normal working hours, needs prior permission from the “Owner / Owner Representative”. Extension for working hours shall be planned well in advance. Granting of such extension in working hours will be at the discretion of the “Owner / Owner Representative” and may be refused if in their opinion, it is not safe to work beyond the normal working hours.

l) **Always walk;** never run at work site unless specifically instructed during emergency situation. Use regular aisles & gangways. Do not take shortcuts. Do not enter in an area other than your own workplace without getting permission.

17.3 Statutory Requirements:

a) Do not panic in case of an emergency. Follow the instructions of the responsible person for handling emergency. The responsible person during emergency is either Site Controller or the concerned team leader.
b) Do not indulge in horseplay. Throwing of objects or making loud and unusual noises may distract attention of others from work and can cause an accident.
c) Never use compressed air for cleaning your clothes or body. This may harm others.
d) Never tamper with machinery, guards, safety devices or interlocks.
e) Pressure/vacuum gauges, temperature indicators & other measuring devices should be installed as per requirements of “Owner Representative”. Calibration certificates should be produced on demand.
f) Maintain good housekeeping at the site.
g) Report unsafe conditions or unsafe acts to the “Owner / Owner Representative”.
h) The “Contractor's” employees must not bring weapons of any kind inside the project premises.
i) Respect 'ENGINE STOP' signs during gas or fire alarms.

17.4 Applicable Statutory Rules & Act

The “Contractor's” is responsible for complying with all the Statutory Safety Requirements prescribed under the relevant **Acts and Rules**. Without prejudice to the generality of what has been stated above, the contractor is expected to comply with the statutory requirements of various acts Not Limited to such as:

a) Factories Act and Rules.
b) Gas Cylinder Rules.
c) Petroleum Act and Rules.
d) Local Electricity Act.
e) Local Boilers Act.
f) Local Explosives Act.
g) Oil Industry Safety Directorate Guidelines (OISD).
h) Rules of Labour Department.
i) Rules of ESIS.
j) Rules of Provident Fund Department.

17.4.1 Personal Protective Equipment (PPE)

It is the sole responsibility of the “Contractor's” to provide the necessary Personal Protective Equipment (PPE) to his work force. Use of following PPE is considered as an essential requirement.

a) Yellow helmets with chin strap and high visibility vest for all workforces.
b) Safety shoes.
c) Safety belts for working at heights equal or more than 3m from ground level.
d) Safety goggles & gloves for gas cutting / grinding activities.
e) Safety goggles for chipping activity.
f) Face shields & leather glove for welding activity.
g) Electrical gloves for electricians who work in HT zone.
h) It is the responsibility of the Contractor to stock adequate numbers of these PPE’s at site and provides these to his work force.

17.4.2 Inspection of Tools and Tackles

All the tools and tackles should be approved by local authority. Necessary test certificates from competent authorities for tools like chain pulley block, cranes, etc. shall be available at site for inspection. Entry of tools and tackles will be allowed only after inspection of the same by the Plant Engineering Department. No defective tool/tackles are allowed inside.

17.4.3 Safety in Work Area & House Keeping

a) The "Contractor" is allowed to work only in the specific area. Access to any other part of the project is prohibited.
b) The "Contractor" shall keep the work area clean & neat. All scraps and surplus material are cleared from the work place promptly as directed by "Owner / Owner Representative
c) "Contractor" should keep the work area clean after completion of the job. Do not leave any rusted particles, spanners, nuts & bolts etc. at the work place. Place them at the relevant locations.
d) Vehicle movement should be defined in proper manner. SOP to follow for the same.
e) First aid Box to be placed at proper locations with adequate medicines.

17.4.4 Safety in the Use of Equipment & Machinery

The "Contractor" shall organize his operations in a workman like manner and take all necessary precautions to provide safety and prevent accidents in the site to both person and property. The "Owner / Owner Representative" shall have the power to request the contractor to adopt from time to time such measures as he may consider necessary to ensure the above requirement. In particular the contractor shall ensure compliance with the standard safety codes.

17.4.4.1 Ladders

a) Inspect ladders for any damage before use.
b) Use ladders with all members in good conditions. No broken rungs or split side rails.
c) It is important to note that ladder must extend at least 900 mm (3ft) above level of the working platform. This will ensure safe access to platform.
d) Tie the ladder securely at the top. If this is not possible then secure the ladder by the side at the highest point. If you want to support the ladder to a pipeline, get approval from the "Owner / Owner Representative"
e) Never use drums etc. to access heights.
f) Keep a watch on overhead cables and other objects while moving with ladders.
g) Proper Earthing to be given for stationary & movable machineries.

17.4.4.2 Scaffolds

a) A scaffold should be strong enough to bear load of the worker and materials. Normally, scaffolds are erected in such a way that they can withstand at least four times the anticipated working load.
b) Inspect the scaffolding thoroughly before allowing the worker on it.
c) Provide a safe and convenient means to gain access to the working platform.
d) Keep the platform free from any unnecessary obstruction, rubbish and projected nails.
e) Provide toe boards of at least 150 mm and guardrails at 450 mm & 900 mm on all working platforms.
f) Never use platforms less than 30 mm thick.

17.4.4.3 Lifting Tackles

a) The lifting machines, chain pulley blocks etc. must be tested and valid test certificates should be submitted to the "Owner / Owner Representative"
b) Ensure that the chain pulley blocks with locking lever (safety catch) are used.

c) Check the wire rope for distortion, kinking, unevenness and general corrosion. Never use ropes, which are having these defects.
d) Proper crimping should be done for wire rope joints and ends. Use standard 'U' clamp for tying up the rope and object.
e) The safe working loads should be clearly marked on each of the above items. In no case, this rated capacity should be exceeded.
f) Barricade the area where lifting activity is taking place and provided a caution board. No person should stand within a barricaded area.
g) Never work or move below the suspended loads.

17.4.4.4 Welding

a) Use only welding equipment confirming to BS standards.
b) Welding machines shall be in good condition and are to be provided with local isolation switch for emergency isolation.
c) System should be such that electrical shock is prevented. Insulation of electrode holder and welding cables should be checked daily till the completion of work.
d) Earth cabling from welding object on which welding is being done should be properly connected to the welding machine, but not to nearest structure.
e) Barricade the required area and provide a caution board.
f) Ensure that area, in which welding sparks are likely to travel, is free from all possible flammable materials. Keep the cylinders away at safe place.
g) Provide face shield / leather hand gloves to the welder.
h) Make sure that the cables are so laid that sharp edges or heavy objects do not abuse them.
i) Grind all the burrs after the completion of welding / cutting jobs so as to make the corners round, smooth & safe. Ensure that no protruded pieces are left.
j) Welding holder to be kept on an insulated stand during idle time.

17.4.4.5 Gas Cutting Equipment

a) Use torches, rubber-tubing etc. confirming to IS standards.
b) Use cylinders (Oxygen, Acetylene, LPG) approved by the Explosives Department, submit copies of the test certificates to "Owner / Owner Representative".
c) Standard colour codes for the cylinders must be followed. (Oxygen: Black; Acetylene: Maroon; LPG: Red).
d) Cylinder in use to be mounted on trolley or tie the cylinder with chain to avoid toppling.
e) Provide goggles and hand gloves to cutters and helpers.
f) Make sure that the rubber tubing is so laid that sharp edges heavy objects and hot surfaces do not abuse it.
g) Gas cutting rubber tube ends should be fixed with the clamps.
h) Test the valves and joints in tube for leaks by using soap solution daily before the commencement of work. All leaks shall be rectified before lighting the torch.
i) Use proper hose connectors while repairing leaks. Avoid binding with wire or tape.
j) Keep nozzle of gas cutting torch clean and free from defects to avoid distortion of flame and backfiring. Provide flash back arrestor to avoid backfires.
k) Use proper lighter to lit up cutting torch. Do not use match box.
l) Fire Extinguisher to be kept at proper place at the time of welding or cutting.

17.4.4.6 Electrical Safety

a) Use portable grinders, drilling machines, etc. confirming to local standards. All tools should be properly insulated.
b) Never overload cables beyond the rated capacity. This is one of the common causes of fire.
c) Provide rubber gloves to electricians who work in HT zone. Ensure that gloves are tested as per IS 4770:1968 and the same are approved.

d) Before commencing repair or maintenance work on any machine, switch off main supply / remove fuse, display caution tags on machines, switchboards. Follow standard lock out and tag out procedure.
e) All equipment should have earthing arrangements.
f) Do not insert bare wires in sockets for energizing any equipment. Use only plug tops for all electrical equipment.
g) While laying cables, ensure that cables are so laid that they do not obstruct the smooth movement of men and machinery.
h) Make sure that all cables are protected against abuses and possible damage.
i) Use junction / extension boxes for long distances. Open connections are not permitted.
j) Approved flameproof fittings shall be used in flameproof areas.
k) Arrange for sufficient lighting, in case work extension is required beyond normal working hours. Obtain necessary approvals for the same.
l) Check for any underground cables before starting excavation jobs.
m) No loose cable allowed crossing the Road. If cable is required to cross the road it should hang at certain elevation. No joints allowed without proper connections.

17.4.4.7 Machine Guards

a) All the rotating machinery / parts should be protected with proper guards.
b) Necessary safety interlocks should be in place wherever required.
c) Hand grinding machines shall possess proper guard on grinding wheel.

17.4.4.8 Floor Opening

a) Ensure that the floor, slab, duct and equipment openings are properly covered with MS plates or gratings. Barricade the area suitably.
b) Avoid use of wooden planks for covering the openings. MS plates are preferred.
c) Take special precautions for AC ducts, which are smaller sizes and many a times adjacent to walls where the movement of people is more likely.

17.4.4.9 Gas Cylinders

a) Gas cylinders must have valid test certificates. Copy should be given to “Owner Representative”.
b) Standard colour code must be followed.
c) Use proper trolleys to transfer compressed gas cylinders. Do not roll the cylinders.
d) Cylinders shall be properly supported by chains / clamps.
e) All cylinders shall have valve caps.
f) Keep all gas cylinders away from the job in an upright position at a designated place.
g) Do not throw the cylinders from the truck on tires while unloading. Use cradles or unload cylinders on raised platforms.
h) Do not expose cylinders to heat or direct sunlight.
i) Proper labelling should be done to identify empty cylinders.
j) Cylinder valve wrench to be kept at a proper place.
k) Do not apply oil or grease on cylinder valves and fittings.
l) Use only industrial gas cylinders.

17.4.4.10 Movement of Equipment and Machinery

a) Before starting the activity, plan properly by examining the route, taking measurements, if needed, to ensure that sufficient clearances are available.
b) While planning the route, look for overhead cables, pipelines, guide ropes and other protruding objects.
c) Use properly rated trolley to move the equipment / machinery.
d) Ensure no damage to the walls, or other surrounding machinery during movement. Make clear to all the fellow contract men about communication system, to avoid misunderstanding.

e) If you are moving smaller items like pipelines etc. ensure that these items are properly secured and tied.
f) Proper sling arrangement to provide for crane in case of lifting equipment to an elevated height. No person is allowed to lift with equipment.

17.4.4.11 Work Permit System

Work permit must be obtained from “Owner representative” for the following works:

a) Hot work.
b) Excavation.
c) Electrical jobs.
d) Safety clearance must be obtained for work related to:
i. Opening of pipeline joints
ii. Erection, dismantling and movement of heavy equipment.
iii. Working on heights
e) Display of work permit at the place of work is mandatory.
f) Use of Safety Belts is mandatory while working on heights.

17.4.4.12 Emergency Situation, Accidents and First-Aid

a) Report of any incident including but Not Limited to accidents, spills, delays, shortages that could reasonably be expected to impair the safe and prompt delivery of work, requesting additional instructions from the “Owner / Owner Representative” regarding performance. Such notice by “Contractor” shall promptly be confirmed in writing, fully describing the circumstances.
b) “Contractor” will ensure all incidents and accidents are immediately reported to the “Owner / Owner Representative”
c) If any emitting, spilling, venting, discharging, or loss of any substances, air contaminants, or pollutants of any nature or kind into the environment ("Discharges") occurs as a result of or in connection with the performance of any work hereunder by Contractor, its agents, employees, subcontractors, or other persons for whom “Contractor” is responsible, “Contractor” shall immediately proceed, at its sole cost and expense, to stop or abate such Discharges, and (regardless of fault) shall immediately notify to “Owner / Owner Representative” and make any other notification of such occurrence to governing or regulatory bodies as may be required of Contractor by applicable law. “Contractor” shall, at its sole cost and expense, be responsible for all Discharge response actions and environmental remediation required as a result of any such Discharge, including management of any waste materials resulting from any Discharge response action and remediation.
d) If “Contractor’s” staff or labours suffer an injury, he shall inform the Contractor’s supervisor and seek first aid immediately, whatsoever minor the injury is.
e) In case of any emergency/accident in absence of any authorized person from Contractor, the “Owner / Owner Representative” shall be authorized to take all decisions related to relevant hospitalization or medical treatment whatsoever arising out of the situation at the “Contractor’s” expense account.

17.4.4.13 Penalty for Non-Compliance

It is expected that “Contractors” and their workmen will strictly follow the safety guidelines. If the “Owner / Owner representatives” notices any non-compliance then, we reserve the right to penalize the subcontractor in the form of a suitable compensation for the time our management have invested in correcting the situation arising out of the contractor not following the instructions and/or guidelines. We reserve the right to terminate the contract at any point of time if, in our opinion, deviations are repetitive and/or the contractor is responsible for creating unsafe situations.

17.4.4.14 Compliance Audit

"Contractor" shall allow "Owner" agents or independent contractors engaged by it for such purpose, during normal business hours and upon no less than 48 hours' notice, access to "Contractor's" facilities and records for the purpose of conducting audits from time to time to verify Contractor's compliance with applicable laws as required by "Owner / Owner Representative" standards or general industry standards.

17.4.4.15 Performance Report

"Contractor" agrees to provide to "Owner / Owner Representative", prior to the fifth (5th) business day of each month, a performance report for the preceding month on the basis of the agreed set of key performance indicators as may be agreed, and such other information as "Owner / Owner Representative" may request from time to time. In addition to this Contractor agrees to provide information on the "Owner / Owner Representative" performance compared to the "Contractor's" performance. This shall include, but is not limited to:

a) Owner Specific:
   i. Incidents/accidents meeting "Owner / Owner Representative" standards for reporting of EHS incidents;
   ii. Number of near misses / learning events; and
   iii. Reports on safe / unsafe acts.
b) General:
   i. Number of incidents/accidents with breakdown in cause and effects; and
   ii. Number of near misses / learning events.

17.4.4.16 Complaint Handling

"Contractor" will ensure that all complaints and/or alleged non-conformances are fully investigated and any proposed corrective and/or preventative measures, or an intermediate complaint status, shall be reported to "Owner / Owner Representative" within five (5) business days after receipt of the notification of complaint or non-conformance.

"Contractor" shall undertake corrective and/or preventative measures or substantive steps to do so as soon as is reasonably practicable but within 28 business days of receipt of complaint or non-conformance that will result in effective structural solutions to avoid reoccurrence.

17.4.4.17 Security Plan

"Contractor" will ensure it has security plans in place hereby meeting all legal requirements. "Contractor" agrees to share security plan or relevant parts of security plan if and when required by "Owner / Owner Representative" in order to support and improve overall security of operations.

17.4.4.18 Response to Media Enquiries

If an accident or other incident occurs on the factory premises, "Contractor" shall - and only when specifically asked for - only give out very brief details to the media, namely:

a) Date, Time and Place of incident.
b) If possible (and if appropriate), give out reassuring messages about the fact that the emergency services are in attendance dealing with the problem.
c) For any other questions or issues in relation to EHS, the "Contractor" should contact the "Owner / Owner Representative".

20 Specification for Terminal Server

Sr. No.	Parameters	Requirement
1	Type	24/ 8 Port – Dual LAN Redundanat
2	Make	As per approved vendor list
3	Peripheral/Device Connector	Peripheral Ports with RJ connector support
4	Dual LAN Redundancy & Dual Host Redundancy	Required
5	Data Format	Asynchronous Data Transfer
6	LAN Protocol	TCP/IP
7	LAN Connector	8 Pin Modular RJ 45 And DB9 Male
8	LAN interface Speed	100/1000 Mbps
9	Power Supply	230V AC+/- 10 %, 50Hz +/- 5% with dual power input
10	Operating Temperature	0 to 50 Deg.C
11	Humidity	10 to 95% RH
12	No. of Ethernet port for Host connectivity	Two
13	Serial Interface	16 RS 232/485/422 Ports
14	Magnetic Isolation	Built in 1.5 KV
15	Optical Isolation	2 KV
16	Accessories	8 –pin RJ 45 to DB9 Female connection cable 150 cm , Document & Software CD.

18 Specification for Operation Work Station

Sr. No.	Parameters	Requirement
1	Make	As per approved vendor list
2	Type	Dual Screen Tower Model
3	Processor	Intel I5
4	Cache	4MB, L2 cache
5	RAM	8 GB Minimum
6	Operating System	Genuine Windows 7, Windows 8 Ultimate (64 -bit) Shall support : Red Hat® Enterprise Linux WS v.5, Ubuntu Linux
7	Expansion Slots	PCI Express X 16 card connector - 1 no., PCI card connector - 2 nos
8	Hard Disc Drive	500 GB SATA Drives
9	BIOS	BIOS 8MB flash memory for system BIOS
10	Networking	Integrated Broadcom® BCM57780 -Gigabit 1 LAN One Single port NIC-Broadcom Gigabit Ethernet installed in Pcle X 16 Slot_1
11	I/O Channel (Slots)	3 PCI, 1 PCIeX1 , 1 PCIe X 8 (X 4 electrical), 2 PCIe X 16
12	Ports &Slots	Serial : 1 no. 9-pin Connector, DTE, 16650-compatible Parallel : 1 Rear LAN : 1 Rear RJ45 NIC connector USB: 9 nos. USB 3.0 (2 on front, 4 on back & 3 internal HDMI : 1 No.
13	Input Device	USB Standard Qwerty Key Board
14	Mouse	USB Scroll Mouse 2-Button
15	Audio Port	Integrated High-Definition Audio with 24-bit analog to digital and 24-bit digital to analog stereo conversion
16	Graphics	NVIDIA Quadro FX1700 (1GB)
17	Resolution	1680 x 1050
18	Monitor Screen	21" / 22" Wide Screen LED Monitor
19	Power Supply	180 to 260VAC, 50Hz +/- 3Hz / 2.0A (Max.)

19 Specification for Laser Printer

Sr. No.	Parameters	Requirement
1	Make	As per approved vendor list
2	Service	For Alarm/Event/Report printing
3	Print quality (colour)	Up to 600 x 600 dpi
4	Print speed (colour)	Up to 17 ppm
5	Print speed (black, normal quality, A4)	Up to 17 ppm
6	Duplex print options	Automatic (standard)
7	Processor speed	300 MHz
8	Pages per month	Up to 50000
9	Standard memory	128 MB
10	Memory slots	One 100-pin DIMM slot
11	Standard connectivity	1 Hi-Speed USB (compatible with USB 2.0 specifications) port, 1 built-in Fast Ethernet Print Server (10/100Base-TX, RJ45)
12	Compatible network operating systems	Microsoft® Windows® 7, XP Professional, Server 2003, 2008;
13	Input Device	USB Standard Qwerty Key Board
14	Mouse	USB Scroll Mouse 2-Button
15	Audio Port	Integrated High-Definition Audio with 24-bit analog to digital and 24-bit digital to analog stereo conversion
16	Network interface	Built-in print server (10/100Base-TX Ethernet/Fast Ethernet, RJ-45)

20 Specification for DOT MATRIX Printer

Sr. No.	Parameters	Requirement
1	Make	As per approved vendor list
2	Nos of Pins in PUNJAB STATE	9 pin.
3	Columns	136 columns at 10 cpi
4	Print Speed (cps)	1550 cps -10 cpi
5	Paper Path	Front or Rear in, Top Out
6	Nos. of copies	Original + 6
7	Interface	Bi Directional Parallel And serial I/F , USB ,10/100 Base Tx.int. Print Server

21 Specification for UPS

21.1 Technical Specification

The design, manufacture and supply of the UPS System, along with all components shall conform to the following Indian/International Standard of latest revisions and I.E. Rules: -

Table 19.1: Codes and standards

Codes			Description
IS	:	8623	Specification for factory built assemblies of Switchgear and Control Gear (up to 1000 V)
IS	:	13947	Specifications for Air break Switches, disconnector and fuse combination units.
IS	:	6619	General requirements and methods of tests for lead acid storage batteries.
IEC	:	146	Inverters and Converters
IS	:	1651	Stationary cells and batteries, lead-acid type (with tubular positive plates) (superseding IS:541)
IS	:	3700	Essential Ratings and Characteristics of Semi-Conductor Devices :Reverse blocking triode thyristor
IS	:	3715	Letter Symbols for Semi-Conductor Devices.
IS	:	5001	Guide for preparation of Drawings for Semi-Conductor Devices and Integrated Circuits
IS	:	5469	Code of practice for the use of Semi-Conductor Junction Devices, Thyristors and for Diodes
IS	:	6619	Safety Code for Semiconductor Rectifier Equipment
IS	:	13947	Specification for Low-voltage Switchgear and Control gear
IS	:	1248	Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories
IS	:	12063	Classification of degrees of protection provided by enclosures of electrical equipment
IEC	:	620401	Uninterruptible Power System (UPS)Part 1: General and safety requirements for UPS
IEC	:	620402	Uninterruptible Power Systems (UPS) EMC Requirements
IEC	:	620403	Uninterruptible Power Systems (UPS) Method of specifying the performance and test requirements
IEC	:	60146	Semiconductor converters general requirements & line commutated converters Pt 1-1: Specifications of basic requirements
IEC	:	60269	Low-voltage fuses : Part 2 : Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)
IEC	:	60085	Electrical Insulation - Thermal evaluation and designation
ISO	:	7779	Acoustics - Measurement of airborne noise emitted by information technology and telecommunications equipment
IS	:	5-2003	Colors for ready mixed paints & enamels

21.2 Operation Philosophy / Requirements

21.2.1 Parallel Redundant with static Bypass System

1. A parallel redundant system shall comprise of two UPS modules which are paralleled at the output. This allows a significant increase of the system's availability and improves the total power capability in regard to overloads and short circuits
2. AC UPS system shall have 100% redundancy i.e. system shall have standby Rectifier/Charger and Inverter, common batteries & stabilized mains bypass source. The Inverter sections shall be operated in parallel. Both units shall be synchronized with each other and with mains by pass supply.
3. In the event of an interruption or depression in the AC mains voltage to the Rectifier/Charger, the SMF-VRLA battery [common for two UPS modules] shall supply the power requirements of the

load, via the inverter. If both inverters develop fault, the load shall be transferred to the bypass supply through the static switch. Momentary power loss shall not be more than 20 msec at any point of time.

4. Both UPS modules shall have the same priority and shall equally share the total load. During normal operation, 50% of the nominal power rating of either unit shall not be exceeded.
5. Facilities shall be provided to enable Auto/Manual initiation of uninterrupted transfer of the load from the inverter to the mains bypass, and from the mains bypass to the inverter.

❖ **Operation modes**

a. Normal operation:

Each part of the overall system is available with any power sources in tolerance. Both, Rectifiers and inverters units are equally sharing the total output power. Bypass source is Stand-by and acting as synchronization source.

b. Power failure/system fault on one module:
Faulty UPS module switches to stand-by operation while the other healthy module will continue to carry the full load. No power re-routing by means of switches is required. This also preserves the precious battery power as long as possible

c. Input Power failure on both modules:
Both modules call up battery operation simultaneously and discharge the battery bank still delivering 50% of the total output power. Co-ordinated changeover to bypass takes place if the battery capacity is completely used up

d. Overload condition :

Both modules are capable to continuously supply 100% of their nominal rating which equals to 200% overall power requirements. In case this value is exceeded and after the given overload profile, an uninterruptible transfer to bypass mains would occur by closing static bypass switches simultaneously.

21.3 Performance Requirements

21.3.1 Rectifier and charger unit

1. The rectifier / charger unit shall be solid state and shall provide direct current to the inverter unit and for battery charging. The charger rating shall be sufficient for charging discharged batteries as well as supplying power to inverter.
2. An input AC filter shall be incorporated into the rectifier / charger unit. This filter is to reduce the current harmonics fed back into the input AC line to not more than 5%. The filter is also used to improve the input power factor so that it is 0.8 lagging or better.
3. The DC output of the rectifier unit shall remain within the limits of ± 1% under any of the following conditions. Switched diodes or supplementary battery cells as a means of limiting DC voltage variations are not acceptable:
   - Specified supply variation.
   - Output between zero and 100 % of rated output
   - The rectifiers shall be capable of limiting the output current to 110 % of rectifier rating and be capable of operating continuously at that current.
   - Output power shall be controlled via a full wave half controlled thyristor/diode bridge with free
   - wheeling current facility. The output current shall be smoothed by means of series reactance or equal. Ripple in the rectifier output voltage shall not exceed 2 % of nominal voltage for all values of load within charger rating. The output filter shall be adequate to ensure that DC output of rectifier /charger will meet the input requirements of Inverter

4. Power semi-conductors in the rectifier / charger shall be fused with fast acting fuses, so that loss of any one power semiconductor will not cause cascading failures. All fuses shall be provided with a blown fuse indicator with an alarm indicator on the control panel.

21.3.2 Inverter Unit

1. The inverter unit shall be a solid state device capable of accepting the output of the rectifier / charger or the unregulated voltage of the battery and provide regulated rated AC output within specified limits.
2. The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and be adjustable ±5% of rated frequency. The oscillator shall hold the inverter output frequency to ±0.1% for both steady state and transient conditions. Drift shall not exceed ±0.1% during a 24 hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed ±0.1% from the rated frequency.
3. The inverter output shall maintain synchronized with the static bypass line provided the static bypass line remains within 4% of the nominal frequency. If the line frequency goes outside these limits, the inverter is to break sync with the line and run on its internal frequency. When the line frequency returns, within limits, the inverter output is to automatically re-synchronize with the line. The unit shall be provided with an internal switch so that the synchronizing frequency range can be varied from 1% to 4% in step of 0.5%.
4. The inverter shall be capable to sustain an overload across its output terminals up to 150% load for 10sec and 125% for 10 minutes, without reducing the output voltage. If the load requirement is greater than 150%, it shall be fed from static bypass line.

21.3.3 Static Transfer Switch

1. The load transfer-switching device shall comprise a continuously rated thyristor switch. It shall have a continuous current rating equivalent to the rated output of the UPS and shall be short time rated to meet the following requirements:

– 100 % of UPS rating for 50 ms;
– 150 % of UPS rating for 60 s.

Facilities shall be provided to initiate manually and automatically transfer of the load from the inverter supply to the bypass supply, and vice versa, without interruption of the vital supply. The criteria for load transfer shall be as follows:

- Transfer of the load from the inverter to the bypass

Load transfer shall only be possible when:

– The bypass voltage is within ± 5% of rated UPS output voltage, and
– The bypass frequency is within ±4% of rated frequency, and
– The inverter output and bypass voltages are synchronized

Automatic transfer of the load shall be initiated when:

– The inverter output voltage drops below 95% of the nominal output voltage. Transfer should be accomplished before the voltage reaches 90% of the nominal value, or
– The inverter output voltage exceeds 105% of the nominal output voltage. Transfer should be accomplished before the voltage reaches 110% of the nominal value, or
– The inverter output current limit is exceeded.

- Re-transfer of the load from the static bypass to the inverter

Load re-transfer shall be possible only when:

– The inverter output voltage is within ± 5% of the nominal output voltage for more than 3 seconds.
– The inverter output and bypass voltages are synchronised.

- The fault which resulted in the initiation of the transfer has been cleared.
- Output load current is less than or equal to the normal rating of the AC UPS.

21.3.4 Bypass Transformer & Bypass voltage stabilizer

1. Bypass input to Static Transfer Switch shall be through Transformer and Voltage Stabilizer.
2. The Bypass Transformer shall be three phase, natural air cooled type suitable for indoor location. The short circuit impedance of bypass transformer shall be less than 4% Voltage Stabilizer shall be of Servo Controller / Static type.
3. The stabilized bypass supply shall be designed to regulate the output voltage over complete range of load from no load to full load and for specified input supply variation.
4. The stabilized bypass supply shall have a continuous current rating equivalent to the rated output of the UPS unit and be capable of conducting a current ten times the rated output for the duration more than the fault clearing time of the type of fuse provided

21.3.5 Maintenance Bypass switch

A manually operated make-before-break changeover switch in a segregated compartment shall be

provided in order to bypass the UPS power circuits (inverter as well as static switch) for maintenance and repair purposes. It should have three switching positions:

“Auto” : Inverter is connected to the vital loads with the static bypass energized for automatic transfer.

“Test” : Vital loads are connected to the bypass circuit with the static switch Circuit energized for synchronization tests.

“Maintenance/Bypass”: Vital loads are connected to the bypass circuit with the static switch Circuit isolated

21.3.6 Battery

1. A Battery for the UPS shall be sized with sufficient capacity to maintain UPS output at the specified load for a specified duration. The battery shall be Sealed Maintenance Free VRLA type in accordance with IS 1651. Batteries shall be supplied along with the racks.
2. Inter cell connectors & terminals shall be insulated or otherwise provided with protective covering to prevent inadvertent short-circuiting. The end of discharge voltage (EODV) for individual battery cells shall be specified by Manufacturer.
   a. For Battery Sizing, the following factors / data shall be considered unless specified otherwise in the data sheet:
   b. Load Power Factor of 0.8
   c. Ageing Factor of 1.25 for SMF-VRLA Battery
   d. Back-up time shall 30 min (there should be two battery bank for 1 hour each).
   e. Minimum end cell voltage for SMF-VRLA Battery shall be 1.8V per cell.
   f. Battery state of charge factor.
3. The batteries will be installed separately from the UPS unit in a suitable conditioned environment on free standing support racks, which may be of steel or equivalent & located in same room. The batteries shall be positional so that possible leakage of electrolyte or emission of gaseous products shall not cause damage to other equipments or adjacent cells.
4. The lowest rack for accommodating battery cell shall be at least 30cm above ground level.
5. For SMF-VRLA batteries, temperature compensation of the battery charging voltage shall be provided for the rectifier, with an accuracy of ± 1 %. The temperature sensor shall be located in the centre of the battery rack and shall adjust the rectifier output voltage in line with the battery Manufacturer’s recommendations.

6. Battery spacing for SMF-VRLA cells shall be a minimum of 10 mm to ensure an even temperature distribution. Vertical separation between layers shall be sufficient to permit free and safe access for cell measurements and/or replacement.
7. The UPS Module shall have a Battery Circuit Breaker (MCCB). This circuit breaker is to be mounted in the battery cabinet. When open, there shall be no battery voltage present in the UPS module cabinet. The UPS module shall be automatically disconnected when the battery reaches the minimum discharge voltage level or when signaled by other control functions.

21.3.7 General

1. Suitable protection shall be provided in control circuit to guard against instability of phase controlled rectifiers due to electrical oscillations which may be present in the input supply caused emergency DG set.
2. Transient / surge protection circuit shall be provided in the input circuit to rectifiers to protect the UPS from surges and voltage spikes.
3. All breaker shall be adequately rated for continuous rating as well as breaking capacity as applicable. Paralleling of breaker / switch / contactor pole to achieve the required current rating is not acceptable. All output isolating device shall be double pole type.
4. All electronic power devices including thyristor, transistors (IGBTs), diodes etc. shall be rated under operating conditions for approximately 200% of maximum current carried by the devices. All other electrical components such as transformer, reactor, breaker, contactors, switches, bus bars etc. shall be subjected PIV greater than 50% of its rated value.
5. All thyristor, power transistors, diodes and other electronic devices of UPS shall be protected with high speed semiconductor fuses. I2t co-ordination between fuse and semi conducting power devices shall be ensured

21.4 Performance, Guarantee /Warrantee

Vendor shall guarantee design, materials/workmanship and performance for a period of twelve months (12) from the date of initial operation or eighteen (18) months after delivery at job site, of all goods to the supplied under order, whichever date shall first occur.

21.5 Data require from vendor

SR. NO.	DESCRIPTION	SPECIFIED	VENDOR DATA
1	GENERAL		
a	Application	For Instrumentation supply	
b	Capacity kVA	7.5	
c	Installation	INDOOR.	
d	Quantity	1 (One)(redundant)	
e	Type of UPS	TRUE ONLINE DOUBLE CONVERSION (IGBT) BASED	
2	A C INPUT		
a	Voltage (415 / 230 V).V	415 (± 10%) 3 ph	
b	Frequency.Hz	50 ± 3%	
c	Wiring - 3PH / 1PH-4 wire / 2 wire	3 PH - 4 Wire	
d	Input power factor.	0.8	
e	Power watts input.	VENDOR TO FURNISH	
f	Input current limit.	VENDOR TO FURNISH	
3	D C INPUT		
a	Nominal DC Bus Voltage.	VENDOR TO FURNISH	
b	Battery capacity.	SUITABLE FOR TIME SHALL 30Min. (THERE SHPULD BE TWO BATTERY BANK FOR 30 Min EACH).	
c	Type of battery.	DRY TYPE, SEALED, MAINTAINENCE FREE.	
d	AH capacity of battery	VENDOR TO FURNISH	
4	A C OUTPUT		
a	Voltage.	415/230 V To be furnished later	
b	Frequency.Hz	50	
c	Voltage adjustment range.	± 5%	
d	Output rating.kVA	To be furnished later on	
e	Load power factor.	0.8	
f	Inverter capacity.	VENDOR TO FURNISH	
g	Efficiency.	VENDOR TO FURNISH	
h	Current limit.	VENDOR TO FURNISH	
i	Waveform distortion.	VENDOR TO FURNISH	
j	Regulation.	VENDOR TO FURNISH	
5	MISC.		
a	Reference Drawing.		
6	GENERAL		
a	Thickness of sheet steel.	2mm thick CRCA sheet steel	
b	Overall dimensions.	VENDOR TO FURNISH	
c	Cubicle weight.	VENDOR TO FURNISH	
d	Ventilation	VENDOR TO FURNISH	

7	MAKE TYPE & BRIEF PARTICULARS	
a	MCB	Hager / Siemens
b	Diodes	VENDOR TO FURNISH
c	Battery	PANASONIC/ EXIDE
d	Meters	Enercon / Conzerv / HPL
e	Selector switch	SIEMENS / KAYCEE
f	Indicating lamp	SIEMENS / Teknik
g	Terminal blocks	Phoenix
h	Transistors	VENDOR TO FURNISH
i	MCCB	L&T / SIEMENS / Schneider

Notes:

1. Isolation bypass arrangement shall be provided to feed the load in the event of failure of ups maintenance.
2. Static switch shall be provided to take care of transfer of load in the event of supply failure.
3. Battery back-up time shall 30 min. (there should be two battery bank for 1 hour each) be considered for ups.
4. Proposed general arrangement for ups with all the specified accessories shall be submitted along with quotation.

22 Equipment Guarantee & AMC

1. All items forming part of the scope of supply shall be guaranteed for defects in quality and workmanship for a period of **twenty four Months** from the date of successful completion of the integrated SAT & Handing over of the complete system by the vendor to DAFFPL or for **twenty six months** from the date of mechanical completion of work by vendor, whichever is earlier.
2. All the apparatus shall be guaranteed against defective design, poor workmanship and defective material of construction.
3. All the equipment/items shall be capable of performing the duties specified in this specification without damage, distortion of failure of any component.
4. The vendor shall repair and replace any parts of the equipment supplied by vendor at his own expenses, in the event of non-fulfilment of guarantee.
5. Break down maintenance aspect of the system during the guarantee period will be attended on call basis within 24 hours after fault reporting from location site. 4 Numbers of quarterly preventive maintenance visits and emergency visit as and when required. Visits are re-scheduled or adjustable against the total number of regular/emergency visit.

22.1 Annual Maintenance Contract

Vendor shall quote for the annual maintenance contract for period of five years after completion of guarantee period. During the AMC, Vendor will hold the inventory of minimum spares inventory at the site required for maintaining the system in operating condition. Vendors have to provide list of of minimum spares items including qtn. required at site during AMC period along with price bid documents.These spares shall need to be positioned at site before SAT and kept at site throughout the AMC period. The vendor shall ensure availability of spares (at minimum) at all time at the site and in the custody of DAFFPL location-in-charge.

The vendor shall not take-up any extra item unless he received specific instructions in writing from Site In charge of DAFFPL.

22.1.1 Comprehensive Warranty Clause / Scope

The entire system shall be covered under **Comprehensive Warranty** for a period of **twenty four Months** from the date of successful completion of the integrated SAT & Handing over of the complete system by the vendor to DAFFPL or for **twenty six months** from the date of mechanical completion of work by vendor, whichever is earlier. During the defect liability / warranty period, vendor will take complete responsibility for any defect observed in the system (i.e. in instrumentation, software, hardware, communication & networking media's / protocol interfacing with SAP or any other equipment & services related to the TLF automation system) & rectify / replace the same immediately, free of cost, during start-up and on-line operation of TLF Loading facilities, within the Warranty period. The price for this shall be inclusive of all the cost including travel, stay, incidental expenses etc. complete. Vendor's obligation during warranty period scope shall be as below at no extra cost.

1. Replacement of spares in case of break down for all the equipments, instruments as supplied under referred contract.

2. Attending break down calls and making the system operational within 24 hours from the time of call.
3. Arranging quarterly visit of OEM vendor's representative of following items / systems for preventive maintenance.

4. Quarterly visit of TAS vendor's System Engineer for system cleanup and performance checking of all servers and workstations.
5. Posting of competent and qualified resident engineer continuously for a period of two years having job responsibility as per the tender.
6. Calibration of transmitters, flow transmitters, temperature transmitters in case performance found unsatisfactory.

22.1.2 Terms and Conditions for Post Warranty Annual Maintenance Contract for 5 Years for Terminal Automation System

1. Terminal shall enter into a Maintenance Contract for 5 years which will start after the expiry of warranty period of **twenty four Months** from the date of successful completion of the integrated SAT & Handing over of the complete system by the vendor to DAFFPL or for **twenty six months** from the date of mechanical completion of work by vendor, whichever is earlier and will remain valid for 5 years.

2. Spares during AMC

The spares shall be stocked at the DAFFPL site in the custody of DAFFPL. In case of usage of spares beyond the list, the spares shall be replenished by vendor as per unit rates submitted along with proposal. TAS vendor to replenish the stock within shortest possible time frame and the invoice be raised to DAFFPL.

3. Price for Spares

The prices specified for spares are valid for five year from the date of the starting of the contract.

4. Scope of devices

TAS vendors Service Engineer to visit once in a quarter for checking system performance / carrying out preventive maintenance of entire scope work order system. At the end of visit, detailed summary report will be generated and submitted to Plant In-Charge for their records and necessary corrective actions, if any

- TAS vendors System Engineer to visit once in a quarter for system cleanup and performance checking of all servers and workstations.
- OEM vendors service engineer to visit once in a quarter for carrying out preventive maintenance.
- Carrying out break down calls as and when required / informed by DAFFPL location and making the system operational within the stipulated time including arranging for spares, services of OEM etc. complete. (Limited to total nos. of visits stipulated in contract). Additional visits, required if any, shall be charged on a per day rate basis as specified in proposal.
- Co-ordination for Annual stamping & and re stamping (arising out of repair & maintenance) of truck loading metering system and custody transfer metering system by local W&M body. However, charges towards the same will be borne by vendor.
- If possible, replacement of faulty equipment on temporary basis to be provided by TAS vendor in case faulty equipment is not getting repaired with in 32 hours

The AMC will come into effect from the date of expiry of the warrantee period i.e. 24 months from the date of completion of SAT or 26 months from the date mechanical completion, whichever is earlier and will remain valid for 5 years

DAFFPL reserves the right to renew the AMC contract after expiry of the current AMC on a mutually agreeable rates and conditions

5. Working Hours/Response Time

Preventive maintenance to be carried out within the normal working hours of 09:00 hrs to 05:00 hrs

Breakdown maintenance calls to be attended as per the details given below :

- Service engineer to reach site within 24 hours from the time of receipt of complaint from DAFFPL
- System to be made operational within 32 hours from the time of receipt of complaint from DAFFPL

6. For Service

TAS vendor shall raise quarterly invoice at the end of each quarter and payment shall be made by DAFFPL within 30 days after receipt of invoice along with service reports / MOM.

7. For Spares

Within 30 days after receipt of material and submission of invoice

8. Price Basis

For Services: Service tax and cess should be included in the rates quoted
For Supply: The rates offered should be inclusive of P&F, Freight, Insurance, excise duty, sales tax and other applicable taxes and duties

9. General Terms and Conditions

A. Electricity & water if required for carrying out maintenance will be provided by DAFFFPL free of cost.
B. Vendor to observe all safety, statutory rules and regulations applicable at the locations.
C. All labours, materials, equipment, tools & tackles to be provided by vendor at their own cost.
D. Vendor to submit Bank Guarantee equal to the 10% of AMC contract value as security deposit for Part-A and Part-B separately.

10. Cost of AMC to Include

A. Cost for travel, stay, incidental expenses etc of vendor’s personal during routine visits
B. Cost for travel, stay, incidental expenses etc of vendor’s personal during break down calls.
C. Faulty parts/ components/ unit beyond repair and replaced by vendor can be taken back by the vendor with the written permission of Engineer in charge.

23 Approved Vendor List

Sr. no	Item Description	Approved Brand
1	Pressure gauges	General Instruments
		WIKA
		WAREE
2	Temperature Elements (Multipoint)	Emerson (SAB)
		Honeywell (ENRAF)
		E&H
3	Temperature gauge	General Instruments
		Detriv Instrumentation & Electronics
		WAREE
		Alflow
4	Transmitters	Emerson
		Yokogawa
		Honeywell
		E&H
		ABB
		Invensys
		Moore
5	Radar type Level TX	Emerson (SAB)
		Honeywell (ENRAF)
		E&H
6	Level Switch, Level Gauges	Transducers & Controls
		R.K.Dutt
		SBEM
		Chemtrol
		Vega
7	PLC	GE
		Siemens
		ABB
		Honeywell
		Allen Bradly
		Schneider
		Invensys
		Mitsubishi
8	Solenoid Valve	ASCO
		Norgren-Herion

Sr. no	Item Description	Approved Brand
		Rotex
9	Motor operated Valve actuator	Rotork
10	Air Filter Regulator	Shavo Norgen
		Placka
		Panker
		ABB
11	SS Tubes	NFC
		Choksi.
		Ratnamani
		L&T Limited
12	Fittings/Air Headers	Astec
		Excel Hydro pneumatics
		Parker
		Swagelok
13	Annunciators	Minilec
		Instalarm Instruments Pvt Ltd
		Industrial Controls & Appliances Pvt Ltd (ICA)
14	Panel Enclosures	Rittal
15	Junction Box (Flameproof)	Baliga
		Flameproof controls and gears
		Sudhir Switch gear
		Flexpro electricals
16	Relays	Siemens
		Omron
		Phoenix
17	Signal Distributor & Trip Alarm Unit	MTL/P&F
18	Power Supply	Aplab
		Meanwell
		MTL
		E&H
		T&F
		Delta
19	D.C. Contactor	Siemens/L & T
20	Digital Panel Indicator	Yokogawa

Sr. no	Item Description	Approved Brand
		ABB
		Radix
		Masibus
21	Cables	KEI
		Thermocab
		Lapp
		Delton
		Universal
		Brooks
		Belden
22	DCS	Yokogawa
		Emerson
		Honeywell
		ABB
23	Structural steel	SAIL / TISCO or equivalent brand with prior approval of Engineer-in-charge
24	MS Pipe	Maharashtra Seamless
		Indian Seamless Tubes
		Ratnamani Metals & Tubes
		Surya Roshni Ltd.
		Jindal Pipes
		Mukat pipes
		Lalit Profiles
		MAN Industries
		Welspun Gujrat Stahl
		Mahalaxmi Seamless
		Heavy Metals & Tubes Ltd
25	SS Pipes	Heavy Metals & Tubes Ltd
		Rajendra Mech Industries
		Ratnamani Metals & Tubes
		Sandvik Asia ltd
		Jindal Saw Pipes
26	Pipe Fitting	M S Fittings
		EBY Industries
		Swastik lloyds
		Gujarat Infra pipes
		Tube Products Incorporate
		Tee Kay Tubes

Sr. no	Item Description	Approved Brand
		Commercial Supply Agency
		Eften
		Tube Bend
27	Flanges	Chaudhry Hammer
		Swastik lloyds
		JAV Forgings
		Kunj Forgings
		M S Fittings
		Echjay Industries
		Echjay Forgings
		Paramount Forge
28	Gaskets	IGP Engineers Ltd
		Madras Industrial Products
		Star Flex Sealings
		Goodrich Gaskets
		Champion Jointings
		Uni Klinger Ltd
29	Fasteners	AEP Company
		Fasteners & Allied Products
		JJ Industries
		Pacific Forgings & fasteners
		Precision Engineering Industries
		Pioneer Nuts & Bolts P Ltd
30	Tray(GI)	Indiana
		Steelite Industries
		Superfab Industries
		Premier Power Products
31	Printer (Laser Jet)	HP
		Cannon
		Panasonic
32	Printer (Dot Matrix)	Epson
		Wipro
33	Hart Communicator	Rosemount
		Emerson
34	Barrier Gate	Technica

Sr. no	Item Description	Approved Brand
		Gandhi automation Pvt Ltd
		Metachem
35	MCP	Baliga
		Tecnik
		FCG
		MEDC
		kheraj
36	CCTV	Pelco
		Honeywell
37	Gas detector	Honeywell
		Siemens
		Eclipse
		Oldhaman
38	Limit switch for HOV	Honeywell
		Emerson
		Rotex
39	Fire Alarm Panel	Siemens
		Honeywell
40	Mass Flowmeter	Emerson
		E & H
41	Industrial PC	Moxa
		Advantech
42	Server /Work station	HP
		IBM
		Dell
43	Batch controller	GE
		FMC
		Honeywell
		GE
44	Fibre Optic Cable	AT & T
		Lapp
		Siemens
		ABB
		Molex
45	PA System	Motorolla
		Siemens

Sr. no	Item Description	Approved Brand
		Zenetel
		Bosch
46	Ethernet Switch	Moxa
		Siemens
47	Control desk	Pyrotech
		ABB
		Siemens
48	Terminal Block	Elemax
		Phonix
		Connectwell
49	Insertion Type Turbine Flow Meter	Woltex
		Capstan
		Rockwin
50	HMI	Siemens
		Schneider
		ABB
51	RTU	Siemens
		ABB
		Schneider
		Rockwell
		GE
		L&T
52	TAS / LRC Software	GE
		Honeywell
		Siemens
		ABB
		Emerson
53	UPS	DB-Emerson
		Apc
		Fuji
		Hi-Rel
		Siemens
54	Flame Detector IR type	Detronics
55	Glands	Comet
56	Magnetic Float type Level switch	Pune Tech Control

Sr. no	Item Description	Approved Brand
57	Guided Wave Radar type Level TX	Emerson
		E&H
58	Thermal Relief Valve	Nirmal
		Kingsley
59	Valves	Audco
		BDK
		Saunders
		Fluidline
60	Multi Cable Transit (MCT)	Rocktex
		Hilti
		ABB

NOTE:

Bidder to follow the above mentioned makes. Makes of Items not listed here or In case none of the above makes are available, bidder to follow the equivalent makes with prior approval from client deviation from approved make list is not allowed.

It will be the responsibility of the bidder to provide all supporting documents to establish that the brand/make offered by them is equivalent to the specified make and client's decision regarding approval of equivalent make shall be final and binding.

TECHNICAL SPECIFICATIONS FOR MAINTENANCE FREE EARTH FOR ELECTRICAL INSTALLATION

CONTENTS

Serial No.	Description
13.0	COMPLETION REPORT CERTIFICATION
14.0	GUARANTEE (DELETED)
15.0	INFRINGEMENT OF PATENT RIGHTS
16.0	ANNEXURE - A

TECHNICAL SPECIFICATIONS FOR MAINTENANCE FREE EARTH FOR ELECTRICAL INSTALLATION

FOREWORD

Earthing is essential in any electrical installation to provide safety. The conventional GI pipe earthing system employing charcoal & salts are provided for various applications as per IS:3043. Corrosion of metallic parts is comparatively fast besides maintenance by way of watering of earth pits and chiselling of corrosion prone parts & their replacement require monitoring which may not always be feasible in certain crowded and inaccessible areas.

This document is intended to provide guide lines for installation & testing of long lasting earthing system for various applications to meet requirement of rules 51, 61 of Indian Electricity Rule, 1956.

1.0 SCOPE

This specification covers components, enhancing material & jointing used and procedure for constructing the earth pit for maintenance free earthing system to ensure that the resistance to earth is near zero consistent throughout the year.

2.0 REFERENCES

This specification requires the reference to the following documents:

IS 3043-1987	Indian standard code of practice for earthing
IEEE 80	IEEE guide for safety in AC sub-station grounding
IEEE 837	Standard for qualifying permanent connections used in substation grounding.

Indian Electricity Rules 1956 with latest amendments

Wherever, reference to any specification appears in this document, it shall be taken as a reference to the latest version of that specification unless the year of issue of the specification is specifically stated.

3.0 APPLICATIONS

Earthing systems covered in this document shall be for providing effective grounds for

i. Sub-Stations
ii. RTUs, supply control posts
iii. Transformer and Generator neutral earths
iv. Lightning arrester earths
v. Equipment earths including panels
vi. In applications for PRS, UTS, FOIS, COIS, ATMs and data processing centre etc.

4.0 SELECTION OF EARTH SYSTEM

S. N.	Installations / Current Capacity	IR Value Required	Soil Type / Resistivity	Earth System
1.	House hold earthing / 3 kA	8 ohm	Normal Soil / upto 50 ohm – mtr	Single Electrode
			Sandy Soil / between 50 to 2000 ohm - mtr	Single Electrode
			Rocky Soil / More than 2000 ohm - mtr	Multiple Electrodes
2.	Commercial premises Office buildings / 5 kA	2 ohm	Normal Soil / upto 50 ohm - mtr	Single Electrode
			Sandy Soil / upto 2000 ohm - mtr	Multiple Electrodes
			Rocky Soil / More than 2000 ohm - mtr	Multiple Electrodes
3	Transformers, substation earthing, LT line equipment / 15 kA	1 - 2 ohm	Normal Soil / upto 50 ohm - mtr	Single Electrode
			Sandy Soil / upto 2000 ohm - mtr	Multiple Electrodes
			Rocky Soil / More than 2000 ohm – mtr	Multiple Electrodes
4	Transformers, substation earthing, HT line equipment / 40 kA	less than 1 ohm	Normal Soil / upto 50 ohm - mtr	Single Electrode
			Sandy Soil / upto 2000 ohm - mtr	Multiple Electrodes
			Rocky Soil / More than 2000	Multiple Electrodes

S. N.	Installations / Current Capacity	IR Value Required	Soil Type / Resistivity	Earth System
			ohm - mtr	
5	Lightning arresters, extra high current applications etc. / 50 kA	less than 1 ohm	Normal Soil / upto 50 ohm - mtr	Single Electrode
			Sandy Soil / upto 2000 ohm - mtr	Multiple Electrodes
			Rocky Soil / More than 2000 ohm -mtr	Multiple Electrodes
6	PRS, UTS, RTUs, FOIS, COIS, ATMs and data processing centre etc. / 5 KA	less than 0.5 ohm	Normal Soil / upto 50 ohm - mtr	Single Electrode
			Sandy Soil / upto 2000 ohm - mtr	Multiple Electrodes
			Rocky Soil / More than 2000 ohm - mtr	Multiple Electrodes

Note: Single / multiple electrode in above earth system shall be either rod earth electrode or concentric pipe earth electrode as per clause 8.1.

5.0 TYPE OF SOILS

Soil can be classified in to various types, though based on the size of the particles it contains:

5.1 NORMAL SOIL

Black cotton soil, vegetable soil, garden soil, loamy garden, soil shallow black, soil medium black soil, deep black soil and marshy soil etc. having low soil resistivity value (up to 50-ohm meter)

5.2 SANDY SOIL

This type has the big particles and the size of the particles does determine the degree of aeration and drainage that the soil allows. It is granular and consists of rock and mineral particles that are very small. Therefore, the texture is gritty and sandy soil is formed by the disintegration and weathering of rocks such as limestone, granite, quartz and shale, thus resulting in over-drainage. It warms very fast in the spring

season. Coastal area, silt soil, red sandy soil, sandy clay and coastal alluvium etc having soil resistivity up to 2000 ohm-meter are considered as sandy soil.

5.3 ROCKY SOIL

The area containing rocks, pebbles, uneven hard surface laterite soil, lime stone, sand stone, gravel, granite and chalk etc having soil resistivity more than 2000 ohm-meter is considered as rocky soil. This type of soil does not absorb moisture and are extremely poor conductor.

6.0 LOCATION OF EARTH ELECTRODE

Where there is option, site should be chosen in one of the following types of soil in the order of preference given:

a. Wet marshy ground;
b. Clay, loamy soil, arable land.
c. Clay and loam mixed with varying proportions of sand, gravel and stones;
d. Damp and wet sand, peat.

Dry sand, gravel chalk, limestone, granite, very stony ground and all locations where virgin rock is very close to the surface should be avoided,

7.0 MEASUREMENT OF EARTH ELECTRODE RESISTANCE

The earth resistance shall be measured using fall of potential method as per para 37 of IS:3043.

8.0 EARTHING SYSTEM

The earthing system includes earth electrode, installation of earth electrode in suitable pit size, construction of earth pit with cover for the installation, connection of earth electrode with equipotential earth bus and connection of equipment to equipotential earth bus.

8.1 EARTH ELECTRODE

The earth electrode is the main component of the earthing system which is in direct contact with the ground and thus provides a means of releasing or collecting any earth leakage currents. The material should have good electrical conductivity and should not corrode in a wide range of soil conditions. For an effective earthing system, two types of earth electrodes can be used as described here:

8.1.1 Rod earth electrode

8.1.1.1 High tensile-low carbon steel rod having diameter not less than 17mm complying with requirements of BS 4360 Grade 43A or EN10025:2-004 S275JR, molecularly bonded by 99.99% pure high conductivity copper on outer surface with copper coating thickness 250 micron or more, Length 3000 mm (minimum). Length of the electrode may be increased in multiple of 1 meter to reduce earth resistance if required. To increase the length, pieces of similar rod shall be either exothermally welded to basic 3-meter electrode or connected using socket of suitable size. These sockets shall also be molecularly bonded by 99.99% pure high conductivity copper on inner & outer surface with copper coating thickness 250 micron or more.

8.1.1.2 Copper bus bar of size 250 mm x 50 mm x 6 mm having electrical conductivity of 101% IACS, minimum 99.9% copper content shall be exothermically welded to rod with 4 holes of 12 mm dia. (2 on each side) for connecting earthing conductor.

8.1.1.3 Current carrying capacity: The design of the electrode should be such as to have more than 15 kA current carrying capacity for 1 second.

8.1.2 Concentric pipe earth electrode:

8.1.2.1 Primary conductor

MS pipe with 25 - 50 mm diameter, class B, ISI mark as per IS-1239, Length 2000 or 3000 mm as per table at para 8.1.2.7.

8.1.2.2 Secondary conductor

MS pipe with 40-100 mm diameter, class B, ISI mark as per IS-1239, Length 2000 or 3000 mm as per table at para 8.1.2.7.

8.1.2.3 Conductive mixture

For hermetically filling inside the cavity i.e. between secondary conductor & primary conductor, crystalline compound is to be injected in the electrode assembly. It is a combination of high conductivity metal alloys, copper & aluminium powder, conductive carbon / cement and bonding material etc. mixed in different proportion. The mixture is forced (pressurized) filled inside the earth electrode in the paste form and after solidification of the same, the end caps are welded. The metal alloys shall help in conducting the current and conductive carbon gives anti corrosive property. Bonding material should provide strength to the mixture. Resistivity of the mixture shall be less than 0.2 ohm-meter. Resistivity shall be tested by making a 20cm cube of the material and checking resistance across the opposite face of the cube.

8.1.2.4 Complete electrode shall be molecularly bonded by 99.99% pure, high conductivity copper on outer surface with copper coating thickness 300 micron or more.

8.1.2.5 Its surface shall be clean and free from any visible oxide layer or foreign material.

8.1.2.6 Copper bus bar of size 250 mm x 50 mm x 6 mm having electrical conductivity of 101% IACS, minimum 99.9% copper content shall preferably be exothermically welded to earth electrode or connected with the help of two number stainless steel nut bolts of appropriate size having 4 holes of 12 mm dia. (2 on each side) for connecting earthing conductor.

8.1.2.7 Current carrying capacity: The design of the electrode should be such as to have more than following current carrying capacity in kA (for 1 second):

S. N.	Current Capacity	Primary Conductor Diameter	Electrode Dimensions (Dia. x Length)
1.	3 kA	25 mm	40 mm x 2000 mm
2.	5 kA	25 mm	40 mm x 3000 mm
3.	15 kA	25 mm	50 mm x 3000 mm
4.	40 kA	40 mm	80 mm x 3000 mm
5.	50 kA	50 mm	100 mm x 3000 mm

Note: For more than 50 KA applications, multiple electrodes of 50 KA capacity shall be installed and connected.

8.2 EARTH ENHANCEMENT MATERIAL:

Earth enhancement material is a superior conductive material that improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It may contain conductive cement, graphite, hydrous aluminium silicate, sodium montmorillonite etc. and shall not contain bentonite. It improves conductivity of the earth electrode and ground contact area. It shall have following characteristics-

i. It should have low resistivity preferably bellow 0.2 Ohm-meters. Resistivity shall be tested by making a 20 cm. cube of the material and checking resistance across the opposite face of the cube.
ii. It shall not depend on the continuous presence of water to maintain its conductivity.
iii. It should be a little alkaline in nature with pH value >7 but <9, test certificate from NABL approved laboratory to be provided for the composition so designed.
iv. It should have better hygroscopic properties to absorb moisture. It should absorb and release the moisture in dry weather condition and help in maintaining the moisture around the earth electrode.
v. It should have capacity to retain >10% moisture at 105 ºC. Test certificate from NABL approved lab to be submitted for the composition so designed.
vi. It should have water solubility < 5%. Test certificate from NABL approved lab be submitted for the composition so designed.
vii. It should be granular with granule size 0.1 mm to 3 mm.
viii. It should be non toxic, non reactive, non explosive & non corrosive.
ix. It shall be thermally stable between -10 degree centigrade to +60 degree centigrade ambient temperature.

x. It shall not decompose or leach out with time.
xi. It shall not pollute the soil or local water table and meets environmental friendly requirement for landfill.
xii. It should expand & swell considerably and removes entrapped air to create strong connection between earth electrode and soil.
xiii. It should be diffuses into soil pores and creates conductive roots enlarging conductive zone of earth pit.
xiv. It shall be permanent & maintenance free and in its "set form", maintains constant earth resistance with time.
xv. It shall not require periodic charging treatment or replacement.
xvi. It shall be suitable for any kind of electrode and all kinds of soils of different resistivity.
xvii. It shall not cause burns, irritation to eye, skin etc.
xviii. Minimum quantity of earth enhancement material to be supplied:

For 5' x 5' x 10' earth pit – Min. 75 kgs per pit

For 300 mm bore type earth pit – Min 50 kgs per pit

xix. The Earth enhancement material shall be supplied in sealed, moisture proof bags. These bags shall be marked with Manufacturer's name or trade name, quantity, batch no & date of manufacture.

8.2.1 Backfill material

Normally the excavated soil shall be used if it is free from sand, gravel and stones. In case the excavated soil contains sand, gravel and stones these shall be removed by appropriate methods such as hand picking, sieving etc. Small proportion of sand in the soil may be permissible. Material like sand, salt, coke breeze, cinders and ash shall not be used because of its acidic and corrosive nature. If the excavated soil contains sand, gravel and stone in large proportion and it is not feasible to remove these economically, good quality soil from other place may be used for backfilling.

While backfilling the soil shall be thoroughly compacted with at least 5 kg compactor. In case the soil is dry, small quantity of water may be sprinkled only to make it moist enough suitable for compacting. Large quantity of water

may make the soil muddy which is not suitable for compacting and after drying the soil may contain voids which may permanently increase earth resistance.

8.3 EQUIPOTENTIAL BUS & EARTHING CONDUCTOR

i. A copper bus bar of size 300 mm x 25 mm x 6 mm to be installed in the equipment room as equipotential bus and must be connected with preferably copper strip of 25 mm x 3 mm (suitable length) from instrument to the bus bar. The connecting terminal of the earth electrode to the bus bar must be connected by copper strip of 25 mm x 3 mm (suitable length) buried inside a trench of 300 mm width x 600 mm depth (from the earth pit to the nearest wall). It shall be duplicated. However, it shall be ensured that only minimum required length is used and any extra length is cut away to keep the earth impedance minimum.
ii. It shall be high conductivity copper having electrical conductivity of 101% IACS i.e. minimum 99.9% copper content The maximum specific resistance of the copper strip earthing conductor shall be 17.241×10^{-7} ohm cm at 20 ºC.
iii. At a temperature of 20 ºC, its density shall be 8.89 gm/cm^3.
iv. Its surface shall be clean and free from any visible oxide layer or foreign materials.
v. It shall preferably be connected to earth electrode and earth bus bar with the help of exothermic welding or at least two number stainless steel nut bolts of appropriate size.
vi. Normally a single length of copper strip shall be used for each duplicate copper strip earthing conductor and no joint should be used. However, in situation requiring greater length one joint in each copper strip shall be permitted. The joints shall be made by exothermic welding of at least 10mm overlapping portion of the strips.

8.4 CONSTRUCTION OF UNIT EARTH.

i. Make 5 ft x 5 ft x 10 ft earth pit. If it is not possible to make such a pit due to non-availability of clear space at locations like ATM, High mast lighting tower, Passenger information systems, PRS etc. or in rocky soil, min. 300 mm bore up to 10 ft deep can be made using earth auger or any other method. Earth pit larger than specified size can be made, if required.
ii. Sleeve the soil digged and remove the gravels and stones. If soil quality is good (without Murum and rocks) then add some quantity of earth enhancement material in the soil for using as backfill.

iii. If the soil seems unusable (containing large quantity of gravel, stones, murum, sad etc.) then replace the soil with black cotton soil.
iv. Insert the electrode at the centre of the earth pit and arrange to keep it vertical in the pit.
v. Arrange for adequate quantity of water supply for the earth pit. (Approx. 600 litres)
vi. Fill the pit with the backfill and keep on adding the earth enhancement material surrounding the electrode and simultaneously watering the pit.
vii. With a steel bar or pipe, keep on poking the soil gel and stirring intermittently for removing the air pockets and proper settlement of the pit.
viii. The procedure to be repeated till completion of the filling of the earth pit along with the packing material and sufficient watering adequate ramming.
ix. The pit should be very compactly rammed and watering for 2-3 days and addition of soil if required be done.
x. Make trench of 600 mm (depth) x 300 mm (wide) from the earth pit to the nearest point of connection.
xi. Construct inspection chamber with cover for the installation.
xii. Measure the earth resistance as per IS 3043:1987 code of practice. Earth resistance value shall be less than 1 ohm in non-rocky/non-sandy surface by single electrode Installation and in rocky surface by multiple electrode installation (not more than three electrodes & its individual earth pits). For earthing purpose, if solid rocky layer is found within 10 feet from ground level while digging the earth pit then it is considered rocky surface. Coastal area, silt soil, red sandy soil and sandy clay are considered as sandy surface.
xiii. If required resistance is lower than the resistance of single earth electrode then multiple earths can be constructed and interconnected.

8.4.1 Construction of ring earth by providing multiple earth pits

i. Wherever it is not possible to achieve required earth resistance with one earth electrode / pit due to difficult / rocky soil conditions, provision of ring earth consisting of more than one earth pit shall be done. The number of pits required shall be decided based on the resistance achieved for the earth pits already installed. The procedure mentioned above for one earth pit shall be repeated for other earth pits.
ii. The distance between two successive earth electrodes shall be min. 3 mtrs / and max. up to twice the length of the earth electrode.

iii. These earth pits shall then be inter linked using 25 X 3 mm copper strip or 50 x 6 mm GI strip to form a loop preferably using exothermic welding or with the help of at least two number of stainless steel nut bolts of appropriate size.
iv. The interconnecting strip shall be buried no less than 600 mm (0.6 m) below the ground level. This interconnecting strip shall also be covered with earth enhancing compound.

8.4.2 Inspection chamber

i. A 300 X 300 X 300 mm (inside dimension) concrete box (wall thickness min. 50 mm) with smooth cement plaster finish shall be provided on the top of the pit. A concrete lid 25 to 50 mm. thick, with pulling hooks, painted black shall be provided to cover the earth pit. PVC sleeve of appropriate size shall be provided in concrete wall to take out earthing connections.
ii. The masonry work shall be white washed inside and outside.
iii. Care shall be taken regarding level of the floor surrounding the earth so that the connector is not too deep in the masonry or projecting out of it.
iv. Earth Pit Cover shall be made of heavy duty poly plastic of size 25cm dia and 25cm deep.
v. Indicator Plate: A indicator(metallic) of size30cm x 30cm with minimum 50cm long support for fixing in ground shall be provided on each earth pit indicating following:
(i)Pit no (ii) Earth Pit & max resistance values (iii) Date of testing (iv) Due date of testing (v) Equipment name etc.

9.0 MARKING:

The marking shall be clear, distinct and visible to the naked eye from a distance of about 1 meter; the size of marking shall be of minimum 25 mm. Following information shall be legibly and indelibly marked on the packed sets:

a. Specification no.
b. Name of the manufacturer
c. Batch no. & Date of manufacturer
d. Current carrying capacity

10.0 TESTS-

Following tests shall be done on one sample-

10.1 Testing of copper coating shall be done as described below:-

i. The copper coating mentioned in clause 8.1 shall not be less than the prescribed thickness at any point and shall comply with the adherence requirement in para (ii) & (iii) below.
ii. Length of the electrode with one end cut to a 45 degree point shall be driven between two steel clamping plates or the jaws of a vise set 0.04 in (1.02 mm)
iii. less than the diameter of the electrode, so as to shear off sufficient metal to expose the bond between the copper coating and electrode. Peeling of the coating by the steel plates or the jaws of the vise is acceptable, but there shall be no other evidence of separation of the coating from the metal core.
iv. At room temperature, a length of the electrode is rigidly held in a clamp or vise and the free end is bent by applying a force normal to the electrode at a distance from the clamping device equal to 40 times the diameter. The magnitude of the force and the direction of application of force shall be such that the electrode is permanently bent through a 30-degree angle. While bending of the electrode there shall be no evidence of cracking of the copper coating.

10.2 Material composition of rod shall be tested as per standards mentioned in clause no. 8.1.1.1.

10.3 MS pipes shall be tested as per IS:1239.

10.4 Copper bus bars of shall be tested for percentage of copper as per IS:14644.

10.5 Current carrying capacity test on rod electrode shall be done as per clause no. 8.1.1.3 and for concentric pipe electrode as per 8.1.2.7.

10.6 Corrosion Test: As per IS:2119, salt spray test for analysis of effect of corrosion for the specific electrode shall be done through NABL approved testing lab, preferably for 500 hrs. or more.

10.7 Exothermic weld material shall be tested as per provisions of IEEE 837.

10.8 Electrical properties test on conductive mixture as per clause no. 8.1.2.3.

10.9 Physical, chemical & electrical properties test on earth enhancement material as per clause no. 8.2.

10.10 Toxic content tests for cadmium, lead, mercury, hexavalent chromium, polybrominated biphenyls (PBBs) & polybrominated diphenyl ethers (PBDEs) on conductive mixture & earth enhancement material.

Certificates from NABL approved laboratories shall be submitted with test results of above tests. Test certificates shall not be more than three years old.

For dimension, weight and specific resistance average of 3 readings shall be taken. Average value shall be within specified limits and individual values shall not go beyond double of tolerances.

11.0 ACCEPTANCE TESTS

11.1 Following shall constitute acceptance tests and shall be done on 100% sample basis for all the tests mentioned below except where otherwise indicated–

a. Physical check for earth electrode as per clause no. 8.1.1.1 for rod type electrode and as per clause no. 8.1.2.7 for concentric pipe type electrode.
b. Physical check for copper bus bar as per clause no. 8.1.1.2 for rod type electrode and as per clause no. 8.1.2.6 for concentric pipe type electrode.
c. Dimensional and construction feature tests of inspection chamber (Cl. no. 8.4.2)
d. Earth enhancement material as per clause no. 8.2(xviii) & 8.2(xix).
e. Earth resistance measurements as per clause no. 7.0.

11.2 REJECTION:

In case the any component tested and inspected in accordance with this specification, fail to pass the tests or comply with the requirement of the specification, another two component from the same lot shall be inspected in accordance with the specification and if one of them also fail to pass the test, the whole lot of that component shall be rejected subject to the discretion of the purchaser or his nominee.

12.0 INSPECTION:

All the gauges / test & measuring instruments shall be under calibration control at the time of inspection and proof to this office shall be produced.

Inspection and testing shall be carried out by the inspecting authority nominated by the purchaser to ensure that all the requirements of this specification are complied with for the acceptance of the materials offered by the supplier for inspection.

The purchaser or his nominee shall have right of free access to the works of the manufacturer and to be present at all reasonable times and shall be given facilities by the manufacturer to inspect the manufacturing process at any stage of manufacture. He shall have the right to reject whole or part of any work or material that does not conform to the terms of this specification or any other specification or requirement applicable and may order the same to be removed / replaced or altered at the expense of the manufacturer. All reasonable / complete facilities considered necessary by the inspecting authorities for the inspection shall be supplied by the manufacturer free of cost.

The manufacturer shall at his own cost prepare and furnish the necessary test pieces and appliances for such testing as may be carried out at his own premises in accordance with the specification. Failing the existence of facilities at his own premises for the prescribed tests, the manufacturer shall bear the cost of carrying out the tests in an approved laboratory, workshop or test house.

13.0 COMPLETION REPORT & CERTIFICATION:

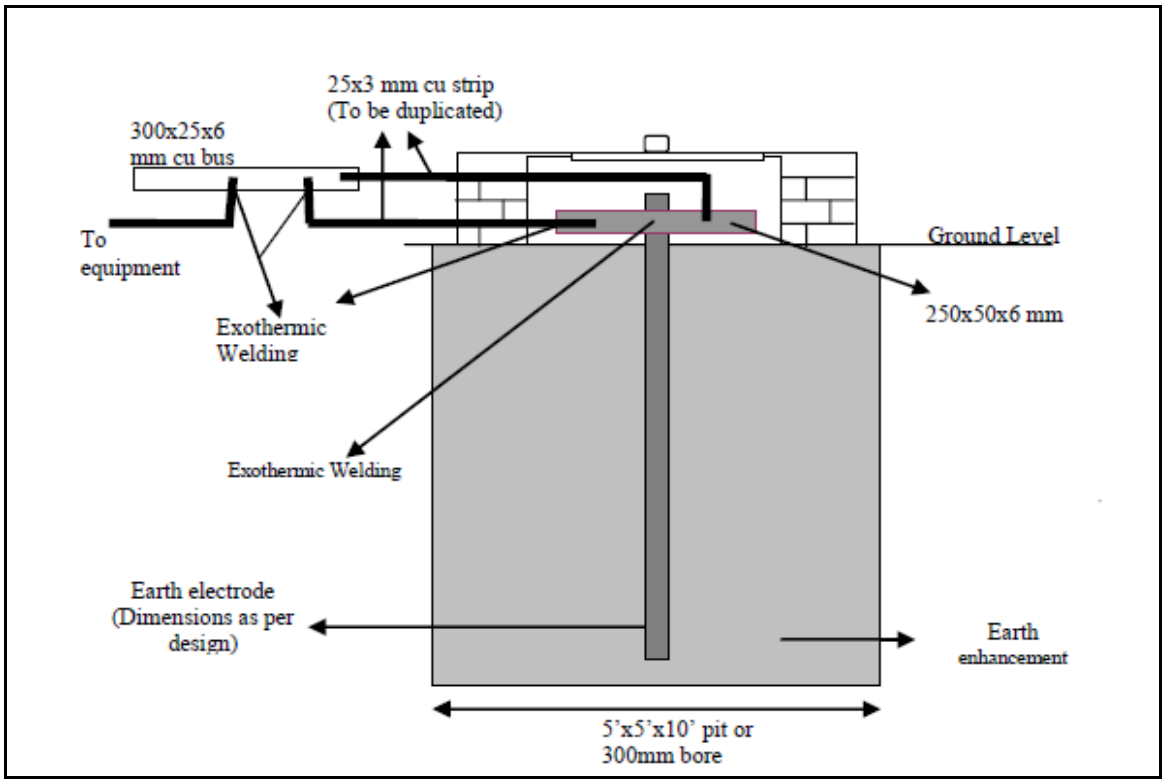
13.1 The last documents for the completion of the procedure will be submission of the work completion report to the concern Railway authority. After testing the earth values of the pits and proper recording in presence of Railway authority, certified grounding self-adhesive certificate shall be provided for all installations and the same will be displayed / pasted at the place of installation.

13.2 The complete layout with dimensions of the earthing & bonding system shall be submitted by the supplier in appropriate size (in three copies) after commissioning showing commissioning date, earth resistance, specification no. and manufacturer's name.

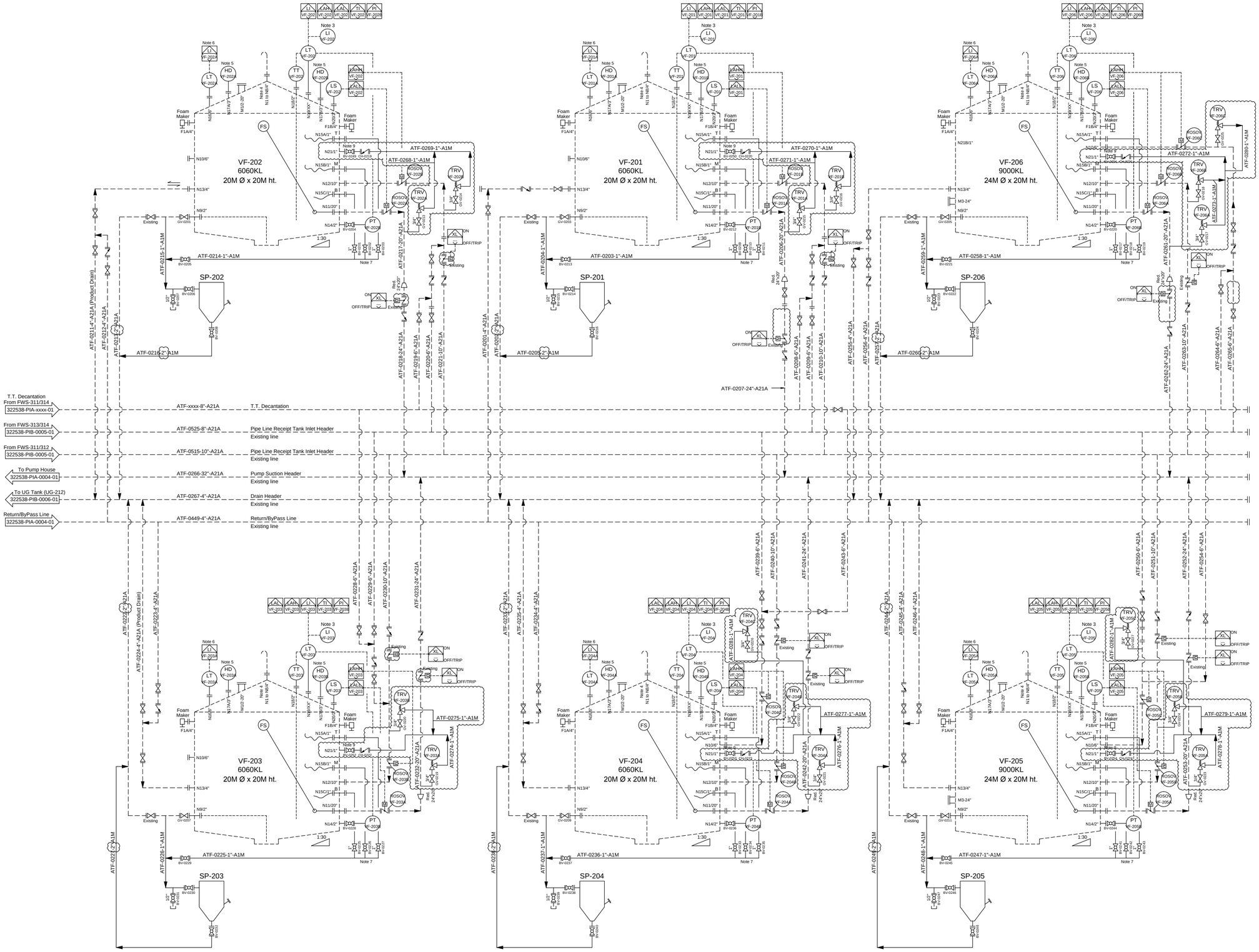
14.0 ANNEXURE - A

General Arrangements for Earth System

ANNEXURE - A
GENERAL ARRANGEMENTS FOR EARTH SYSTEM



EARTH ELECTRODE INSTALLATION



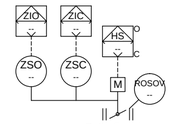
Notes

1. For standard legend & nomenclature refer drawing no. 322538-PIB-0001-01.
2. All drain valve shall be normally closed.
3. Local Indication provided at tank side at readable height.
4. Nozzle number N1 to N8 are existing nozzles given as air vent.
5. Existing arrangement.
6. Servo type level transmeter. Nozzle size shall be finalised after vendor details.
7. Ball valves shall be nearer to respective AL Jeck Sampler.
8. All NRVs shall be plate type non-return valves.
9. Ball valve provided from trv release to tank nozzle shall be off flanged type.

Equipment List

S.No.	Tag No.	Description	Qty.	Capacity	MOC	Remarks
1	VF-201	ATF Tank	01	6060 KL	-	-
2	VF-202	ATF Tank	01	6060 KL	-	-
3	VF-203	ATF Tank	01	6060 KL	-	-
4	VF-204	ATF Tank	01	6060 KL	-	-
5	VF-205	ATF Tank	01	9000 KL	-	-
6	VF-206	ATF Tank	01	9000 KL	-	-
7	SP-201	AL Jeck Sampler	01	50 Ltrs	-	-
8	SP-202	AL Jeck Sampler	01	50 Ltrs	-	-
9	SP-203	AL Jeck Sampler	01	50 Ltrs	-	-
10	SP-204	AL Jeck Sampler	01	50 Ltrs	-	-
11	SP-205	AL Jeck Sampler	01	50 Ltrs	-	-
12	SP-206	AL Jeck Sampler	01	50 Ltrs	-	-

Reference drawings



Typical Remote operated shutoff valve Arrangement

Rev	Date	Drawn	Description	Ch'k'd	App'd
0	16.09.15	JBP	Issued for Engineering		

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Title

Modernization of Existing Fuel Farm Process & Instrument Diagram of Fuel Tank Farm Area

Designed	JCP		Eng check	MMS	
Drawn	JBP		Coordination	AKM	
Dwg check	HRS		Approved	VST/AKS	

Scale at A1	Status	Rev	Security
NTS	EXE	0	STD

Drawing Number

322538-PIA-0002-01

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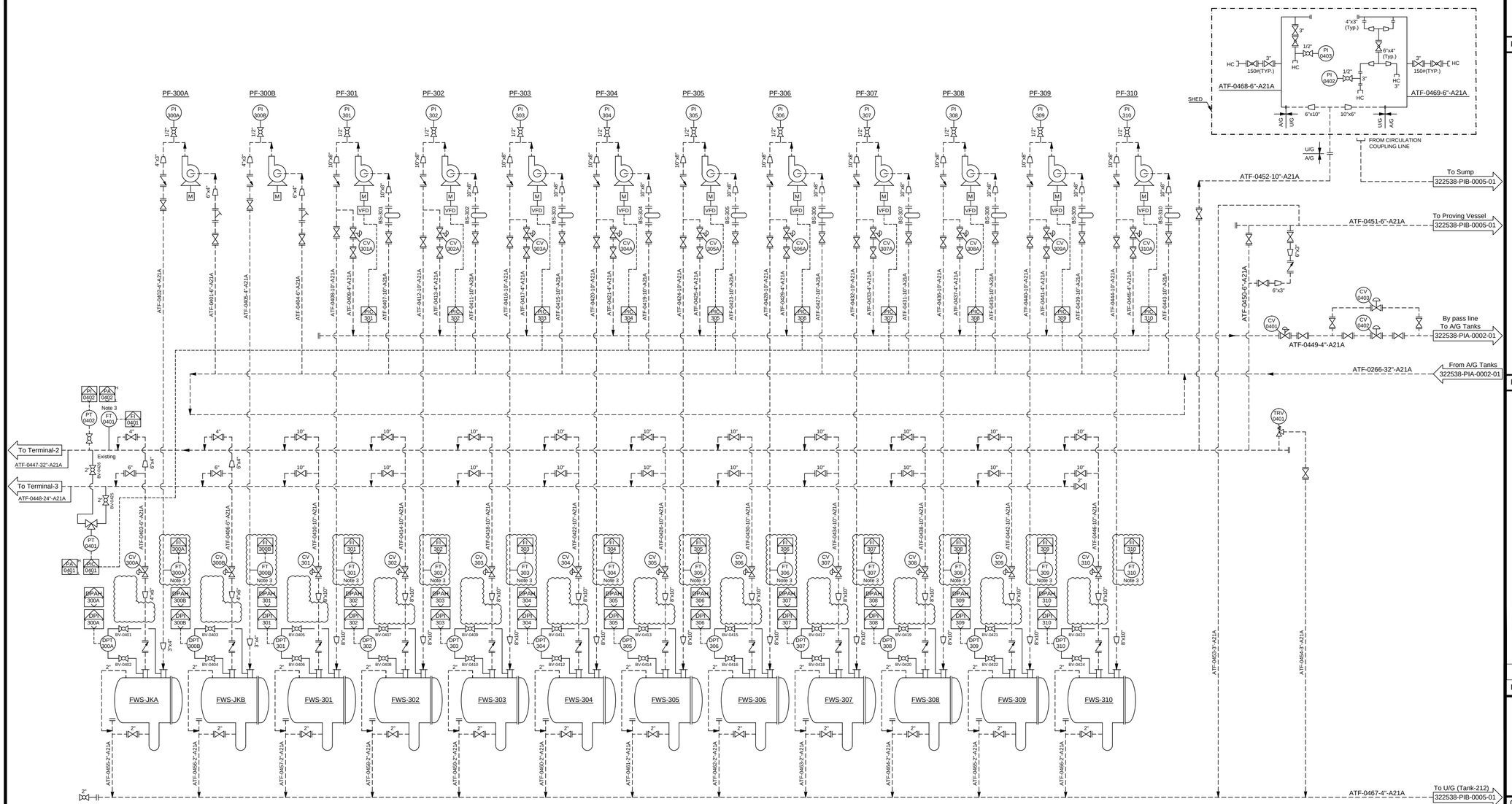

MOTOR /PUMP SCHEDULE

Pump No.	Motor No.	Motor Make	Rating (kw)	RPM	Phase	Voltage (V)	Current	Frquency	Pump flow rate (M^3/Hr)	Pump Head	Pump Meke
PF-301	HP-301	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-302	HP-302	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-303	HP-303	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-304	HP-304	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-305	HP-305	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-306	HP-306	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-307	HP-307	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-308	HP-308	Kirlosker	160	2975	3 Ph	415	270 A	50 AZ	275	155 M	Union C. Pump
PF-309	HP-309	Crompton Greaves	200	2960	3 Ph	415	330 A	50 AZ	275	155 M	KSB
PF-310	HP-310	Crompton Greaves	200	2960	3 Ph	415	330 A	50 AZ	275	155 M	KSB
PF-300A	JK-A	Kirlosker	50	2975	3 Ph	415	90 A	50 AZ	40	75 M	Union C. Pump
PF-300B	JK-B	Kirlosker	50	2975	3 Ph	415	90 A	50 AZ	40	75 M	Union C. Pump

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Notes

1. For standard legend & nomenclature refer drawing no. 322538-PIB-0001-01.
2. All drain valve shall be normally closed.
3. All Flow Meters shall be clamp on type.

Key to symbols

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
0	16.09.15	JBP	Issued for Engineering		

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Title

Modernization of Existing Fuel Farm
Process & Instrument Diagram of
Pipe Line Manifold of
Fuel Hydrant Pump House

Designed	JCP		Eng check	MMS	
Drawn	JBP		Coordination	AKM	
Dwg check	HRS		Approved	VST/AKS	

Scale at A1	Status	Rev	Security
NTS	EXE	0	STD

Drawing Number

322538-PIA-0004-01

Line Legend

- Process/Utility Line
- Existing LIne
- Vendor & Skid Line

Instrument Line Legend

- Instrument Primary Line
- Electrical Signal Line
- Pneumatic Signal Line

Service Fluid Designation

ATF	-	Aviation Turbine Fuel
AV	-	Oil & Water Mixture
RW	-	Raw Water

Abbreviation (General)

HS	-	Hand Switch
VFD	-	Variable Frequency Drive
ROSOV	-	Remote Operated shutoff valve
MOV	-	Motor Operated Valve
GOV	-	Gear Operated Valve
HOV	-	Hydraulically Operated Valve
ZSO	-	Limit Switch Open
ZSC	-	Limit Switch Close
ZSIO	-	Open Indication
ZSIC	-	Close Indication
NC	-	Normally Close
NO	-	Normally Open
PB	-	Push Button
RO	-	Restriction Orifice
ESD	-	Emergency Shut Down
FC	-	Fail Close
FO	-	Fail Open
HC	-	Hose Connection
BL	-	Battery Limit
A/G	-	Above Ground
U/G	-	Under Ground

Valves

- Normally Open
- Normally Close
- Gate Valve (GV)
- Globe Valve (GLV)
- Ball Valve (BV)
- Check Valve (CH)
- Butterfly Valve (BF)
- Diaphragm Valve (DV)
- Plug Valve (PL)
- Needle Valve (NV)
- Piston Valve (PV)
- Pressure Relief Valve
- Control Valve
- Control Valve (Downstream Self Actuating)
- Control Valve (Upstream Self Actuating)
- Control Valve With Positioner
- Control Valve With Hand Wheel
- Motor Operated Valve
- Motor Operated Valve With Hand Wheel
- Hydraulicallay Operated Valve
- ON-OFF Valve With Pneumatic Actuator
- Drain With Blind Flange
- Drain With Threaded Cap

Fitting & Accessories

- T-Type Strainer
- Y-Type Strainer
- Reducer (Concentric)
- Reducer (Eccentric)
- Basket Strainer
- Spectacle Blind (Normally Open)
- Spectacle Blind (Normally Close)
- Open Drain Funnel
- Expansion Bellow
- Flexible Hose
- Load Cell
- Vortex Breaker
- Static Mixer
- Flame Arrestor
- Rupture Disc
- Dampner
- Spray Ball
- Sight Glass (Double Window)
- Sight Glass (Tubular)
- Slope
- Blind Flange
- Hose Coupling
- Continuity Arrow
- Scope (Client / Consultant)

Instrument

- Flow Element (Orifice)
- Turbine Meter
- PD Meter
- Rotameter
- Sonic Meter
- Magnetic Meter
- Vertex Meter
- Pitot tube
- Mass Flow Meter
- Venturi Meter
- Water Meter
- Diaphragm Seal
- I/P Converter
- Interlock

Instrument Location

Discrete Instruments	DCS	PLC	SCADA	
				Field or Locally Mounted
				Primary Location Normally Accessible to an Operator
				Primary Location Normally Inaccessible to an Operator (Central or Main Control Room)
				Auxiliary Location Normally Accessible to an Operator (Secondary or Local Control Room)
				Auxiliary Location Normally Inaccessible to an Operator (Secondary or Local Control Room)

Instruments Identification

Pressure

PA	-	Pressure Alarm
PCV	-	Pressure Control Valve
PE	-	Pressure Element
PG	-	Pressure Gauge
PI	-	Pressure Indicator
PIC	-	Pressure Indicating Controller
PS	-	Pressure Switch
PT	-	Pressure Transmeter
PRC	-	Pressure Recorder And Controller
DPI	-	Differential Pressure Indicator
DPS	-	Differential Pressure Switch

Temperature

TA	-	Temperature Alarm
TCV	-	Temperature Control Valve
TE	-	Temperature Element
TG	-	Temperature Gauge
TI	-	Temperature Indicator
TIC	-	Temperature Indicating Controller
TS	-	Temperature Switch
TT	-	Temperature Transmeter
TRC	-	Temperature Recorder & Controller

Flow

FCV	-	Flow Control Valve
FE	-	Flow Element
FI	-	Flow Indicator
FIC	-	Flow Indicating Controller
FIQ	-	Flow Indicator and Totaliser
FRC	-	Flow Recorder And Controller
FS	-	Flow Switch
FT	-	Flow Transmeter
FQC	-	Flow Intergrator And Controller

Level

LA	-	Level Alarm
LCV	-	Level Control Valve
LE	-	Level Element
LG	-	Level Gauge
LI	-	Level Indicator
LIC	-	Level Indicating Controller
LS	-	Level Switch
LT	-	Level Transmeter

Lines Idefication

XXX - XX XX - XXX - XXX - XX

- XXX — Insulation Specification
- XX — Piping Material Code
- XX — Line Size (Inch)
- XXX — Serial number (Line No.)
- XXX — Two Digits of Drawing Number
- XX — Fluid Service Code

Insulation/Tracing Type

IH	-	Insulation Hot
IC	-	Insulation Cold
IP	-	Insulation for Protection
SJ	-	Steam Jacketed
ET	-	Electrical Traced
ST	-	Steam Traced
ICH	-	Cold & Hot Insulation

Instrument Tag Identification

PG - XX YY A/B/C

- A/B/C — Suffix in Alphabetic Letters A, B, C, etc.
- YY — Serial No. of Instrument
- XX — Equipment Tag or Two Digits of Drawing Number
- PG — Instrument Function Nomenclature

Notes

Reference drawings

Key to symbols

Rev	Date	Drawn	Description	Ch'k'd	App'd
0	09.06.15	JBP	Issued for Engineering		

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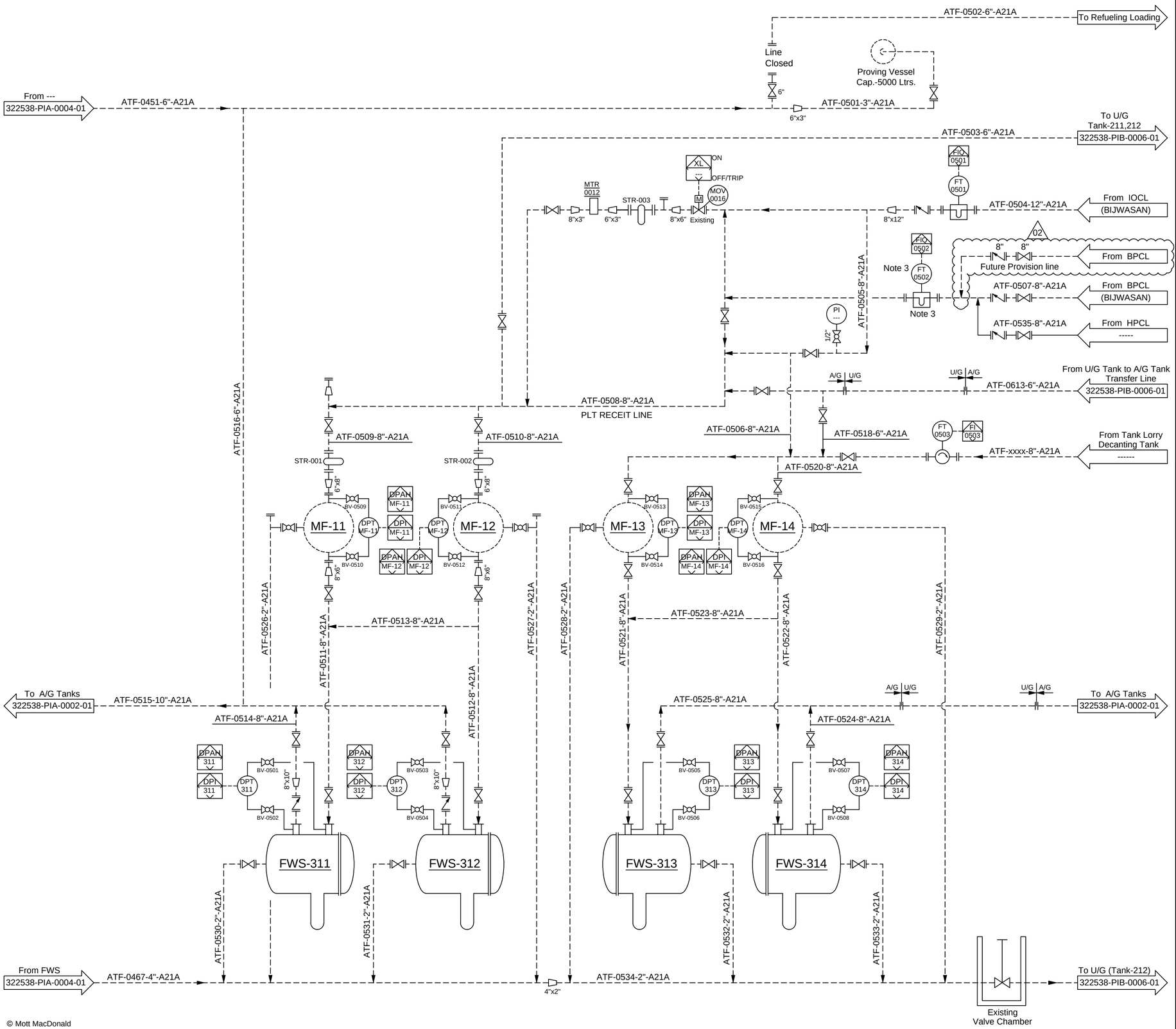
Title
Modernization of Existing Fuel Farm
Legend

Designed	JCP		Eng check	MMS	
Drawn	JBP		Coordination	AKM	
Dwg check	HRS		Approved	VST	

Scale at A2	Status	Rev	Security
NTS	EXE	0	STD

Drawing Number
322538-PIB-0001-01



Notes

1. For standard legend & nomenclature refer drawing no. 322538-PIB-0001-01.
2. All drain valve shall be normally closed.
3. Flow meter shall be custody transfer approved.

Reference drawings

Key to symbols

Rev	Date	Drawn	Description	Ch'k'd	App'd
02	27.10.15	JBP	Added Future line & Issued for Engineering		
01	26.10.15	JBP	Revised as Per Client`s Comments & Issued for Engineering	MMS	VST
0	16.09.15	JBP	Issued for Engineering	MMS	VST

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DAFFPL

Title

Modernization of Existing Fuel Farm
P & I Diagram
Pipe Line Receipt Line From IOCL & BPCL

Designed	JCP		Eng check	MMS	
Drawn	JBP		Coordination	VG	
Dwg check	HRS		Approved	VST	

Scale at A2	Status	Rev	Security
NTS	EXE	02	STD

Drawing Number

322538-PIB-0005-01

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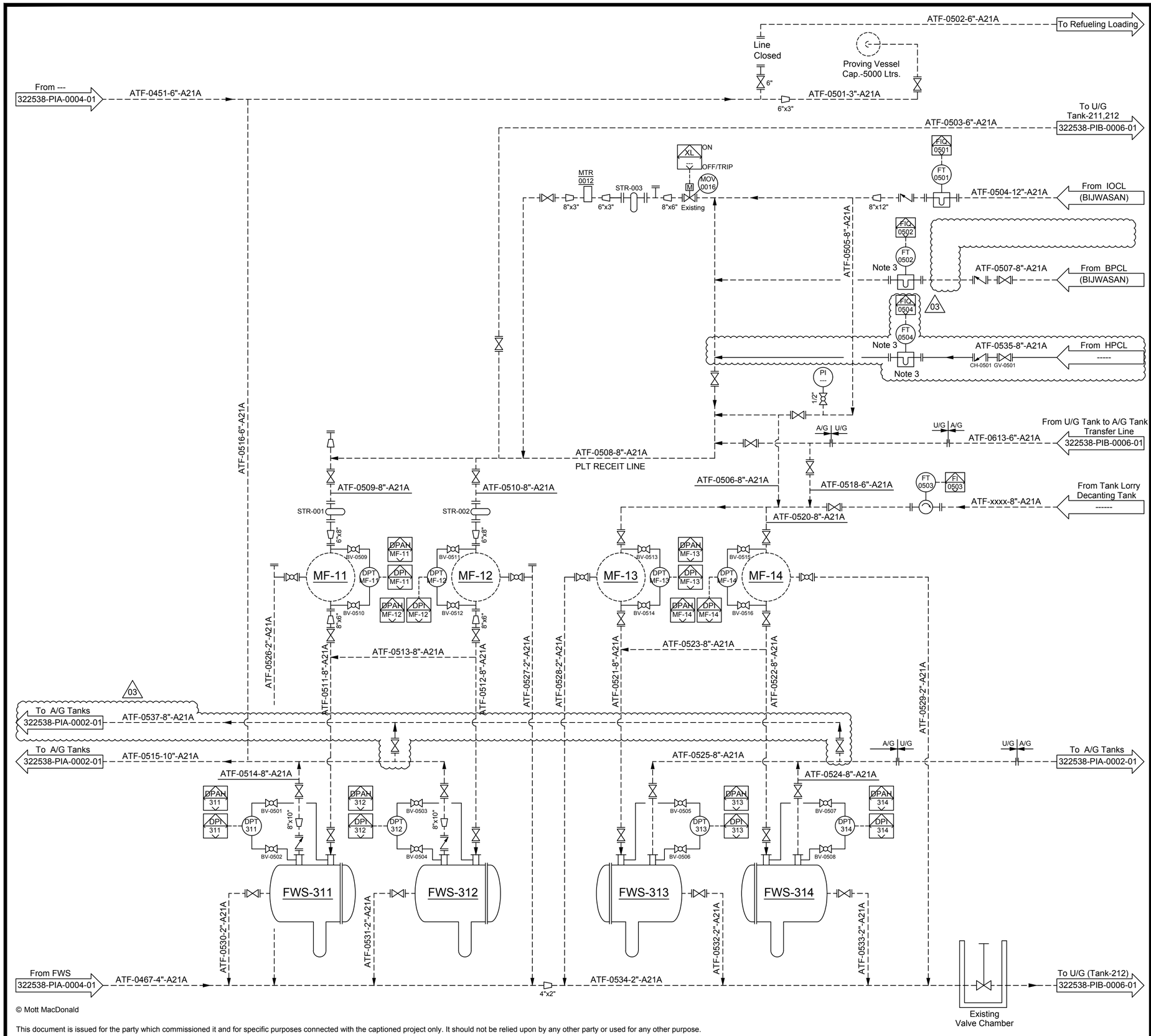

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Notes

1. For standard legend & nomenclature refer drawing no. 322538-PIB-0001-01.
2. All drain valve shall be normally closed.
3. Flow meter shall be custody transfer approved.

Reference drawings

Key to symbols

Rev	Date	Drawn	Description	Ch'k'd	App'd
03	01.03.16	CBP	Revised as per requirement & Issued for Engineering		
02	27.10.15	JBP	Added Future line & Issued for Engineering	MMS	VST
01	26.10.15	JBP	Revised as Per Client`s Comments & Issued for Engineering	MMS	VST
0	16.09.15	JBP	Issued for Engineering	MMS	VST

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IGI Airport,New Delhi - 110061

DAFFPL

Title

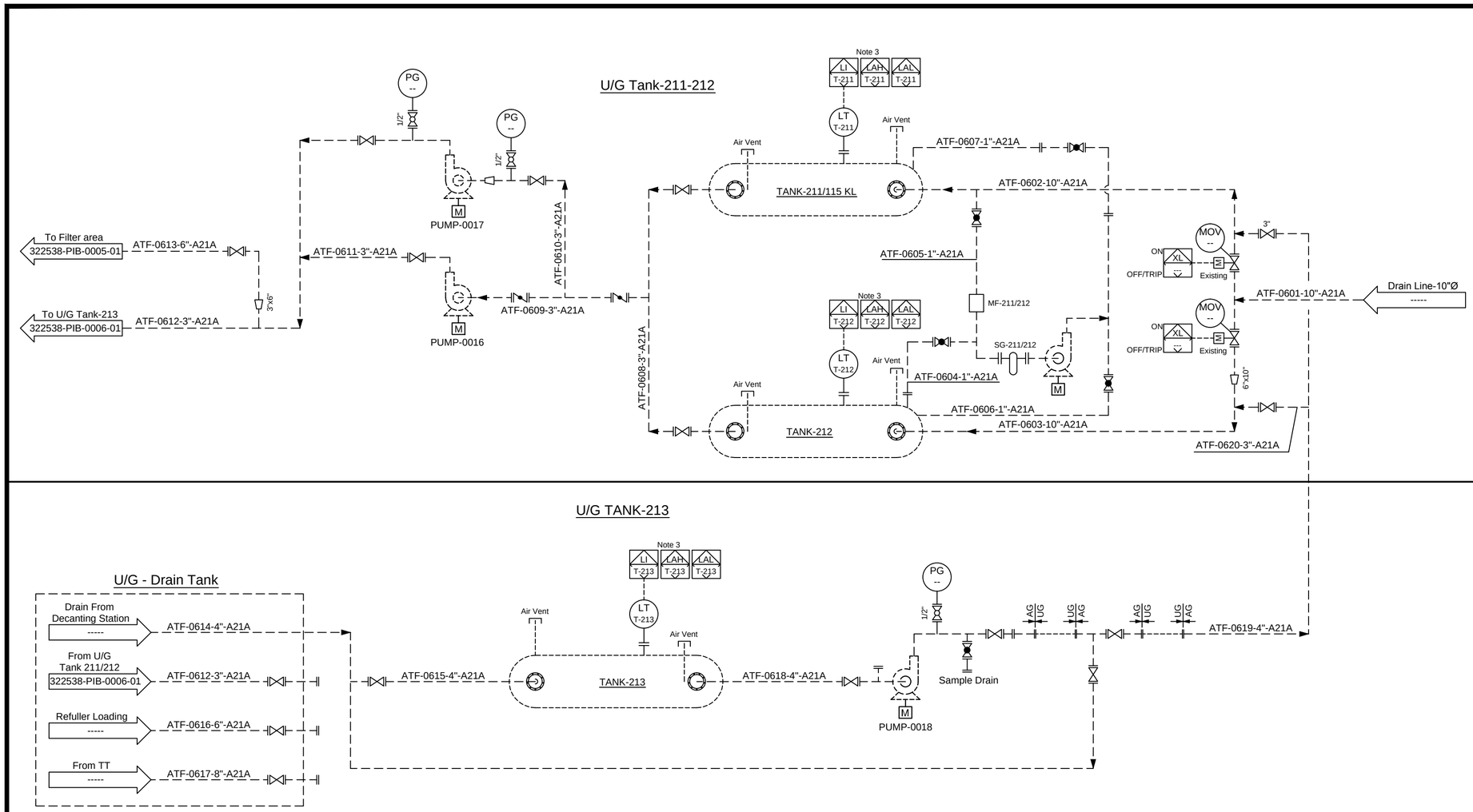
Modernization of Existing Fuel Farm
P & I Diagram
Pipe Line Receipt Line From IOCL,BPCL & HPCL

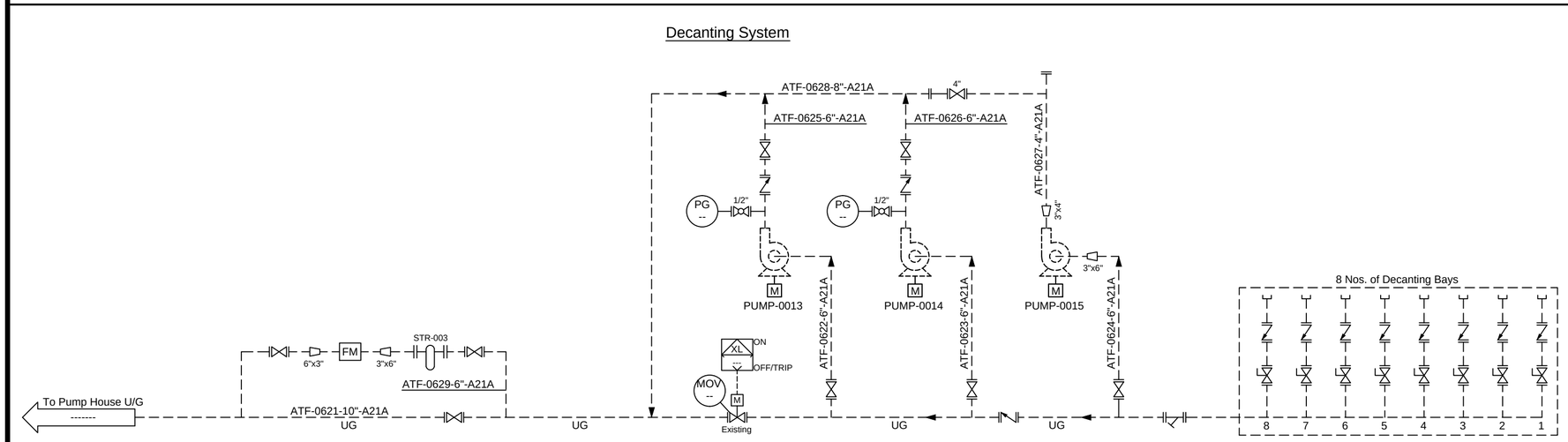
Designed	JCP		Eng check	MMS	
Drawn	JBP		Coordination	VG	
Dwg check	HRS		Approved	VST	

Scale at A2	Status	Rev	Security
NTS	EXE	03	STD

Drawing Number

322538-PIB-0005-01





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Notes

1. For standard legend & nomenclature refer drawing no. 322538-PIB-0001-01.
2. All drain valve shall be normally closed.
3. Existing arrangement.

EQUIPMENT LIST

S.NO	EQUIPMENT TAG	EQUIPMENT NAME	NUMBER	CAPACITY
01	PUMP-0016/0017	SLOP PUMP	02	40m³
02	PUMP-0018	DRAIN PUMP	01	30m³
03	PUMP-0013/0014	TANK LORRY DECANTING PUMP	02	80m³
04	PUMP-0015	TANK LORRY DECANTING PUMP	01	80m³
05	UG TANK 211	UNDER GROUND TANK	01	115 KL
06	UG TANK 212	UNDER GROUND TANK	01	200 KL
07	UG TANK 213	UNDER GROUND TANK	01	10 KL

Key to symbols

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M/s Delhi Aviation Fuel Facility Pvt. Ltd.
Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

Title
Modernization of Existing Fuel Farm
P & I Diagram
Under Ground Tank &
Decanting System

Designed	JCP		Eng check	MMS	
Drawn	JBP		Coordination	AKM	
Dwg check	HRS		Approved	VST	

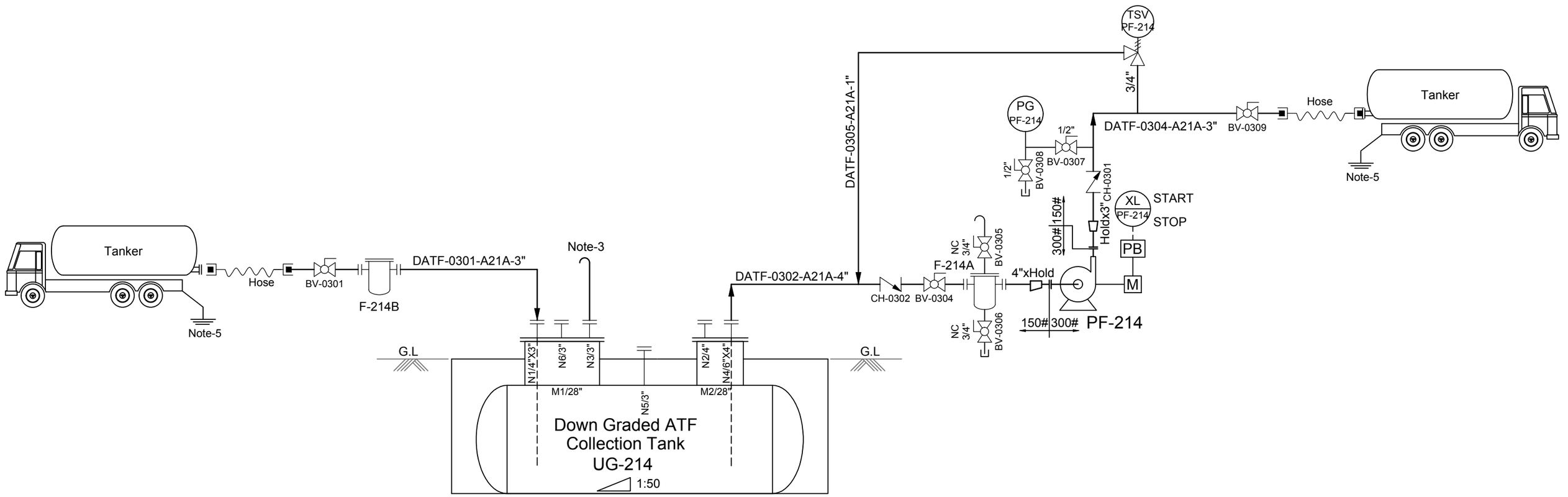
Scale at A2	Status	Rev	Security
NTS	EXE	0	STD

Drawing Number
322538-PIB-0006-01

Note :
1. For abbreviation & symbols refer drawing no 322538-PIB-0001-01.
2. The vent at the highest point and the drain at the lowest point, shall be provided in the pipe lines. The size of vent and drain shall be 3/4".
3. The vent shall be located at a height of not less than 4 meters above the ground level.
4. All ball valves shall be considered as quarter turn taper type.
5. Earthing provision for truck.

Equipment List

Sr No.	Tag No.	Description	QTY.	Capacity	MOC	Remarks
1	UG-214	Down Graded ATF Collection Tank	01	45 kL	MS	02
2	PF-214	Down Graded ATF Transfer Pump	01	20 M^3/hr @ 2.0 Kg/cm^2g	CS	



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Aviation Fuelling Station
Shahbad,Muhammad Pur
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Rev	Date	Drawn	Description	Ch'k'd	App'd
0	18.05.15	AGG	Issued for engineering	HRS	VST
01	21.05.15	AGG	Revised as per client's comment & Issued For Engineering	HRS	VST
02	29.06.15	AGG	Revised as per client's comment & Issued For Engineering		

Title
Modernization of Existing Fuel Farm
Process & Instrument Diagram of
Down Graded ATF Transfer System

Drawn	AGG	
Checked	HRS	
Approved	VST	

Scale at A3
NTS

Drawing Number
322538-PIC-0003-01

Security	Status	Rev
STD	EXE	02

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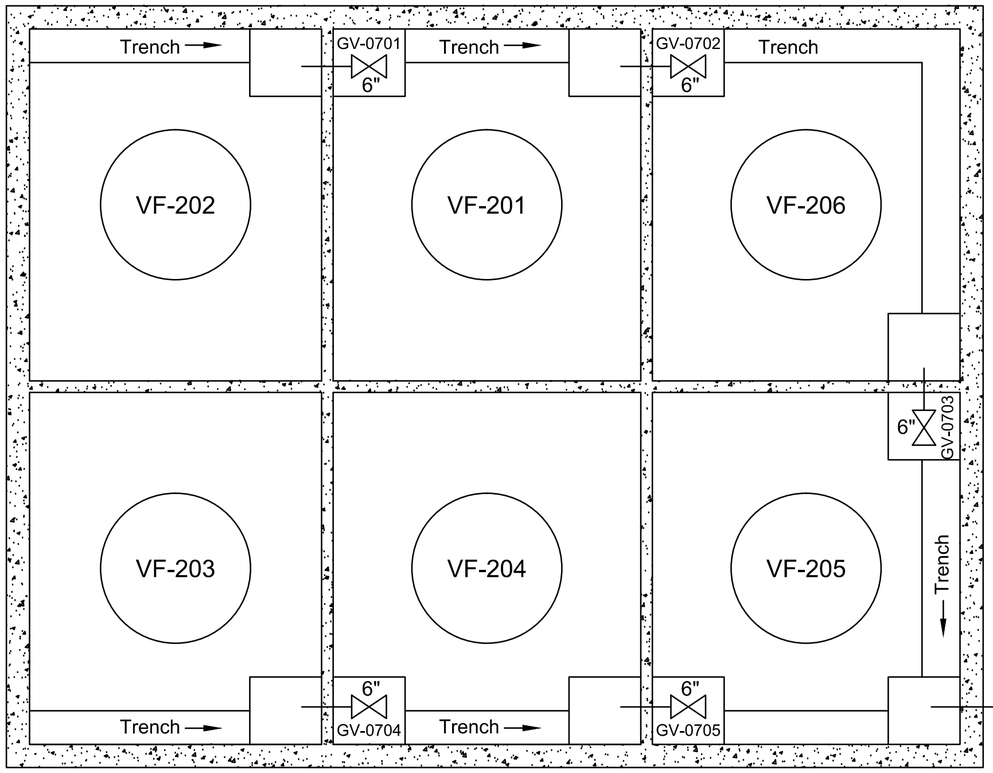
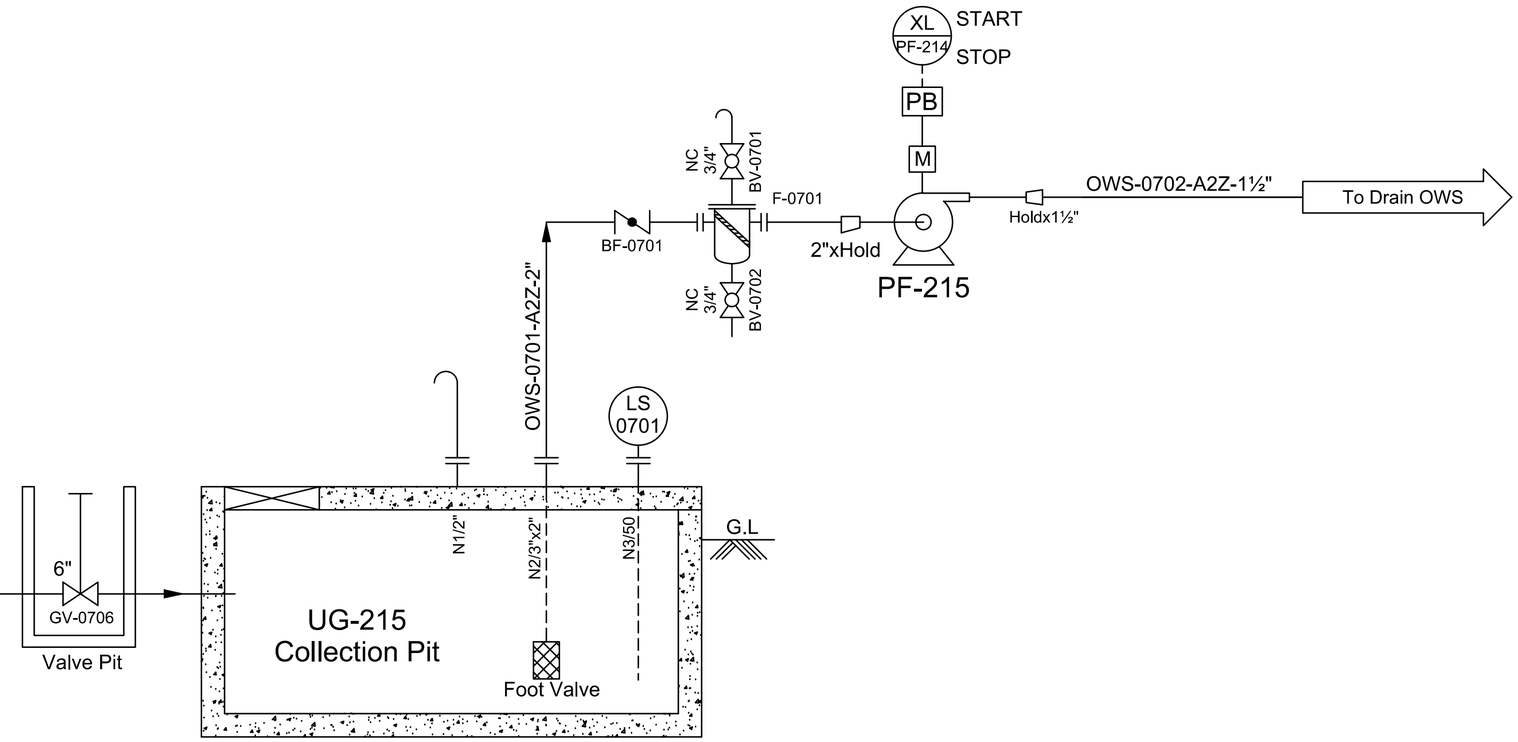
Note :
1. For abbreviation & symbols refer drawing no 322538-PIB-0001-01.
2. The vent at the highest point and the drain at the lowest point, shall be provided in the pipe lines. The size of vent and drain shall be 3/4".

Equipment List

Sr No.	Tag No.	Description	QTY.	Capacity	MOC	Remarks
1	UG-215	Oil Water Collection Tank	01	3.2 KL	RCC	
2	PF-215	Storm Water Transfer Pump	01	10 M^3/hr @ 1.1 Kg/cm^2g	CS	





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Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

Rev	Date	Drawn	Description	Ch'k'd	App'd
0	14.09.15	JBP	Issued for Engineering		

Title
Modernization of Existing Fuel Farm
Process & Instrument Diagram of
Oil Water Collection & Transfer

Drawn	CBP	
Checked	HRS	
Approved	VST	
Scale at A3	NTS	

Drawing Number: 322538-PIC-0007-01

Security	Status	Rev
STD	EXE	0

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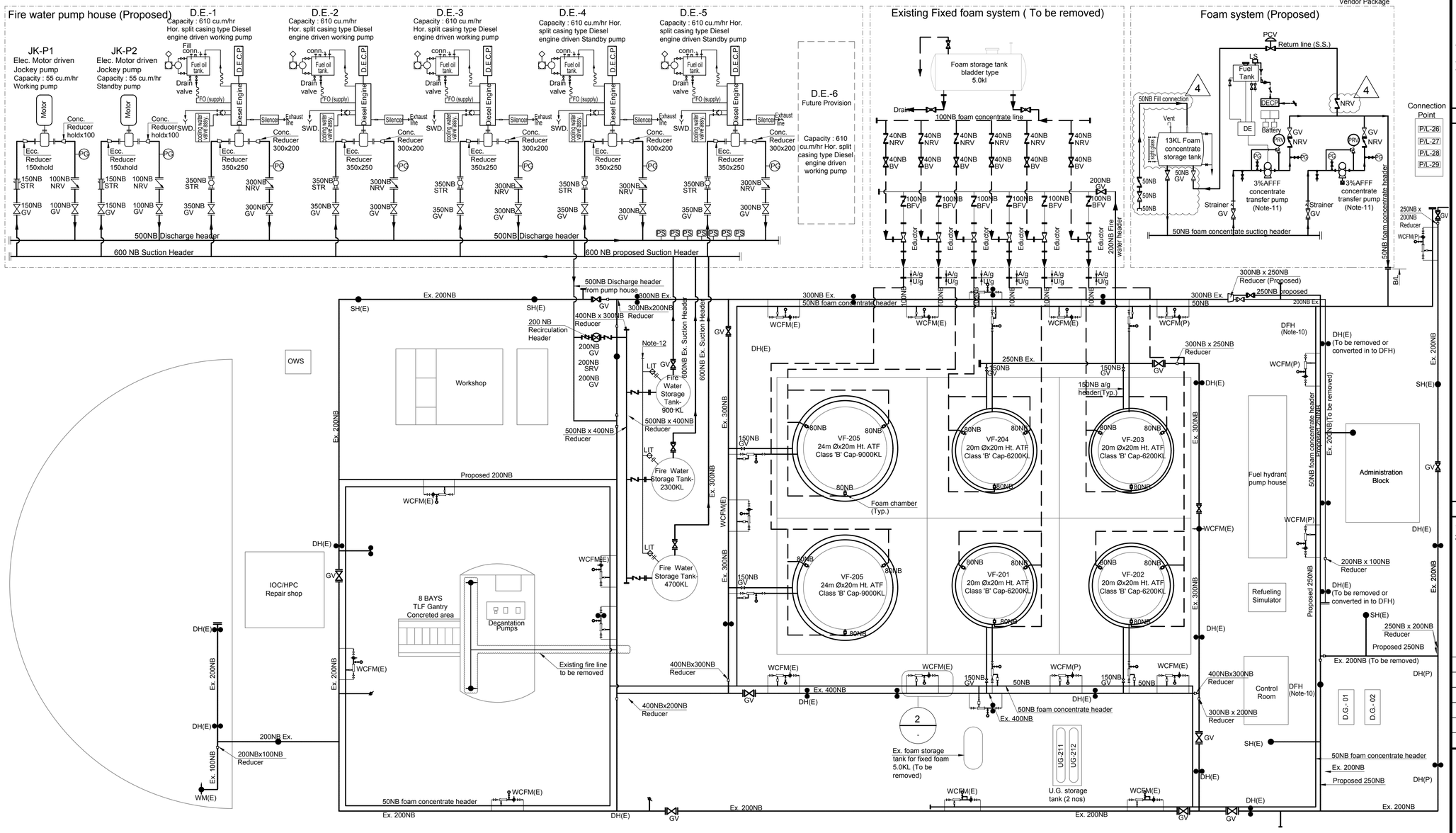


Notes

1. The vent at the highest point and the drain at the lowest point, shall be provided in the pipe lines. The size of vent and drain shall be 20NB.
2. All drain shall be routed to nearest drain pit or as per instruction of engineer in-charge (EIC).
3. All drain valve shall be normally closed.
4. Indicator & transmitter to be located at farthest point of fire hydrant network.
5. All pumps shall have manual starting In addition to auto start.
6. Water pressure in the network shall be maintained at 7.0 Kg/cm2 with the help of Jockey pump (Auto start Stop)
7. Fire pumps shall be stopped manually after fire fighting operation is over.
8. All main and standby pumps shall have provision for auto as well as manual start. however standby pumps shall be set on auto manual mode.
9. Battery charging arrangement shall be provided for stand by batteries also.
10. DFH- Double foam hydrant is provided for trolley mounted HVLR monitor connection.(To be hooked-up with DFH to fight the fire with the help of trolley mounted HVLR monitor.
11. Prime mover added due to increase of length of concentrate network.
12. Level transmitter' signal to be connected to SCADA panel as well as local indication in fire water pump house.

Key to symbols

Abbreviations :

- Centrifugal pump (side suction, side discharge)
- Gate valve (GV)
- Non return valve (NRV)
- Strainer 'Y' Type
- Concentric Reducer
- Eccentric Reducer
- IV = Isolation valve
- Typ. = Typical
- Proposed Hydrant Line
- Water cum foam monitor
- Double headed hydrant
- Existing foam lines
- Proposed foam lines
- Existing fire lines
- Proposed fire lines
- Existing fire line to be removed
- Interlock
- Pressure Indicator
- Electric Motor
- Hose Box
- NC - Normally close
- PH - Pump House
- PG - Pressure gauge
- PS - Pressure switch
- PT - Pressure transmitter
- SOL - Solenoid valve
- GLV - Globe valve
- GV - Gate valve
- BV - Ball valve
- BFV - Butterfly valve
- QBV - Quarter turn ball valve
- DFH- Double foam hydrant
- LIT = Level Transmitter with local indication
- Quick coupling

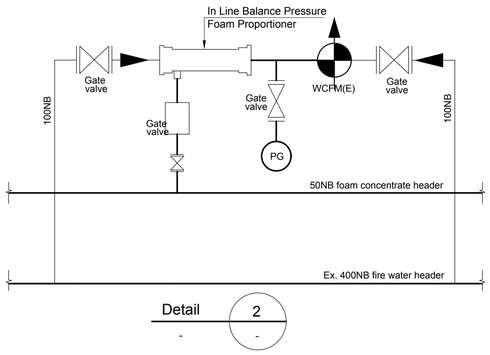
Reference drawings

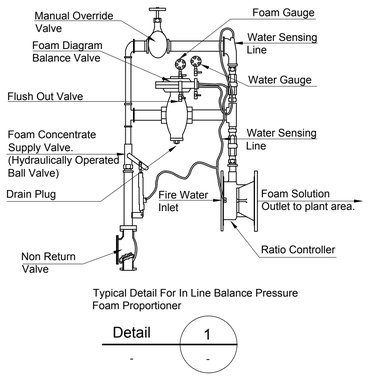
1. DAFFPL-GEL-PID-007-A P & I diagram for existing foam system, of M/s Greenleaf Engg. Ltd.
2. DAFFPL-GEL-PP-013 Existing fire hydrant layout, of M/s Greenleaf Engg. Ltd.

Proposed Pumps:-

Tag No.	Description	Cap/Head	Quantity	Pr.switch setting (kg/cm2)	Remarks
JK-P1	Elec. Motor driven Jockey pump	55 m3/hr. @110mwc	Working	10.5 / 10.0	Auto cut off / cut in
JK-P2	Elec. Motor driven Jockey pump	55 m3/hr. @110mwc	Stand by		
DE-1	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Working	9.5 / -	Auto start, Manual off.
DE-2	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Working	8.5 / -	Auto start, Manual off.
DE-3	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Working	7.5 / -	Auto start, Manual off.
DE-4	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Stand by	6.5 / -	Auto start, Manual off.
DE-5	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Stand by	5.5 / -	Auto start, Manual off.
DE-6	Diesel Engine driven pump	610 m3/hr. @105mwc	--	--	Future space planning

4





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Rev	Date	Drawn	Description	Ch'k'd	App'd
4	28.11.17	BNC	Revised as marked & Issued for Engineering.	JMT	VST
3	23.09.15	BNC	Revised as marked & Issued for Engineering.	JMT	VST
2	28.08.15	BNC	Revised as marked & Issued for Engineering.	MMS	VST
1	19.08.15	KDP	Revised as marked & Issued for Engineering.	MMS	VST
0	31.07.15	BNC	Issued for Engineering.	MMS	VST

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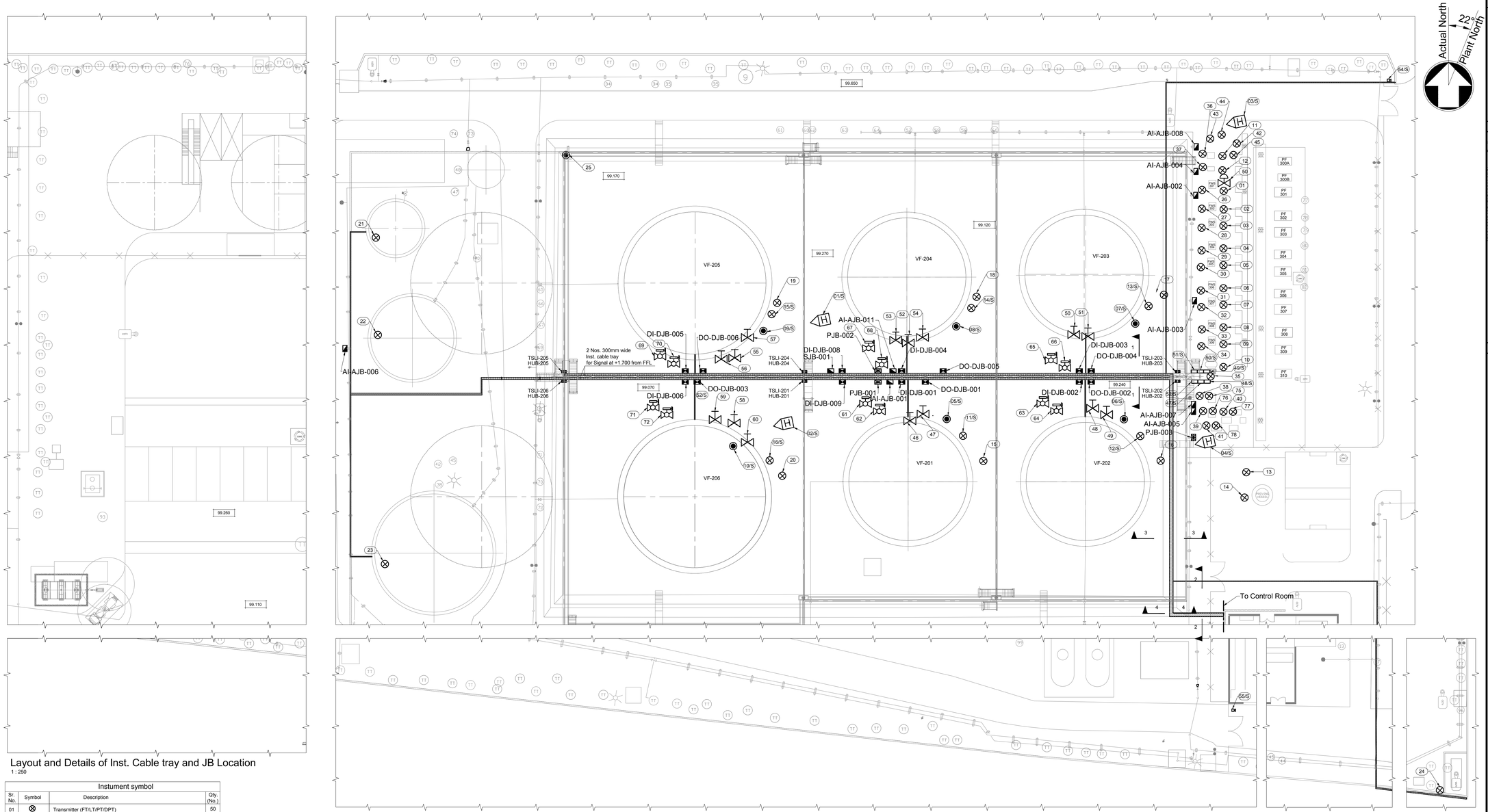
Title
Modernization of Existing Fuel Farm

P & ID for Fire fighting system

Designed	KDP		Eng check	MMS	
Drawn	BNC		Coordination	AKM	
Dwg check	KDP		Approved	VST	
Scale at A1	NTS	Status	EXE	Rev	4
Drawing Number	322538-RIA-0900-01			Security	STD



Layout and Details of Inst. Cable tray and JB Location

1 : 250

Instument symbol

Sr. No.	Symbol	Description	Qty. (No.)
01		Transmitter (FT/LT/PT/DPT)	50
02		Level Switch	07
03		Hand Operated Valve(HOV)	15
04		Motor Operated Valve(MOV)	14
05		Digital Input Junction Box (DI-DJB-001 to 006,008 to 009)	08
06		Digital Output Junction Box (DO-DJB-001 to 006)	06
07		Analogue Junction Box (AI-AJB-001 to 008,AI-AJB-011)	09
08		Signal Junction Box (SJB-001)	01
09		Power junction box (PJB-001 to 003)	03
10		Tank side level Indicator	06
11		HUB	06
12	ESD	Push Button	06
13	H	Hydro Carbon Gas Detector	04
14		Inst. Cable tray for Power	LOT
15		Inst. Cable tray for Process Signal and Safety Signal	LOT
16		Hooter	02

Inst. Location at Tank Farm Area

Sr.No.	Inst. Tag	Ref. Vessel/Line	JB No.
01/S	GD-VF-201	Tank Farm	Direct cable
02/S	GD-VF-202	Tank Farm	Direct cable
03/S	GD-401	Pump House	Direct cable
04/S	GD-402	Pump House	Direct cable
46	ROSOV-VF-201A	ATF-0206-20"-A21A	Direct cable
48	ROSOV-VF-202A	ATF-0210-10"-A21A	Direct cable
50	ROSOV-VF-203A	ATF-0217-20"-A21A	Direct cable
52	ROSOV-VF-204A	ATF-0221-10"-A21A	Direct cable
55	ROSOV-VF-205A	ATF-0261-20"-A21A	Direct cable
58	ROSOV-VF-206A	ATF-0263-10"-A21A	Direct cable
47/S	HS-1	xxxx	Direct cable
48/S	HS-2	xxxx	Direct cable
49/S	HS-3	xxxx	Direct cable
50/S	HS-4	xxxx	Direct cable
51/S	HS-5	xxxx	Direct cable
52/S	HS-6	xxxx	Direct cable
53/S	HS-207	xxxx	Direct cable
54/S	XS-01	xxxx	Direct cable
55/S	XS-02	xxxx	Direct cable

Inst. Location at Tank Farm Area

Sr.No.	Inst. Tag	Ref. Vessel/Line	JB No.
46	ROSOV-VF-201A_NO	ATF-0206-20"-A21A	DI-DJB-001
46	ROSOV-VF-201A_NC		DI-DJB-001
47	ROSOV-VF-201B_NO	ATF-0210-10"-A21A	DI-DJB-001
47	ROSOV-VF-201B_NC		DI-DJB-001
61	MOV-VF-201A_NO	Tank	DI-DJB-001
61	MOV-VF-201A_NC		DI-DJB-001
62	MOV-VF-201B_NO	Tank	DI-DJB-001
62	MOV-VF-201B_NC		DI-DJB-001
05/S	LS- VF 201	VF-201	DI-DJB-001
11/S	LT-VF-201-Hi_Hi	VF-201	DI-DJB-001
48	ROSOV-VF-202A_NO	ATF-0217-20"-A21A	DI-DJB-002
48	ROSOV-VF-202A_NC		DI-DJB-002
49	ROSOV-VF-202B_NO	ATF-0221-10"-A21A	DI-DJB-002
49	ROSOV-VF-202B_NC		DI-DJB-002
63	MOV-VF-202A_NO	Tank	DI-DJB-002
63	MOV-VF-202A_NC		DI-DJB-002
64	MOV-VF-202B_NO	Tank	DI-DJB-002
64	MOV-VF-202B_NC		DI-DJB-002
06/S	LS- VF 202	VF-202	DI-DJB-002
12/S	LT-VF-202-Hi_Hi	VF-202	DI-DJB-002
50	ROSOV-VF-203A_NO	ATF-0232-20"-A21A	DI-DJB-003
50	ROSOV-VF-203A_NC		DI-DJB-003
51	ROSOV-VF-203B_NO	ATF-0230-10"-A21A	DI-DJB-003
51	ROSOV-VF-203B_NC		DI-DJB-003
65	MOV-VF-203A_NO	Tank	DI-DJB-003
65	MOV-VF-203A_NC		DI-DJB-003
66	MOV-VF-203B_NO	Tank	DI-DJB-003
66	MOV-VF-203B_NC		DI-DJB-003
07/S	LS- VF 203	VF-203	DI-DJB-003
13/S	LT-VF-203-Hi_Hi	VF-203	DI-DJB-003
52	ROSOV-VF-204A_NO	ATF-0242-20"-A21A	DI-DJB-004
52	ROSOV-VF-204A_NC		DI-DJB-004
53	ROSOV-VF-204B_NO	ATF-0240-10"-A21A	DI-DJB-004
53	ROSOV-VF-204B_NC		DI-DJB-004
54	ROSOV-VF-204C_NO	ATF-0239-6"-A21A	DI-DJB-004
54	ROSOV-VF-204C_NC		DI-DJB-004
67	MOV-VF-204A_NO	Tank	DI-DJB-004
67	MOV-VF-204A_NC		DI-DJB-004
68	MOV-VF-204B_NO	Tank	DI-DJB-004
68	MOV-VF-204B_NC		DI-DJB-004
08/S	LS- VF 204	VF-204	DI-DJB-004
14/S	LT-VF-204-Hi_Hi	VF-204	DI-DJB-004

Inst. Location at Tank Farm Area

Sr.No.	Inst. Tag	Ref. Vessel/Line	JB No.
55	ROSOV-VF-205A_NO	ATF-0253-20"-A21A	DI-DJB-005
55	ROSOV-VF-205A_NC		DI-DJB-005
56	ROSOV-VF-205B_NO	ATF-0251-10"-A21A	DI-DJB-005
56	ROSOV-VF-205B_NC		DI-DJB-005
57	ROSOV-VF-205C_NO	ATF-0250-6"-A21A	DI-DJB-005
57	ROSOV-VF-205C_NC		DI-DJB-005
69	MOV-VF-205A_NO	Tank	DI-DJB-005
69	MOV-VF-205A_NC		DI-DJB-005
70	MOV-VF-205B_NO	Tank	DI-DJB-005
70	MOV-VF-205B_NC		DI-DJB-005
09/S	LS- VF 205	VF-205	DI-DJB-005
15/S	LT-VF-205-Hi_Hi	VF-205	DI-DJB-005
58	ROSOV-VF-206A_NO	ATF-0261-20"-A21A	DI-DJB-006
58	ROSOV-VF-206A_NC		DI-DJB-006
59	ROSOV-VF-206B_NO	ATF-0263-10"-A21A	DI-DJB-006
59	ROSOV-VF-206B_NC		DI-DJB-006
60	ROSOV-VF-206C_NO	ATF-0265-6"-A21A	DI-DJB-006
60	ROSOV-VF-206C_NC		DI-DJB-006
71	MOV-VF-206A_NO	Tank	DI-DJB-006
71	MOV-VF-206A_NC		DI-DJB-006
72	MOV-VF-206B_NO	Tank	DI-DJB-006
72	MOV-VF-206B_NC		DI-DJB-006
10/S	LS- VF 206	VF-206	DI-DJB-006
16/S	LT-VF-206-Hi_Hi	VF-206	DI-DJB-006
61	MOV-VF -201A_Trip	Tank	DI-DJB-008
63	MOV-VF -202A_Trip	Tank	DI-DJB-008
71	MOV-VF -206A_Trip	Tank	DI-DJB-008
65	MOV-VF -203A_Trip	Tank	DI-DJB-009
67	MOV-VF -204A_Trip	Tank	DI-DJB-009
69	MOV-VF -205A_Trip	Tank	DI-DJB-009

Inst. Location at Tank Farm Area

Sr.No.	Inst. Tag	Ref. Vessel/Line	JB No.
15	LT-VF-201A	VF-201	PJB-001
16	LT-VF-202A	VF-202	PJB-001
20	LT-VF-206A	VF-206	PJB-001
XX	HUB-VF-201	xxxx	PJB-001
XX	HUB-VF-202	xxxx	PJB-001
XX	HUB-VF-206	xxxx	PJB-001
17	LT-VF-203A	VF-203	PJB-002
18	LT-VF-204A	VF-204	PJB-002
19	LT-VF-205A	VF-205	PJB-002
XX	HUB-VF-203	xxxx	PJB-002
XX	HUB-VF-204	xxxx	PJB-002
XX	HUB-VF-205	xxxx	PJB-002
13	FT-501	ATF-0504-8"-A21A	PJB-003
14	FT-502	ATF-0507-8"-A21A	PJB-003

Inst. Location at Tank Farm Area

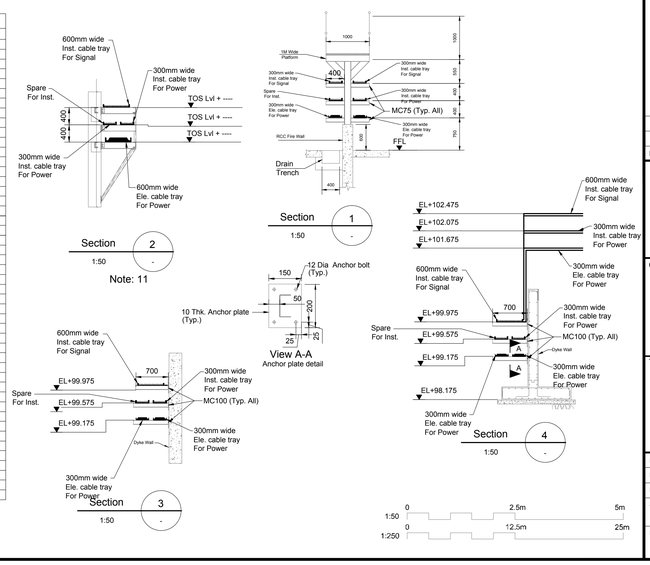
Sr.No.	Inst. Tag	Ref. Vessel/Line	JB No.
46	ROSOV-VF-201A_SOV	ATF-0206-20"-A21A	DO-DJB-001
47	ROSOV-VF-201B_SOV	ATF-0210-10"-A21A	DO-DJB-001
61	MOV-VF-201A_Open	Tank	DO-DJB-001
61	MOV-VF-201A_Close		DO-DJB-001
62	MOV-VF-201B_Open	Tank	DO-DJB-001
62	MOV-VF-201B_Close		DO-DJB-001
48	ROSOV-VF-202A_SOV	ATF-0217-20"-A21A	DO-DJB-002
49	ROSOV-VF-202B_SOV	ATF-0221-10"-A21A	DO-DJB-002
63	MOV-VF-202A_Open	Tank	DO-DJB-002
63	MOV-VF-202A_Close		DO-DJB-002
64	MOV-VF-202B_Open	Tank	DO-DJB-002
64	MOV-VF-202B_Close		DO-DJB-002
58	ROSOV-VF-206A_SOV	ATF-0261-20"-A21A	DO-DJB-003
59	ROSOV-VF-206B_SOV	ATF-0263-10"-A21A	DO-DJB-003
60	ROSOV-VF-206C_SOV	ATF-0265-6"-A21A	DO-DJB-003
71	MOV-VF-206A_Open	Tank	DO-DJB-003
71	MOV-VF-206A_Close		DO-DJB-003
72	MOV-VF-206B_Open	Tank	DO-DJB-003
72	MOV-VF-206B_Close		DO-DJB-003
50	ROSOV-VF-203A_SOV	ATF-0232-20"-A21A	DO-DJB-004
51	ROSOV-VF-203B_SOV	ATF-0230-10"-A21A	DO-DJB-004
65	MOV-VF-203A_Open	Tank	DO-DJB-004
65	MOV-VF-203A_Close		DO-DJB-004
66	MOV-VF-203B_Open	Tank	DO-DJB-004
66	MOV-VF-203B_Close		DO-DJB-004
52	ROSOV-VF-204A_SOV	ATF-0242-20"-A21A	DO-DJB-005
53	ROSOV-VF-204B_SOV	ATF-0240-10"-A21A	DO-DJB-005
54	ROSOV-VF-204C_SOV	ATF-0239-6"-A21A	DO-DJB-005
67	MOV-VF-204A_Open	Tank	DO-DJB-005
67	MOV-VF-204A_Close		DO-DJB-005
68	MOV-VF-204B_Open	Tank	DO-DJB-005
68	MOV-VF-204B_Close		DO-DJB-005
55	ROSOV-VF-205A_SOV	ATF-0253-20"-A21A	DO-DJB-006
56	ROSOV-VF-205B_SOV	ATF-0251-10"-A21A	DO-DJB-006
57	ROSOV-VF-205C_SOV	ATF-0250-6"-A21A	DO-DJB-006
69	MOV-VF-205A_Open	Tank	DO-DJB-006
69	MOV-VF-205A_Close		DO-DJB-006
70	MOV-VF-205B_Open	Tank	DO-DJB-006
70	MOV-VF-205B_Close		DO-DJB-006

Inst. Location at Tank Farm Area

Sr.No.	Inst. Tag	Ref. Vessel/Line	JB No.
XX	CP-T1	xxxx	Direct cable
XX	CP-T2	xxxx	Direct cable
XX	CP-T3	xxxx	Direct cable
XX	PC-1	xxxx	Direct cable
XX	PC-2	xxxx	Direct cable
XX	PC-3	xxxx	Direct cable
XX	PC-4	xxxx	Direct cable
24	LT-HSD-1	xxxx	Direct cable
25	LS-701	Tank	Direct cable

Inst. Location at Tank Farm Area

Sr.No.	Inst. Tag	Ref. Vessel/Line	JB No.
15	LT-VF-201A	VF-201	AI-AJB-001
16	LT-VF-202A	VF-202	AI-AJB-001
20	LT-VF-206A	VF-206	AI-AJB-001
01	FT-301	ATF-0410-10"-A21A	AI-AJB-002
02	FT-302	ATF-0414-10"-A21A	AI-AJB-002
03	FT-303	ATF-0418-10"-A21A	AI-AJB-002
04	FT-304	ATF-0422-10"-A21A	AI-AJB-002
05	FT-305	ATF-0426-10"-A21A	AI-AJB-002
24	DPT-301	FWS-301	AI-AJB-002
25	DPT-302	FWS-302	AI-AJB-002
26	DPT-303	FWS-303	AI-AJB-002
27	DPT-304	FWS-304	AI-AJB-002
28	DPT-305	FWS-305	AI-AJB-002
06	FT-306	ATF-0430-10"-A21A	AI-AJB-003
07	FT-307	ATF-0434-10"-A21A	AI-AJB-003
08	FT-308	ATF-0438-10"-A21A	AI-AJB-003
09	FT-309	ATF-0438-10"-A21A	AI-AJB-003
10	FT-310	ATF-0446-10"-A21A	AI-AJB-003
29	DPT-306	FWS-306	AI-AJB-003
30	DPT-307	FWS-307	AI-AJB-003
31	DPT-308	FWS-308	AI-AJB-003
32	DPT-309	FWS-309	AI-AJB-003
33	DPT-310	FWS-310	AI-AJB-003
11	FT-300A	ATF-0403-6"-A21A	AI-AJB-004
12	FT-300B	ATF-0406-6"-A21A	AI-AJB-004
34	DPT-300A	FWS-JKA	AI-AJB-004
35	DPT-300B	FWS-JKB	AI-AJB-004
13	FT-501	ATF-0504-8"-A21A	AI-AJB-005
14	FT-502	ATF-0507-8"-A21A	AI-AJB-005
21	LT-T-1(FW)	Tank-1	AI-AJB-006
22	LT-T-1(FW)	Tank-2	AI-AJB-006
23	LT-T-1(FW)	Tank-3	AI-AJB-006
36	DPT-311	FWS-311	AI-AJB-007
37	DPT-312	FWS-312	AI-AJB-007
38	DPT-313	FWS-313	AI-AJB-007
39	DPT-314	FWS-314	AI-AJB-007
75	MF-311	FWS-311	AI-AJB-007
76	MF-312	FWS-312	AI-AJB-007
77	MF-313	FWS-313	AI-AJB-007
78	MF-314	FWS-314	AI-AJB-007
40	PT-401	ATF-0448-24"-A21A	AI-AJB-008
41	FT-401	ATF-0447-32"-A21A	AI-AJB-008
42	PT-402	ATF-0447-32"-A21A	AI-AJB-008
43	FT-402	ATF-0448-24"-A21A	AI-AJB-008
17	LT-VF-203A	VF-203	AI-AJB-011
18	LT-VF-204A	VF-204	AI-AJB-011
19	LT-VF-205A	VF-205	AI-AJB-011



Notes

1. All dimensions are in mm and elevations are in meters unless otherwise specified.
2. Junction boxes to be Installed at Lvl +1.5m from FFL.
3. Cable tray to be supported at max. 1.5 to 2.0 mtr distance. The location of support, to suit site condition.
4. Refer JB Schedule No. 343596-NJD-0001 for Cable length and termination details.
5. Structural details if shown like rack, stairs, supports etc., are indicative. Refer structural/civil drawings for the same.
6. Refer Piping Layout drawings for Instruments elevation.
7. Refer Hook-up drawings for Instruments Installation details.
8. JB Location shown are tentative, exact location of JB's shall be decided at site to suit site conditions, in consultation with client/site incharge.
9. Provide jumpers to avoid clashings with other services trays and pipes.
10. The Location of Instruments shown in this drawing are tentative and shall be revised as per piping drawing.
11. Given location and support detail are tentative it shall be finalized based on site details.
12. Internal routing of cables in Control room based on site details.

Key to symbols

Abbreviations :

Inst.	= Instrument
TOS	= Top of structure
FFL	= Finished Floor Level
m	= Meter
Ele.	= Electrical
Min.	= Minimum

Reference drawings

1) 322538-APA-0001-01 - Plot plan
3) 322538-CMA-0010-01 - Layout & Details of Platforms of Equipment
3) 322538-MPE-0100-01 - Equipment Plot Plan
4) 322538-MPE-0102-01 - Layout for Proposed Enclose
5) 322538-MPE-0105-01 - Piping Layout Fuel Hydrant Pump House
6) 322538-MPE-0106-01 - Piping Layout ATF Storage Tank

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	16.12.2015	BDP	Issued for construction		
P1	18.09.2015	BDP	Issued for approval	KBT	VST

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Client

M/s Delhi Aviation Fuel Facility Pvt. Ltd.
Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm

Layout and details of Elec. & Inst. Cable tray

Designed	HVM		Eng check	KBT/THS	
Drawn	BDP		Coordination	VST	
Dwg check	SSJ		Approved	VST	
Scale at A0	Status		Rev	Security	
As shown	CON		A	STD	

Drawing Number

322538-NLE-0261-01

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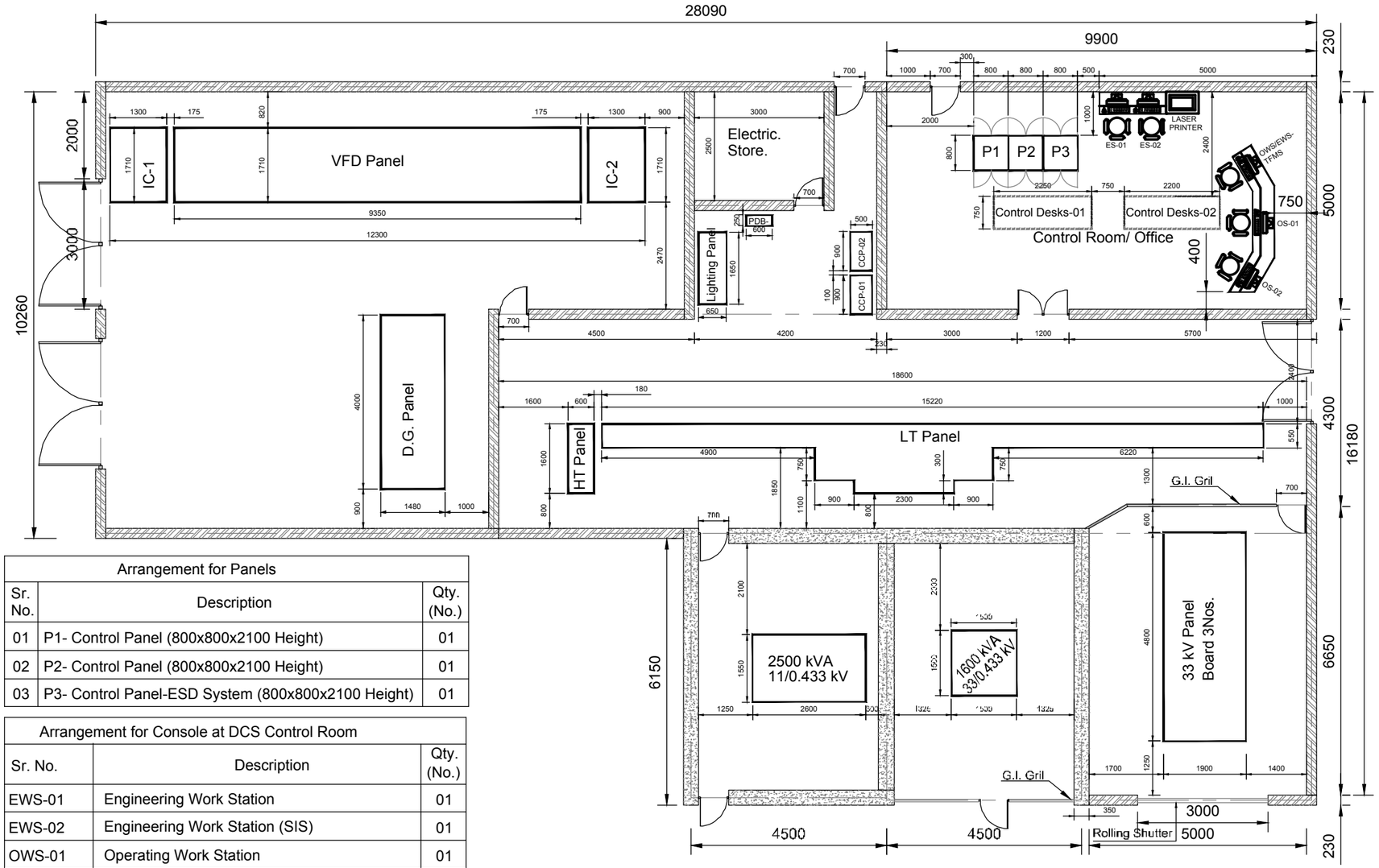

Arrangement for Panels		
Sr. No.	Description	Qty. (No.)
01	P1- Control Panel (800x800x2100 Height)	01
02	P2- Control Panel (800x800x2100 Height)	01
03	P3- Control Panel-ESD System (800x800x2100 Height)	01

Arrangement for Console at DCS Control Room		
Sr. No.	Description	Qty. (No.)
EWS-01	Engineering Work Station	01
EWS-02	Engineering Work Station (SIS)	01
OWS-01	Operating Work Station	01
OWS/EWS-TFMS	Operating Work Station/Engineering Work Station-Tank Farm Management System	01
OWS-02	Engineering Work Station	01

Notes:-

1. All Dimensions are in Millimeters and Levels are in Meters.

1:100 0 5m 10m

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Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	06.08.15	B.D.P.	Issued for approval	K.B.T.	B.K.P.
A	27.08.15	B.D.P.	Issued for construction	K.B.T.	B.K.P.

Title: Modernization of Existing Fuel Farm
HT & LT Sub Station layout

Drawn	BDP	
Checked	KBT	
Approved	AKS/BKP	
Scale at A3	1:100	

Drawing Number: 322538-NLC-0264-01

Security	Status	Rev
STD	CON	A

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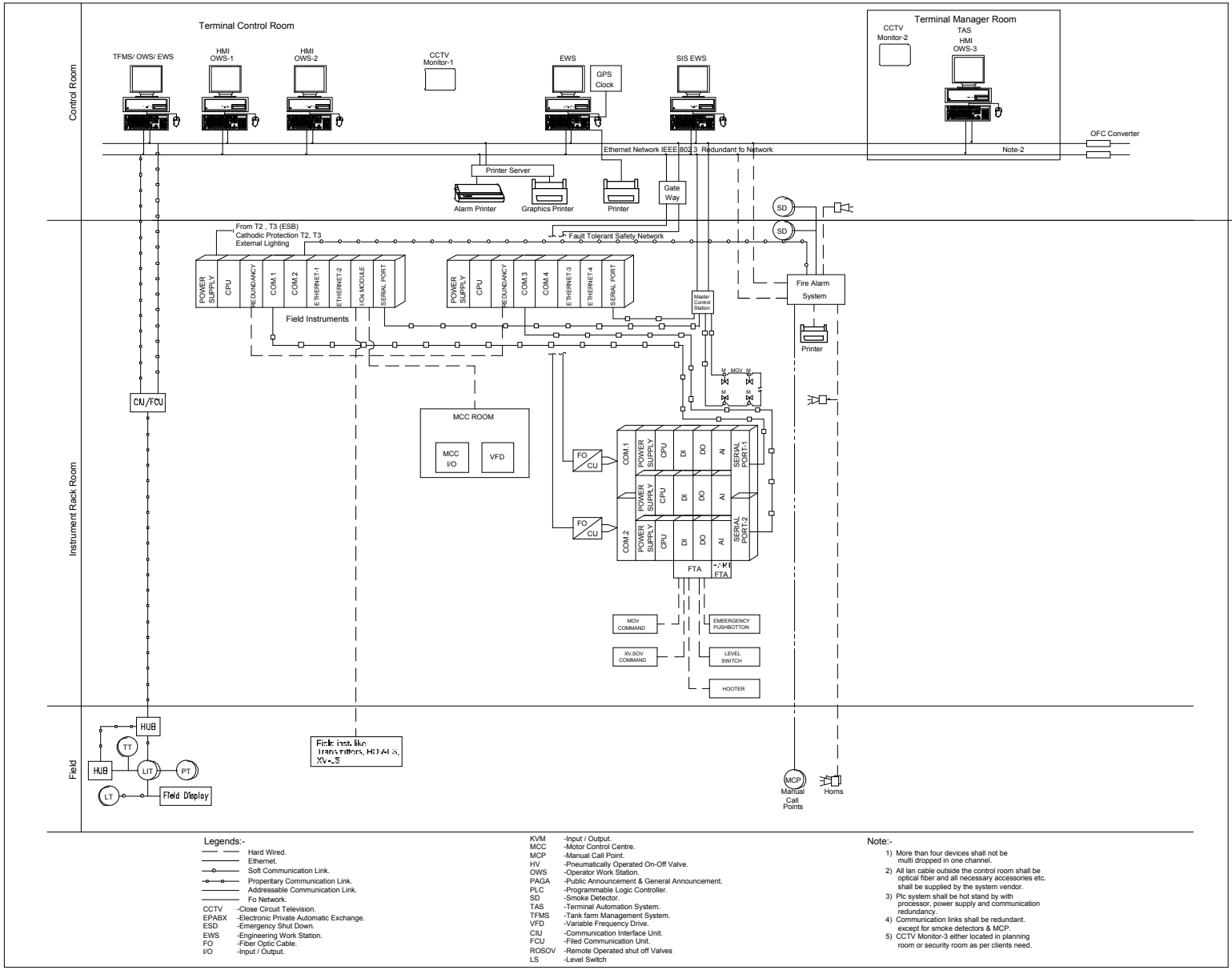

Legends:-

	Hard Wired.
	Ethernet.
	Soft Communication Link.
	Properitary Communication Link.
	Addressable Communication Link.
	Fo Network.
CCTV	-Close Circuit Television.
EPABX	-Electronic Private Automatic Exchange.
ESD	-Emergency Shut Down.
EWS	-Engineering Work Station.
FO	-Fiber Optic Cable.
I/O	-Input / Output.
KVM	-Input / Output.
MCC	-Motor Control Centre.
MCP	-Manual Call Point.
HV	-Pneumatically Operated On-Off Valve.
OWS	-Operator Work Station.
PAGA	-Public Announcement & General Announcement.
PLC	-Programmable Logic Controller.
SD	-Smoke Detector.
TAS	-Terminal Automation System.
TFMS	-Tank farm Management System.
VFD	-Variable Frequency Drive.
CIU	-Communication Interface Unit.
FCU	-Filed Communication Unit.
ROSOV	-Remote Operated shut off Valves
LS	-Level Switch

Note:-

1) More than four devices shall not be multi dropped in one channel.
2) All lan cable outside the control room shall be optical fiber and all necessary accessories etc. shall be supplied by the system vendor.
3) Plc system shall be hot stand by with processor, power supply and communication redundancy.
4) Communication links shall be redundant. except for smoke detectors & MCP.
5) CCTV Monitor-3 either located in planning room or security room as per clients need.

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Rev	Date	Drawn	Description	Ch'k'd	App'd
P2	16.07.15	B.D.P.	Issued for Approval	V.S.T	A.K.M
A	29.07.15	B.D.P.	Issued for Construction	K.B.T.	B.K.P.

Title: Modernization of Existing Fuel Farm System Architecture

Drawn	BDP	
Checked	KBT	
Approved	AKS/BKP	
Scale at A3	N.T.S	

Drawing Number: 322538-NIC-0001-01

Security	Status	Rev
STD	CON	A

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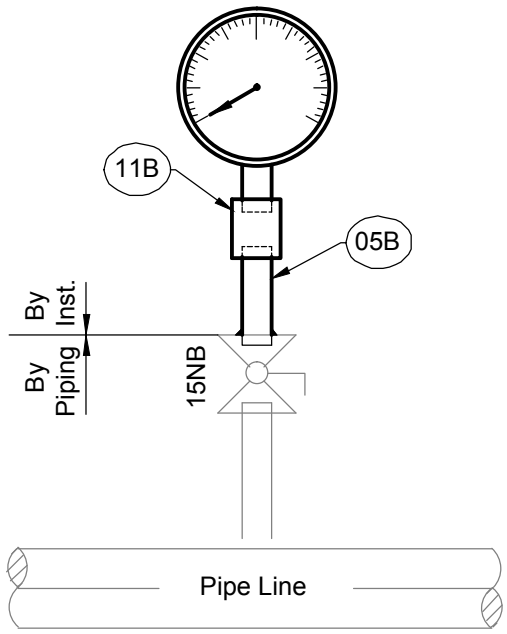
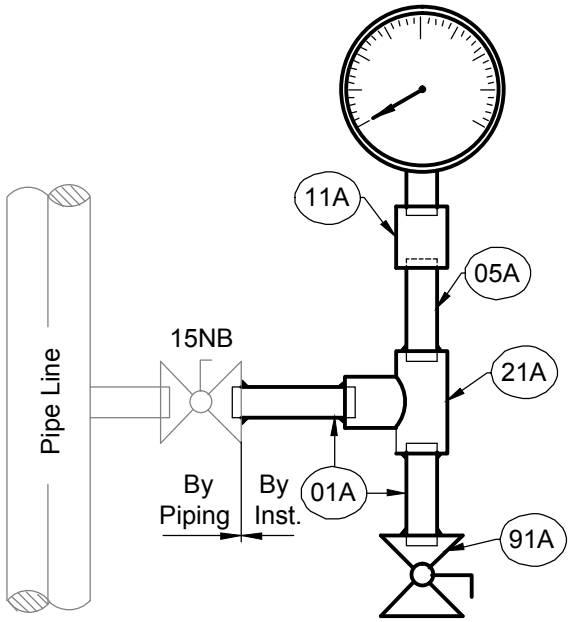
Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP
P1	01.09.15	BDP	Issued for approval	KBT	BKP



Arrangement for horizontal line



Arrangement for Vertical line(with drain)

Sr.No.	Tag No	Line Ref.
1	PG-701	OWS-0703-A2Z-4"
2	PG-702	OWS-0704-A2Z-4"

Sr.No.	Tag No	Line Ref.
1	PG- PF -214	DATF-0304- A21A-3"

Bill of Material

Item Code	Item Description	Material (Spec.)	Qty. per Tag	With Drain	Qty. per Tag	Without Drain	Unit
01A	Nipple (PLxPL) 1/2" x 100mm	A21A	01	01	--	--	Nos.
05A	Nipple (PLxTH) 1/2" x 100mm	A21A	01	01	--	--	Nos.
05B	Nipple (PLxTH) 1/2" x 100mm	A2Z	--	--	01	02	Nos.
11A	15NB Coupling (Scrd.)	A21A	01	01	--	--	Nos.
11B	15NB Coupling (Scrd.)	A2Z	--	--	01	02	Nos.
21A	15NB Tee (SW)	A21A	01	01	--	--	Nos.
91A	Drain Valve (SW)	A21A	01	01	--	--	Nos.

Note :
1. This is standard hook-up drawing and shall be applicable as per P&IDs.
2. The Bill of material is indicative and the Qty. may vary as per site requirements.
3. The welding requirement for instrument installation should be in Mechanical/Piping Contractor scope.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Pressure Gauge
(Bourdon type)

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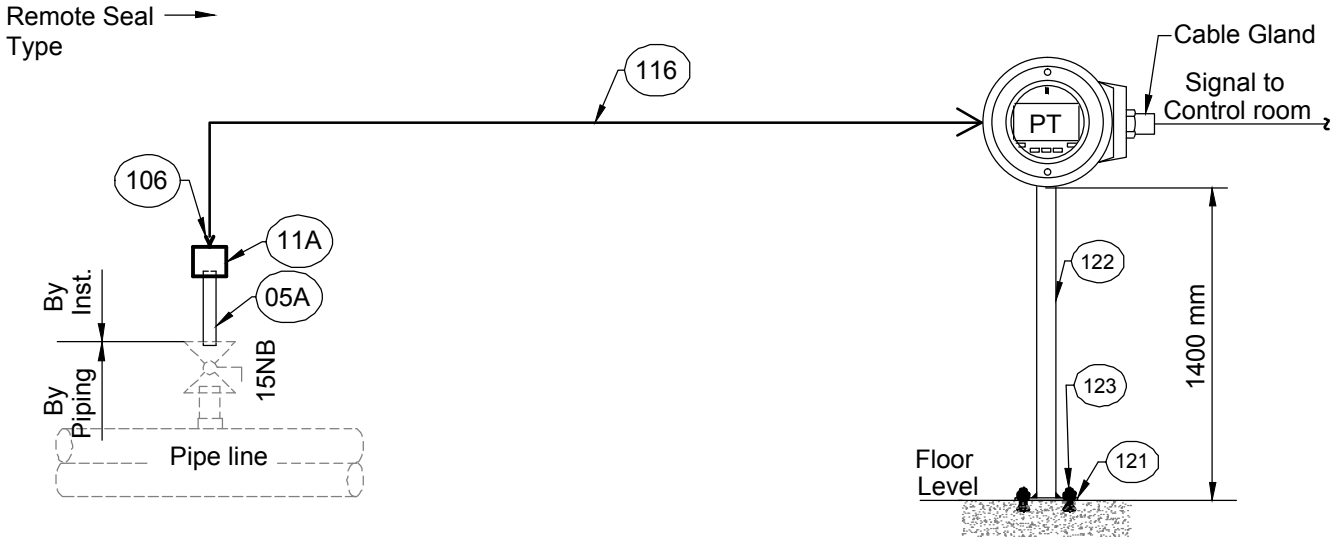
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0191-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Line Ref.
1	PT-401	ATF-0448-24"-A21A

Item code	Item Description	Material (Spec.)	Qty. per Tag	Total Qty.	Unit
05A	Nipple (PLxTH) 1/2" x 100mm	A21A	01	01	Nos.
11A	15NB Coupling (Scrd.)	A21A	01	01	Nos.
106	Male Connector, 1/2" NPT x 1/2" O/D	SS 316	02	02	Nos.
116	Seamless Tube, 1/2" OD x 0.049" Thk.	SS 316	05	05	Mtrs.
121	MS Base Plate, 150 x 150 x 6 mm thk.	MS	01	01	Nos.
122	Ø2" Pipe x 1400mm Long	GI	01	01	Nos.
123	Anchor Fastners, M12 x 125mm Long	MS	04	04	Nos.

Note :
1. This is standard hook-up drawing and shall be applicable as per P&IDs.
2. The Bill of material is indicative and the Qty. may vary as per site requirements.
3. The welding requirement for instrument installation should be in Mechanical/Piping Contractor scope.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Pressure Transmitter
(Diaphragm type)

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Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0195-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
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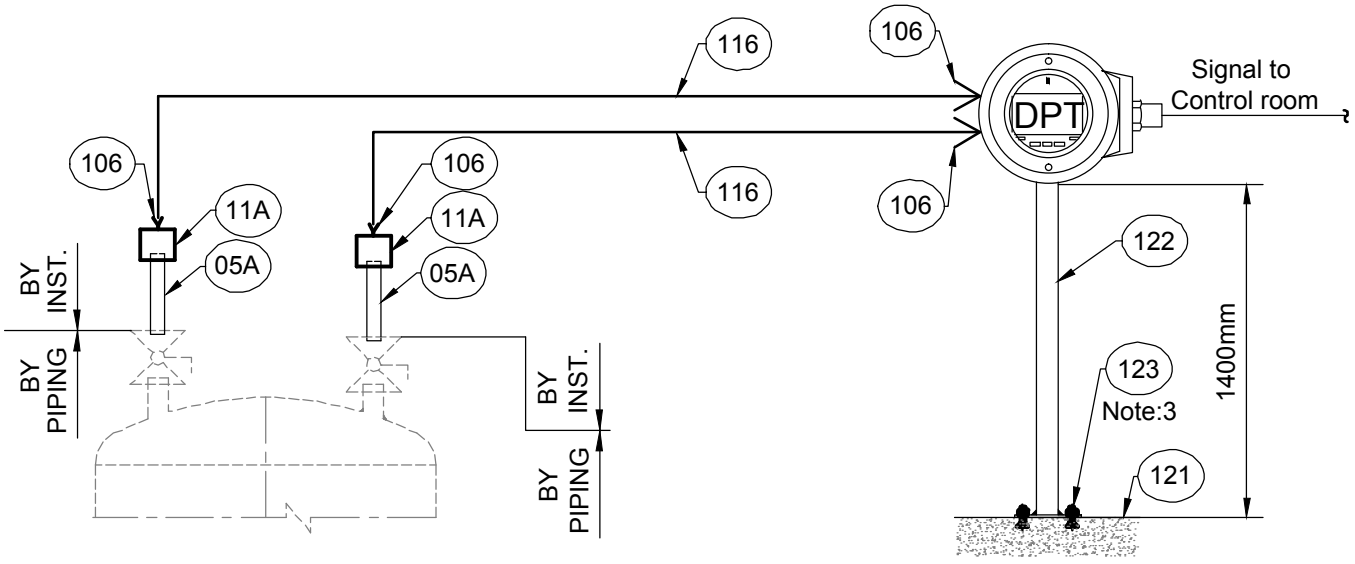
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Line/Vessel Ref.		Sr.No.	Tag No	Line/Vessel Ref.	
1	DPT-301	FWS-301	(A21A)	9	DPT-309	FWS-309	(A21A)
2	DPT-302	FWS-302	(A21A)	10	DPT-310	FWS-310	(A21A)
3	DPT-303	FWS-303	(A21A)	11	DPT-300 A	FWS-JKA	(A21A)
4	DPT-304	FWS-304	(A21A)	12	DPT-300 B	FWS-JKB	(A21A)
5	DPT-305	FWS-305	(A21A)	13	DPT-311	FWS-311	(A21A)
6	DPT-306	FWS-306	(A21A)	14	DPT-312	FWS-312	(A21A)
7	DPT-307	FWS-307	(A21A)	15	DPT-313	FWS-313	(A21A)
8	DPT-308	FWS-308	(A21A)	16	DPT-314	FWS-314	(A21A)

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Pressure Transmitter
(Differential type)

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Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0196-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd		Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP							
P1	01.09.15	BDP	Issued for approval	KBT	BKP							

Bill of Material for Unloading

Item Code	Item Description	Material (Spec.)	Qty. per Tag	Total Qty.	Unit
05A	Nipple (PLxTH) 1/2" x 100mm	A1M	02	32	Nos.
11A	15NB Coupling (Scrd.)	A1M	02	32	Nos.
106	Male Connector, 1/2" NPT x 1/2" O/D	SS 316	04	64	Nos.
116	Seamless Tube, 1/2" OD x 0.049" Thk.	SS 316	05	80	Mtrs.
121	MS Base Plate, 150 x 150 x 6 mm thk.	MS	01	16	Nos.
122	Ø2" Pipe x 1400mm Long	GI	01	16	Nos.
123	Anchor Fastners, M12 x 125mm Long	MS	04	64	Nos.

Note :
1. This is standard hook-up drawing and shall be applicable as per P&IDs.
2. The Bill of material is indicative and the Qty. may vary as per site requirements.
3. The welding requirement for instrument installation should be in Mechanical/Piping Contractor scope.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Pressure Transmitter
(Differential type)

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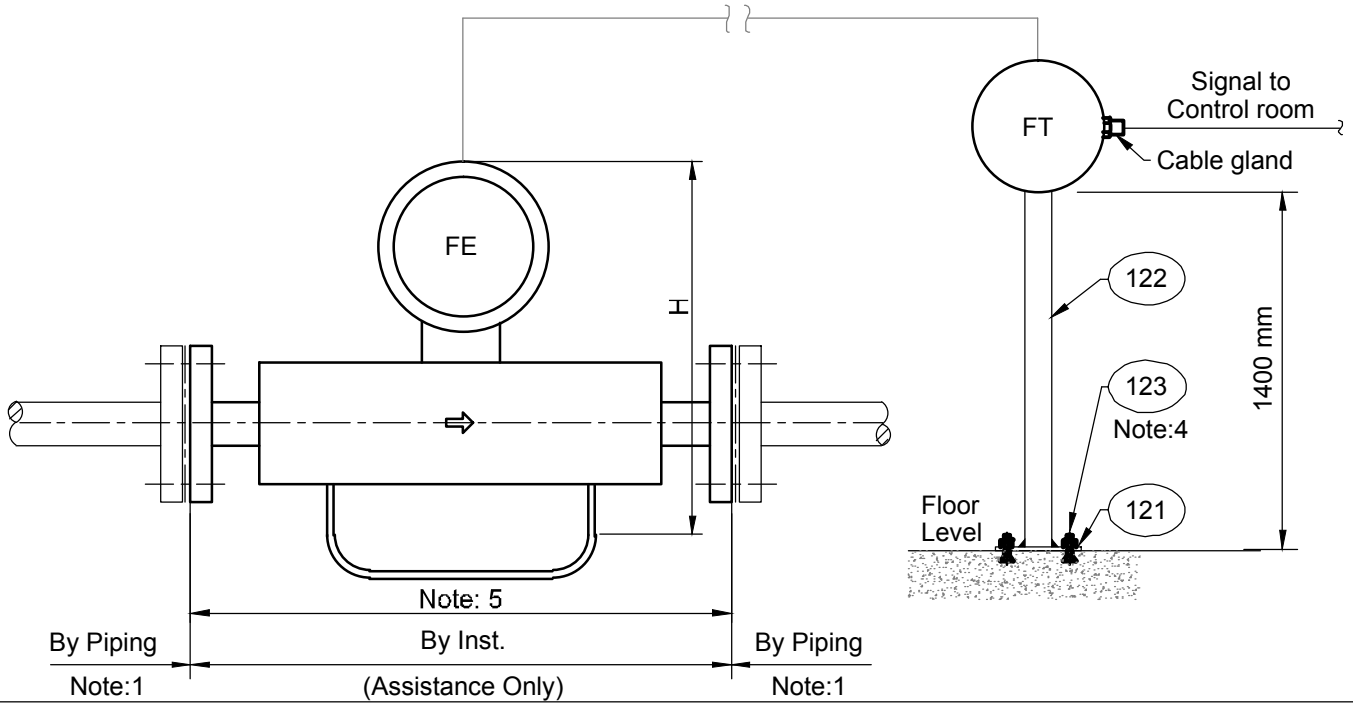
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0196-02	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Line Ref.
1	FT-501	ATF-0504-8"-A21A
2	FT-502	ATF-0507-8"-A21A

Item code	Item Description	Material (Spec.)	Qty. per Tag	Total Qty.	Unit
121	MS Base Plate, 150 x 150 x 6 mm thk.	MS	01	02	Nos.
122	Ø2" Pipe x 1400mm Long	MS	01	02	Nos.
123	Anchor Fastners, M12 x 125mm Long	MS	04	08	Nos.

Note :
1. Gasket, stud, nut with washer etc. Provided by mech / piping as per meter size.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.
3. The bill of material is indicative & the Qty. may vary as per site requirements.
4. Item code no. 123 i.e. anchor fasteners, need not to be considered in case of structural flooring.
5. To be provided as per final vendor details.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Flow Transmitter
(Mass type)

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Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0212-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
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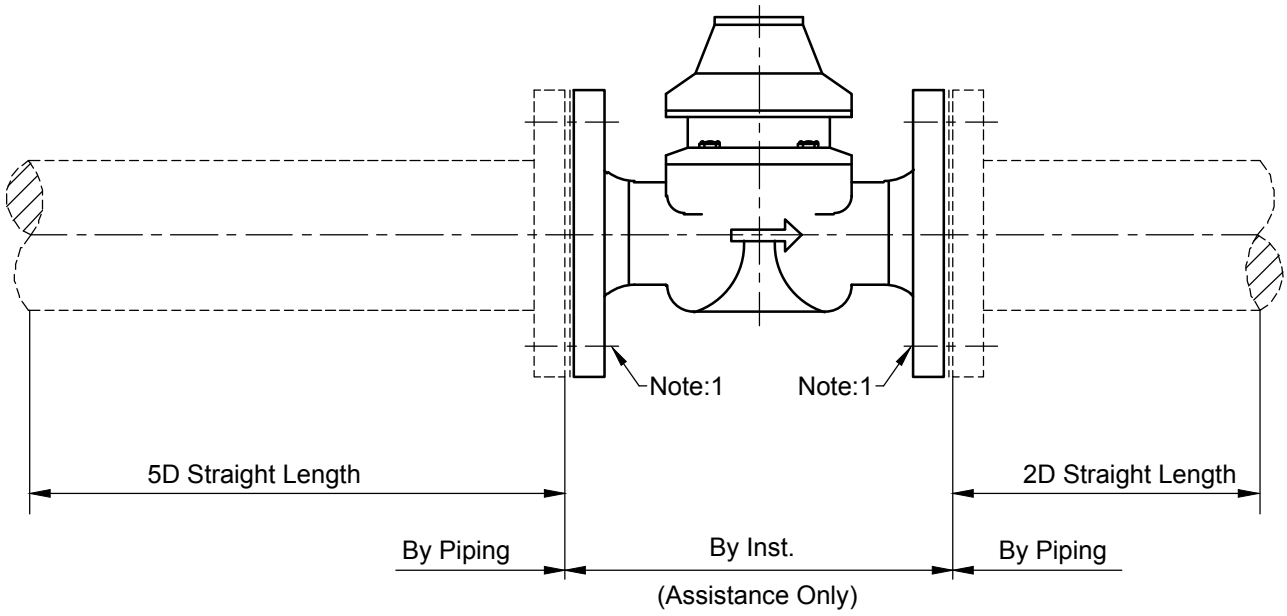
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Line Ref.	Sr.No.	Tag No	Line Ref.
1	FT-301	ATF-0410-10"-A21A	7	FT-307	ATF-0434-10"-A21A
2	FT-302	ATF-0414-10"-A21A	8	FT-308	ATF-0438-10"-A21A
3	FT-303	ATF-0418-10"-A21A	9	FT-309	ATF-0442-10"-A21A
4	FT-304	ATF-0422-10"-A21A	10	FT-310	ATF-0446-10"-A21A
5	FT-305	ATF-0426-10"-A21A	11	FT-300A	ATF-0403-6"-A21A
6	FT-306	ATF-0430-10"-A21A	12	FT-300B	ATF-0406-6"-A21A

Note :
1. Stud, washer, nut, gasket etc. provided by Mech. / Piping.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.
3. Mounting of Flow transmitter shall be by Piping.
4. Instrument Contractor shall provide installation assistance.
5. For straight length confirmation, Ref. Vendor's recommendation.
6. Straight Length Requirement :

Inlet Run (UP stream)	: Reducer	≥ 15 x D
	: Elbow	≥ 20 x D
	: 2 Elbow	≥ 25 x D
	: Control Valve/Pump	≥ 45 x D

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Flow Transmitter
(Turbine type)

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Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0213-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
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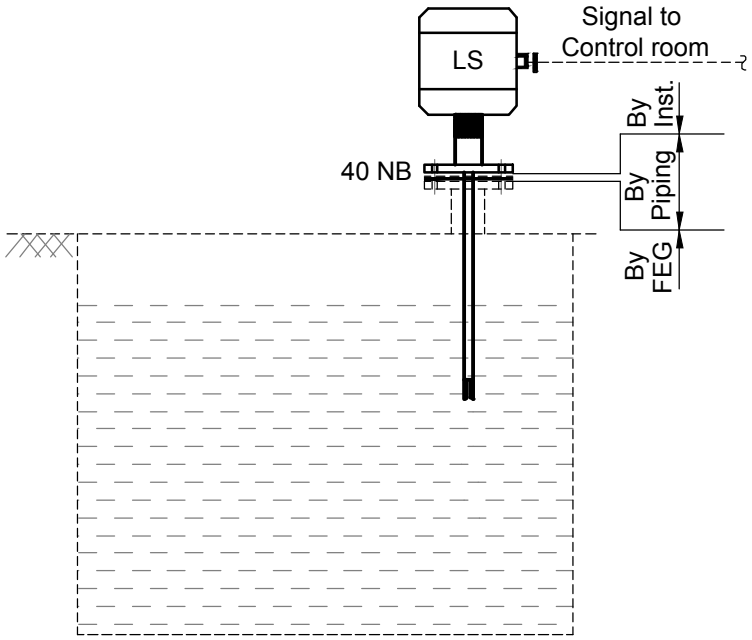
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Vessel Ref.	
1	LS- VF 201	VF- 201	(A21A)
2	LS- VF 202	VF- 202	(A21A)
3	LS- VF 203	VF- 203	(A21A)
4	LS- VF 204	VF- 204	(A21A)
5	LS- VF 205	VF- 205	(A21A)
6	LS- VF 206	VF- 206	(A21A)

Note :
1. Gasket, Nut, Bolt, washer etc. provided by Mech / Piping as per process connection size.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Level Switch
(Vibrating Fork)

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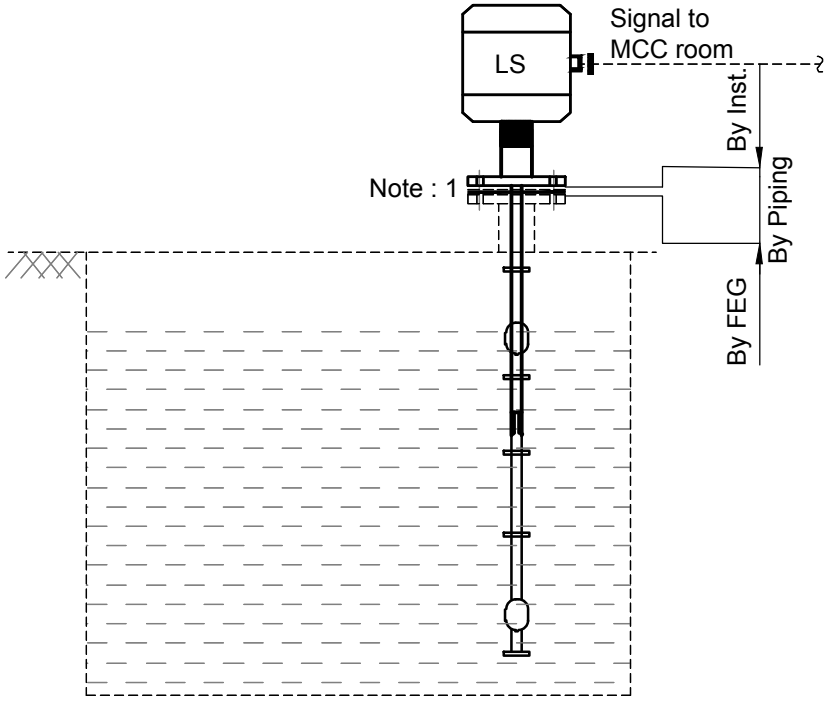
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0231-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP
P1	01.09.15	BDP	Issued for approval	KBT	BKP



Sr.No.	Tag No	Vessel Ref.
1	LS-701	UG-215 (A2Z)

Note :
1. Gasket, Nut, Bolt, washer etc. provided by Mech / Piping as per process connection size.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Level Switch
(Magnetic Float Type)

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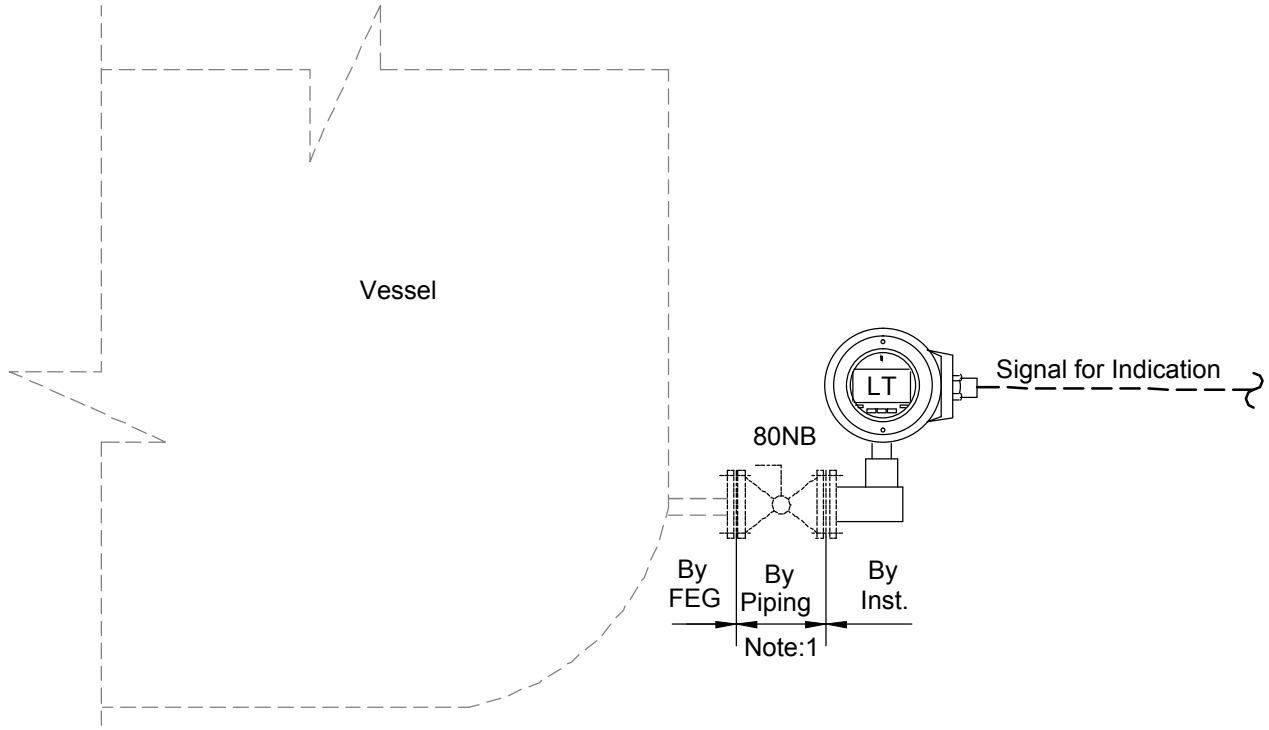
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0233-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Vessel Ref.
1	LT-T-1(FW)	xxxx
2	LT-T-2(FW)	xxxx
3	LT-T-3(FW)	xxxx

Note :
1. Gasket, stud, nut with washer etc. Provided by mech / piping as per 80NB size.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm Level Transmitter (DP type)

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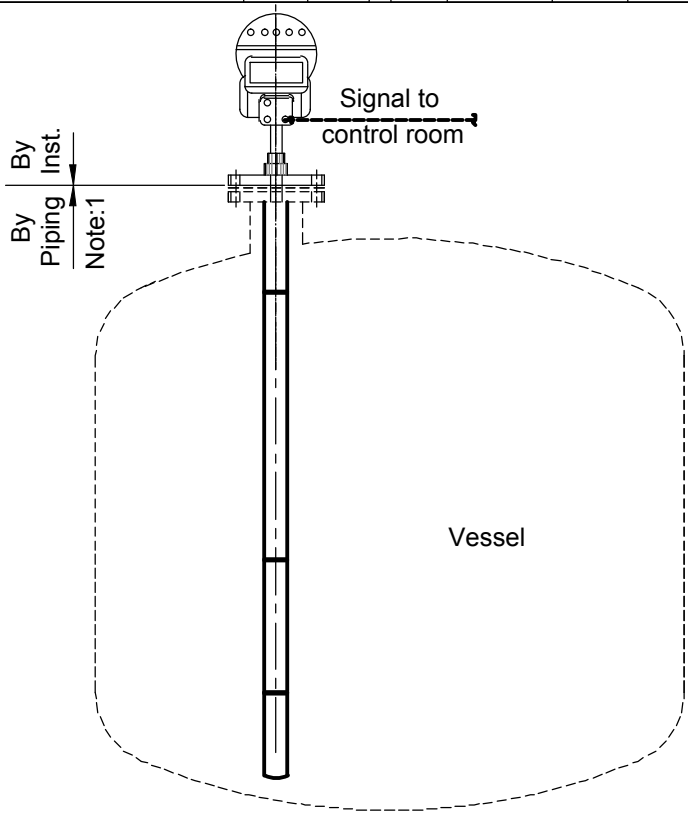
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0237-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Vessel Ref.
1	LT-HSD-1	xxxx

Note :
1. Gasket, stud, nut with washer etc. Provided by mech / piping as per process connection size.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm Level Transmitter (Guidede Wave type)

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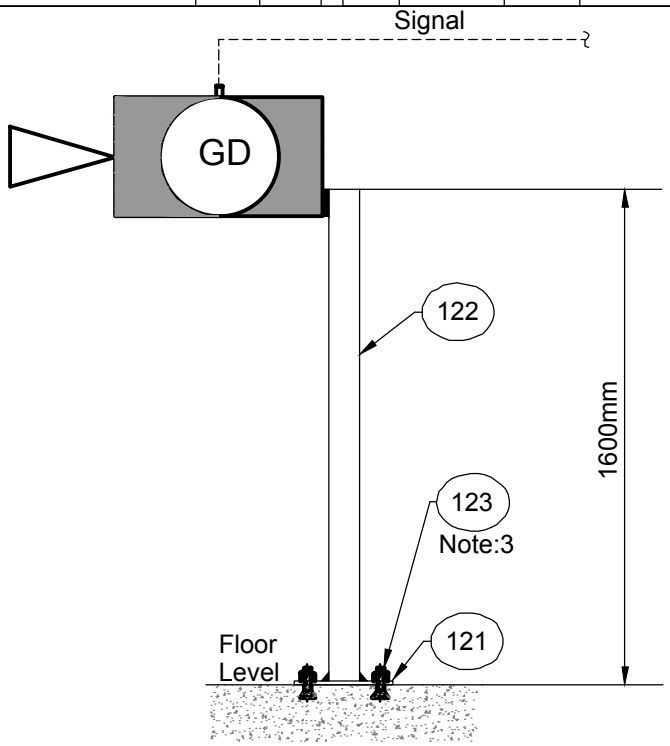
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0240-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Line/Vessel Ref.
1	GD-VF-201	Tank Farm
2	GD-VF-202	Tank Farm
3	GD-401	Pump House
4	GD-402	Pump House

Bill of Material

Item Code	Item Description	Material (Spec.)	Qty. per Tag	Total Qty
121	MS Base Plate, 150 x 150 x 6 mm thk.	MS	01	04
122	Ø2" Pipe x 1400mm Long	MS	01	04
123	Anchor Fastners, M12 x 125mm Long	MS	04	16

Note :
1. This is standard hook-up drawing and shall be applicable as per P&IDs.
2. The bill of material is indicative & the Qty. may vary as per site requirements.
3. Item code no. 123 i.e. anchor fasteners, need not to be considered in case of structural flooring.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm
Gas Detector
(Toxic type)

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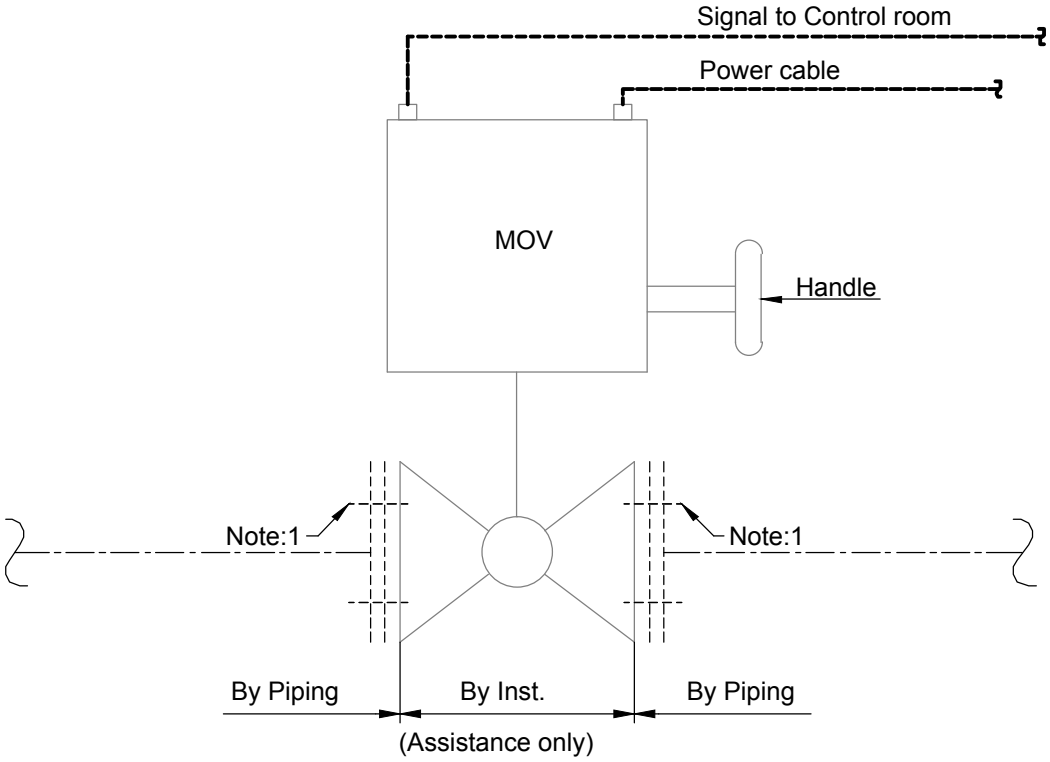
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0269-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No	Line Ref.	Sr.No.	Tag No	Line Ref.
1	ROSOV-VF -201A	ATF-0206-20"-A21A	9	ROSOV-VF -204C	ATF-0239-6"-A21A
2	ROSOV-VF -201B	ATF-0210-10"-A21A	10	ROSOV-VF -205A	ATF-0253-20"-A21A
3	ROSOV-VF -202A	ATF-0217-20"-A21A	11	ROSOV-VF -205B	ATF-0251-10"-A21A
4	ROSOV-VF -202B	ATF-0221-10"-A21A	12	ROSOV-VF -205C	ATF-0250-6"-A21A
5	ROSOV-VF -203A	ATF-0232-20"-A21A	13	ROSOV-VF -206A	ATF-0261-20"-A21A
6	ROSOV-VF -203B	ATF-0230-10"-A21A	14	ROSOV-VF -206B	ATF-0263-10"-A21A
7	ROSOV-VF -204A	ATF-0242-20"-A21A	15	ROSOV-VF -206C	ATF-0265-6"-A21A
8	ROSOV-VF -204B	ATF-0240-10"-A21A			

Note :
1. Stud, washer, nut, gasket etc. provided by Mech / Piping as per process connection size.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm Flow Motorized Valve (On / Off type)

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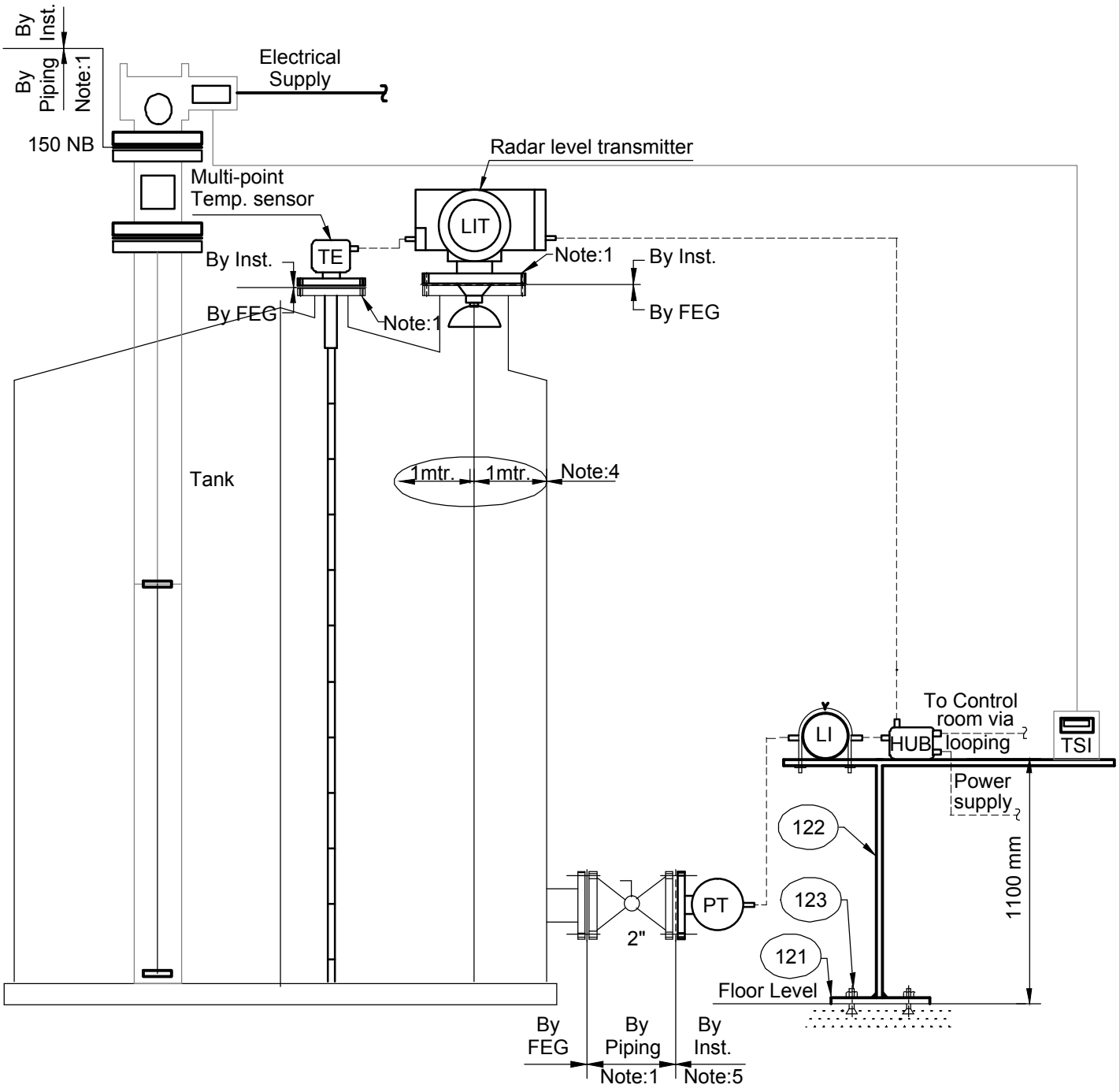
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0284-01	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP
P1	01.09.15	BDP	Issued for approval	KBT	BKP



Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm Tank Gauging

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Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0293-01	APR	P1

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						

Tank Gauging

Sr. No.	Tag No.	Conn. Size	Tag No.	Conn. Size	Tag No.	Conn. Size Note:6	Tag No.	Conn. Size	Vessel Ref.	Material (Spec.)
1	TE-VF-201	2"	PT-VF 201B	2"	LT-VF-201 A	*	LT-VF-201	18"	VF-201	A21A
2	TE-VF-202	2"	PT-VF 202B	2"	LT-VF-202 A	*	LT-VF-202	18"	VF-202	A21A
3	TE-VF-203	2"	PT-VF 203B	2"	LT-VF-203 A	*	LT-VF-203	18"	VF-203	A21A
4	TE-VF-204	2"	PT-VF 204B	2"	LT-VF-204 A	*	LT-VF-204	18"	VF-204	A21A
5	TE-VF-205	2"	PT-VF 205B	2"	LT-VF-205 A	*	LT-VF-205	18"	VF-205	A21A
6	TE-VF-206	2"	PT-VF 206B	2"	LT-VF-206 A	*	LT-VF-206	18"	VF-206	A21A

Bill of Material

Item Code	Item Description	Material (Spec.)	Qty. per Tag	Total Qty.	Unit
121	Base Plate (150 x 150 x 6 mm Thk.)	MS	01	06	Nos.
122	Pipe (2" Ø x 1400 mm Long)	MS	01	06	Nos.
123	Anchor Fastners, M12 x 125 mm Long	MS	04	24	Nos.

Note :

1. Stud, washer, nut, gasket etc. provided by Instrumentation Contractor. as per process connection size
2. This is standard hook-up drawing and shall be applicable as per P&IDs.
3. The Biil of material is indicative & the Qty. may vary as per site requirements.
4. Two mtr clear space required for RADAR type level Transmitter.
5. For PT installation refer hook up No.NHD-47.
6. * Size to be finalized after vendor details.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm Tank Gauging

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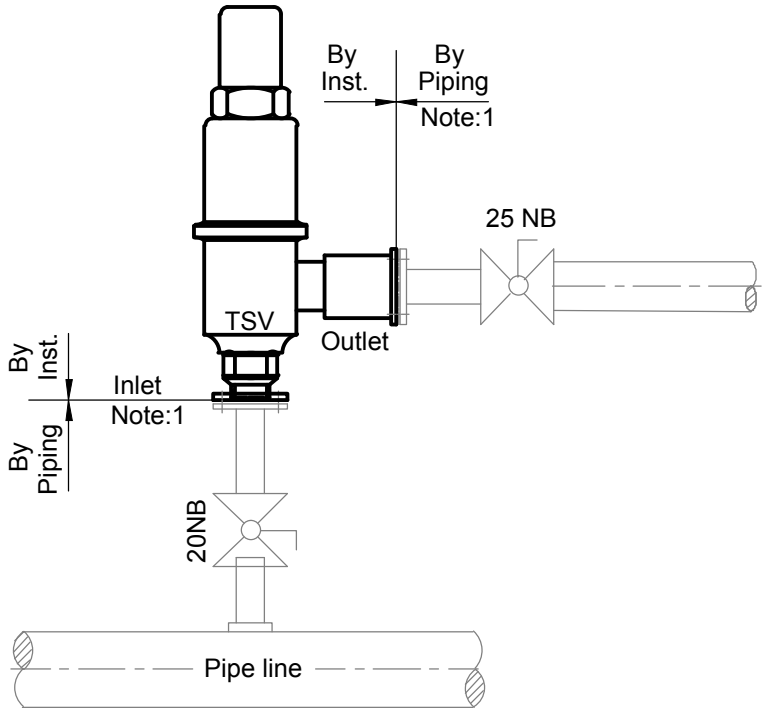
Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0293-02	CON	A

Rev	Date	Drawn	Description	Ch'k'd	App'd	Rev	Date	Drawn	Description	Ch'k'd	App'd
A	15.12.15	BDP	Issued for construction	KBT	BKP						
P1	01.09.15	BDP	Issued for approval	KBT	BKP						



Sr.No.	Tag No.	Line Ref.
1	TSV-PF-214	DATF-0304- A21A-3"

Note :
1. Stud, washer, nut, gasket etc. provided by piping contractor as per valve size.
2. This is standard hook-up drawing and shall be applicable as per P&IDs.

Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd., IGI Airport

Title
Modernization of Existing Fuel Farm Temperature Safety Valve

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Date	Drawn	Checked	Approved	Scale at A4	Drawing Number	Status	Rev
15.12.15	BDP	KBT/THS	BKP/AKS	NTS	322538-NHD-0294-01	CON	A

1	26.12.17	As Client Comment on mail and Issued for Execution	HVM	KBT/THS	JB	AKS
0	12.05.16	Issued for Execution	HVM	KBT/THS	VST	AKS
P2	03.09.15	Issued for approval	HVM	KBT	VST	AKS
Rev	Date	Description	Prepared	Checked	Co'nation	App'ved

Input-Output Count Summary

Process-PLC						
Sr. No.	**I/O type**	**AI**	**AO**	**DI**	**DO**	**Remarks**
1	**Process**	39	0	20	0	
2	**MCC**	10	10	102	32	
Sub-Total		49	10	122	32	
Total		213				
Spare		71	12	146	38.4	20 % Spare
Total		268				

Safety-PLC						
Sr. No.	**I/O type**	**AI**	**AO**	**DI**	**DO**	**Remarks**
1	**Safety**	2	0	69	51	
2	**MCC**	-	-	-	-	
Sub-Total		2	0	69	51	
Total		122				
Spare		5	0	83	61	20 % Spare
Total		149				

Notes:-

1) Referance P&Id for relavant document is Steam Distribution P&ID Drawing No. 354525-PIB-0002-01_Rev.P2

Client M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Shahbad,Muhammad pur
IGI Airport ,New Delhi-110061

Title Instrument Input/Output Count for
Delhi Fuel Aviation Fuel Facility Pvt.Ltd,Delhi

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Date	Prepared	Checked	Co'nation	App'ved	Document No.	Sheet	Rev	Status
26.12.17	HVM	KBT/THS	JB	AKS	322538-NID-0002	1 of 19	1	EXE

FIELD INSTRUMENT I/O LIST FOR Process-DCS

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
~~1~~	~~FT-301~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0410-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~2~~	~~FT-302~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0414-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~3~~	~~FT-303~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0418-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~4~~	~~FT-304~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0422-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~5~~	~~FT-305~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0426-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~6~~	~~FT-306~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0430-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~7~~	~~FT-307~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0434-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~8~~	~~FT-308~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0438-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~9~~	~~FT-309~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0442-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~10~~	~~FT-310~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0446-10"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~11~~	~~FT-300 A~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0403-6"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
~~12~~	~~FT-300 B~~	~~Flow Transmitter_Ultrasonic~~	~~Fuel~~	~~ATF-0406-6"-A21A~~	~~PIA-0004-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	
13	FT-501	Flow Transmitter_Mass	Fuel	ATF-0504-8"-A21A	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
~~14~~	~~FT-502~~	~~Flow Transmitter_Mass~~	~~Fuel~~	~~ATF-0507-8"-A21A~~	~~PIA-0005-01~~	~~-~~	~~-~~	~~-~~	~~-~~	~~4-20 mA~~	~~PLC/DCS~~	Removed Cause Exisiting
15	LT-VF-201 A	Level Transmitter	Fuel	VF-201	PIA-0002-01	1	-	-	-	4-20 mA	PLC/DCS	
16	LT-VF-202 A	Level Transmitter	Fuel	VF-202	PIA-0002-01	1	-	-	-	4-20 mA	PLC/DCS	
17	LT-VF-203 A	Level Transmitter	Fuel	VF-203	PIA-0002-01	1	-	-	-	4-20 mA	PLC/DCS	
18	LT-VF-204 A	Level Transmitter	Fuel	VF-204	PIA-0002-01	1	-	-	-	4-20 mA	PLC/DCS	

FIELD INSTRUMENT I/O LIST FOR Process-DCS

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
19	LT-VF-205 A	Level Transmitter	Fuel	VF-205	PIA-0002-01	1	-	-	-	4-20 mA	PLC/DCS	
20	LT-VF-206 A	Level Transmitter	Fuel	VF-206	PIA-0002-01	1	-	-	-	4-20 mA	PLC/DCS	
21	LT-T-1(FW)	Level Transmitter	Water	Tank-1	-	1	-	-	-	4-20 mA	PLC/DCS	
22	LT-T-1(FW)	Level Transmitter	Water	Tank-2	-	1	-	-	-	4-20 mA	PLC/DCS	
23	LT-T-1(FW)	Level Transmitter	Water	Tank-3	-	1	-	-	-	4-20 mA	PLC/DCS	
24	LT-HSD-1	Level Transmitter	Diesel	Tank	-	1	-	-	-	4-20 mA	PLC/DCS	
25	LS-701	Level Switch	Oily Water	Pit	PIA-0007-01	-	-	1	-	Volt Free	PLC/DCS	
26	DPT-301	Diff.Pressure Transmitter	Fuel	FWS-301	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
27	DPT-302	Diff.Pressure Transmitter	Fuel	FWS-302	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
28	DPT-303	Diff.Pressure Transmitter	Fuel	FWS-303	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
29	DPT-304	Diff.Pressure Transmitter	Fuel	FWS-304	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
30	DPT-305	Diff.Pressure Transmitter	Fuel	FWS-305	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
31	DPT-306	Diff.Pressure Transmitter	Fuel	FWS-306	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
32	DPT-307	Diff.Pressure Transmitter	Fuel	FWS-307	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
33	DPT-308	Diff.Pressure Transmitter	Fuel	FWS-308	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
34	DPT-309	Diff.Pressure Transmitter	Fuel	FWS-309	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
35	DPT-310	Diff.Pressure Transmitter	Fuel	FWS-310	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
36	DPT-300 A	Diff.Pressure Transmitter	Fuel	FWS-JKA	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	

FIELD INSTRUMENT I/O LIST FOR Process-DCS

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
37	DPT-300 B	Diff.Pressure Transmitter	Fuel	FWS-JKB	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
38	DPT-311	Diff.Pressure Transmitter	Fuel	FWS-311	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
39	DPT-312	Diff.Pressure Transmitter	Fuel	FWS-312	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
40	DPT-313	Diff.Pressure Transmitter	Fuel	FWS-313	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
41	DPT-314	Diff.Pressure Transmitter	Fuel	FWS-314	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
42	PT-401	Pressure Transmitter	Fuel	ATF-0448-24"-A21A	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
43	FT-401	Flow Transmitter	Fuel	ATF-0447-32"-A21A	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	Existing
44	PT-402	Pressure Transmitter	Fuel	ATF-0447-32"-A21A	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	Existing
45	FT-402	Flow Transmitter	Fuel	ATF-0448-24"-A21A	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	Existing
46	ROSOV-VF -201A	Motorised Valve	Fuel	ATF-0206-20"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
47	ROSOV-VF -201B	Motorised Valve	Fuel	ATF-0210-10"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
48	ROSOV-VF -202A	Motorised Valve	Fuel	ATF-0217-20"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
49	ROSOV-VF -202B	Motorised Valve	Fuel	ATF-0221-10"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
50	ROSOV-VF -203A	Motorised Valve	Fuel	ATF-0232-20"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
51	ROSOV-VF -203B	Motorised Valve	Fuel	ATF-0230-10"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
52	ROSOV-VF -204A	Motorised Valve	Fuel	ATF-0242-20"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
53	ROSOV-VF -204B	Motorised Valve	Fuel	ATF-0240-10"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
54	ROSOV-VF -204C	Motorised Valve	Fuel	ATF-0239-6"-A21A	PIA-0002-01	--	-	-	-	Modbus	PLC/DCS	

FIELD INSTRUMENT I/O LIST FOR Process-DCS

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
55	ROSOV-VF -205A	Motorised Valve	Fuel	ATF-0253-20"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
56	ROSOV-VF -205B	Motorised Valve	Fuel	ATF-0251-10"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
57	ROSOV-VF -205C	Motorised Valve	Fuel	ATF-0250-6"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
58	ROSOV-VF -206A	Motorised Valve	Fuel	ATF-0261-20"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
59	ROSOV-VF -206B	Motorised Valve	Fuel	ATF-0263-10"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
60	ROSOV-VF -206C	Motorised Valve	Fuel	ATF-0265-6"-A21A	PIA-0002-01	-	-	-	-	Modbus	PLC/DCS	
61	MOV-VF-201A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
62	MOV-VF-201B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
63	MOV-VF-202A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
64	MOV-VF-202B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
65	MOV-VF-203A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
66	MOV-VF-203B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
67	MOV-VF-204A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
68	MOV-VF-204B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
69	MOV-VF-205A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
70	MOV-VF-205B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
71	MOV-VF-206A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng
72	MOV-VF-206B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	1	-	Volt Free	PLC/DCS	Exisitng

FIELD INSTRUMENT I/O LIST FOR Process-DCS

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
73	CP-T1	Cathodic Protection	-	-	-	-	-	1	-	Volt Free	PLC/DCS	Exisitng
74	CP-T2	Cathodic Protection	-	-	-	-	-	1	-	Volt Free	PLC/DCS	Exisitng
75	CP-T3	Cathodic Protection	-	-	-	-	-	1	-	Volt Free	PLC/DCS	Exisitng
76	Photo Cell-1	Photo Cell	-	-	-	-	-	1	-	Volt Free	PLC/DCS	Exisitng
77	Photo Cell-1	Photo Cell	-	-	-	-	-	1	-	Volt Free	PLC/DCS	Exisitng
78	Photo Cell-1	Photo Cell	-	-	-	-	-	1	-	Volt Free	PLC/DCS	Exisitng
79	Photo Cell-1	Photo Cell	-	-	-	-	-	1	-	Volt Free	PLC/DCS	Exisitng
80	DPT-MF-11	Diff.Pressure Transmitter	Fuel	MF-11	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
81	DPT-MF-12	Diff.Pressure Transmitter	Fuel	MF-12	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
82	DPT-MF-13	Diff.Pressure Transmitter	Fuel	MF-13	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
83	DPT-MF-14	Diff.Pressure Transmitter	Fuel	MF-14	PIA-0005-01	1	-	-	-	4-20 mA	PLC/DCS	
84	TE/TT-XXX	Temeprature Transmitter	Fuel	ATF-0448-24"-A21A	PIA-0004-01	1	-	-	-	4-20 mA	PLC/DCS	
NEW ADDED												
85	LT-T-211	Level Transmitter - Guided wave Radar	Fuel	T-211	PIB-0006-01	1	-	-	-	4-20 mA	PLC/DCS	
86	LT-T-212	Level Transmitter - Guided wave Radar	Fuel	T-212	PIB-0006-01	1	-	-	-	4-20 mA	PLC/DCS	
87	LT-T-213	Level Transmitter - Guided wave Radar	Fuel	T-213	PIB-0006-01	1	-	-	-	4-20 mA	PLC/DCS	
Total						39	0	20	0			

FIELD INSTRUMENT I/O LIST FOR - Safety PLC

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
1	GD-VF-201	Gas-Detector	Fuel	Tank Farm	PIA-0002-01	1	-	-	-	4-20 mA	Safety PLC	
2	GD-401	Gas-Detector	Fuel	Pump House	PIA-0004-01	1	-	-	-	4-20 mA	Safety PLC	
3	LS- VF 201	Level Switch	Fuel	VF-201	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
4	LS- VF 202	Level Switch	Fuel	VF-202	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
5	LS- VF 203	Level Switch	Fuel	VF-203	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
6	LS- VF 204	Level Switch	Fuel	VF-204	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
7	LS- VF 205	Level Switch	Fuel	VF-205	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
8	LS- VF 206	Level Switch	Fuel	VF-206	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
9	LT-VF-201-Hi_Hi	Level Radar Hi_Hi	Fuel	VF-201	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
10	LT-VF-202-Hi_Hi	Level Radar Hi_Hi	Fuel	VF-202	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
11	LT-VF-203-Hi_Hi	Level Radar Hi_Hi	Fuel	VF-203	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
12	LT-VF-204-Hi_Hi	Level Radar Hi_Hi	Fuel	VF-204	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
13	LT-VF-205-Hi_Hi	Level Radar Hi_Hi	Fuel	VF-205	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
14	LT-VF-206-Hi_Hi	Level Radar Hi_Hi	Fuel	VF-206	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
15	ROSOV-VF -201A	Motorised Valve	Fuel	ATF-0206-20"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
16	ROSOV-VF -201B	Motorised Valve	Fuel	ATF-0210-10"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
17	ROSOV-VF -202A	Motorised Valve	Fuel	ATF-0217-20"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
18	ROSOV-VF -202B	Motorised Valve	Fuel	ATF-0221-10"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
19	ROSOV-VF -203A	Motorised Valve	Fuel	ATF-0232-20"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
20	ROSOV-VF -203B	Motorised Valve	Fuel	ATF-0230-10"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop

FIELD INSTRUMENT I/O LIST FOR - Safety PLC

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
21	ROSOV-VF -204A	Motorised Valve	Fuel	ATF-0242-20"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
22	ROSOV-VF -204B	Motorised Valve	Fuel	ATF-0240-10"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
23	ROSOV-VF -204C	Motorised Valve	Fuel	ATF-0239-6"-A21A	PIA-0002-01	--	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
24	ROSOV-VF -205A	Motorised Valve	Fuel	ATF-0253-20"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
25	ROSOV-VF -205B	Motorised Valve	Fuel	ATF-0251-10"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
26	ROSOV-VF -205C	Motorised Valve	Fuel	ATF-0250-6"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
27	ROSOV-VF -206A	Motorised Valve	Fuel	ATF-0261-20"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
28	ROSOV-VF -206B	Motorised Valve	Fuel	ATF-0263-10"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
29	ROSOV-VF -206C	Motorised Valve	Fuel	ATF-0265-6"-A21A	PIA-0002-01	-	-	2	1	Volt Free	PLC/DCS	Open Close FB & Emergency Stop
30	MOV-VF-201A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
31	MOV-VF-201B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
32	MOV-VF-202A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
33	MOV-VF-202B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
34	MOV-VF-203A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
35	MOV-VF-203B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
36	MOV-VF-204A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
37	MOV-VF-204B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
38	MOV-VF-205A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
39	MOV-VF-205B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
40	MOV-VF-206A	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)

FIELD INSTRUMENT I/O LIST FOR - Safety PLC

Sr. No.	DCS Tag No.	Tag Description	Service	Location	P&ID No.	Type of Input				Signal Level	System	Remarks
						AI	AO	DI	DO			
41	MOV-VF-206B	Motorised Valve	Fuel	Tank	PIA-0002-01	-	-	2	2	Volt Free	PLC/DCS	Open Close FB(Exisitng)
42	HS-201	Emergency Push Button	-	Nr. Tank-VF-201	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	Each Side of Dyke Wall
43	HS-202	Emergency Push Button	-	Nr. Tank-VF-202	PIA-0002-01	-	-	1	-	Volt Free	Safety PLC	
44	HS-207	Control Room	-	-	-	-	-	1	-	Volt Free	Safety PLC	
45	XS-01	Hooter	-	-	-	-	-	-	1	Volt Free	Safety PLC	
46	XS-02	Hooter	-	-	-	-	-	-	1	Volt Free	Safety PLC	
47	PF-301	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
48	PF-302	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
49	PF-303	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
50	PF-304	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
51	PF-305	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
52	PF-306	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
53	PF-307	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
54	PF-308	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
55	PF-309	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
56	PF-310	Transfer Pump	-	MCC	PIA-0004-01	-	-	-	1	Volt Free	Safety PLC	Emergency Stop
Total						2	0	69	51			

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
1	JK-P-1	Jockey Pump	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
2	JK-P-2	Jockey Pump	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
3	JK-P-3	Jockey Pump	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
4	JK-P-4	Jockey Pump	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
5	TT-P-1	TT Decanting	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
6	TT-P-2	TT Decanting	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
7	TT-P-3	TT Decanting	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
8	TW-P-1	Tube Well	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
9	TW-P-2	Tube Well	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
10	TW-P-3	Tube Well	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
11	HSD-P-1	Diesel Tank	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
12	P-0016	Under Ground Drain - T-211	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
13	P-0017	Under Ground Drain - T-212	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
14	P-0018	Under Ground Drain - T-213	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
15	PLT-P-1	Sump Motor	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
16	P-3	Fire Hydrant	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
17	P-4	Fire Hydrant	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
18	P-5	Fire Hydrant	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
19	P-6	Fire Hydrant	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
20	P-7	Fire Hydrant	-	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
21	PF-215A	OWT	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
22	PF-215B	OWT	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
23	PF-301	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
				Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
24	PF-302	Transfer Pump	PIC-0007	Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
25	PF-303	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
26	PF-304	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
27	PF-305	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
28	PF-306	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
29	PF-307	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
30	PF-308	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
31	PF-309	Transfer Pump	PIC-0007	Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	
				Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
				Start/stop	-	-	-	1	-	PLC/DCS	
				On/Off Indication	-	-	1	-	-	PLC/DCS	

I/O LIST FOR - MCC

Sr. No	DCS Tag No.	Tag Description	PID No.	Discription	Type of Input /Output					System	Remarks
					AI	AO	DI	DO	Soft Signal		
32	PF-310	Transfer Pump	PIC-0007	Auto/Manual	-	-	1	-	-	PLC/DCS	
				Trip	-	-	1	-	-	PLC/DCS	
				VFD Speed Indication Signal	1	-	-	-	-	MODBUS	
				VFD Speed Control Signal	-	1	-	-	-	MODBUS	
33	LT Feeder	-	-	LT-1	-	-	1	-	-	PLC/DCS	
				LT-2	-	-	1	-	-	PLC/DCS	
				LT-3	-	-	1	-	-	PLC/DCS	
				LT-4	-	-	1	-	-	PLC/DCS	
				LT-5	-	-	1	-	-	PLC/DCS	
				LT-6	-	-	1	-	-	PLC/DCS	
TOTAL					10	10	102	32	0		

3	26.12.17	As per Client Comment on mail & Issue for Execution	HVM	KBT/THS	JB	AKS
2	26.05.16	Issue for Execution	HVM	KBT/THS	VST	AKS
1	14.09.15	Issue for Execution	HVM	KBT	VST	AKS
0	11.08.15	Issue for Execution	HVM	KBT	VST	AKS
Rev	Date	Description	Prepared	Checked	Co'nation	App'ved

Instrument Index

Sr. No.	Instrument type	Quantity
1	Pressure Gauge (Bourdon Type)	1 nos.
2	Level Switch(Vibrating Fork Type)	6 nos.
3	Level Switch(Magnetic-Float Type)	1 nos.
4	Pressure Transmitter	7 nos.
5	Differential Pressure Transmitter	20 nos.
6	ROSOV	15 nos.
7	Level Transmitter (Radar type)	6 nos.
8	Level Transmitter (Servo type)	6 nos.
9	Level Transmitter (DP Type)	3 nos.
10	Level Transmitter (Guided Wave Rader Type)	4 nos.
11	Flow Transmitter (Mass)	1 nos.
12	Flow Transmitter (Ultrasonic-Clamp On type)	0 nos.
13	Temperature element- Multipoint	6 nos.
14	Temperature element - with Transmitter	1 nos.
15	Temperature Safety Valve	1 nos.
16	Thermer Relief Valve	15 nos.
17	Gas Detector	2 nos.
	Total	**95** nos.

Client M/s Delhi Aviation Fuel Facility Pvt Ltd
Aviation Fuel Station
Shahbad, Muhammad Pur
IGI Airport - New Delhi - 110061

Title Instrument Index for
M/s Delhi Aviation Fuel Facility Pvt Ltd

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Date	Prepared	Checked	Co'nation	App'ved	Document No	Sheet	Rev	Status
26.12.17	HVM	KBT	JB	AKS	322538-NID-001	1 of 8	3	EXE

Refrence P&ID for Relevant Documents				
Sr. No	**Description**	**P&ID No.**	**Rev.**	**Remarks**
1	Fuel Tank Farm Area	322538-PIA-0002-01	0	
2	Down Graded ATF Transfer System	322538-PIA-0003-01	02	
3	Fuel Hydrant Pump House	322538-PIA-0004-01	0	
4	Pipe Line Receipt line From IOCL & BPCL	322538-PIA-0005-01	1	
5	Under Ground Tank & Decanting System	322538-PIA-0006-01	0	
6	Oil Water Transfer system	322538-PIA-0007-01	0	

Sr. No	Tag No.	Process Variable	Instrument	Type	Service	State	Location	Line / Vessel no.	Line Size / Vessel Nozzle size NB	Piping spec.	PID No.	Hook Up No.	Remark
1	PT-VF 201B	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Tank	VF-201	50	-	PIA-0002-01	NHD-18	
2	TE-VF-201	Temperature	Element	Multi Point	Fuel	Liquid	Tank	VF-201	50	-	PIA-0002-01	NHD-28	
3	LS- VF 201	Level	Switch	Vibrating Fork	Fuel	Liquid	Tank	VF-201	40	-	PIA-0002-01	NHD-13	
4	LT-VF-201	Level	Transmitter	Radar	Fuel	Liquid	Tank	VF-201	XX	-	PIA-0002-01	NHD-21	
5	LT-VF-201 A	Level	Transmitter	Servo Type	Fuel	Liquid	Tank	VF-201	150	-	PIA-0002-01	NHD-22	
6	ROSOV-VF -201A	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0206-20"-A21A	500	A21A	PIA-0002-01	NHD-20	
7	ROSOV-VF -201B	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-20	
8	TRV-VF-201A	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0206-20"-A21A	500	A21A	PIA-0002-01	NHD-100	
9	TRV-VF-201B	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-100	
10	PT-VF 202B	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Tank	VF-202	50	-	PIA-0002-01	NHD-18	
11	TE-VF-202	Temperature	Element	Multi Point	Fuel	Liquid	Tank	VF-202	50	-	PIA-0002-01	NHD-28	
12	LS- VF 202	Level	Switch	Vibrating Fork	Fuel	Liquid	Tank	VF-202	40	-	PIA-0002-01	NHD-13	
13	LT-VF-202	Level	Transmitter	Radar	Fuel	Liquid	Tank	VF-202	XX	-	PIA-0002-01	NHD-21	
14	LT-VF-202 A	Level	Transmitter	Servo Type	Fuel	Liquid	Tank	VF-202	150	-	PIA-0002-01	NHD-22	
15	ROSOV-VF -202A	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0217-20"-A21A	500	A21A	PIA-0002-01	NHD-20	
16	ROSOV-VF -202B	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0221-10"-A21A	250	A21A	PIA-0002-01	NHD-20	
17	TRV-VF-202A	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0206-20"-A21A	500	A21A	PIA-0002-01	NHD-100	
18	TRV-VF-202B	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-100	
19	PT-VF 203B	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Tank	VF-203	50	-	PIA-0002-01	NHD-18	
20	TE-VF-203	Temperature	Element	Multi Point	Fuel	Liquid	Tank	VF-203	50	-	PIA-0002-01	NHD-28	
21	LS- VF 203	Level	Switch	Vibrating Fork	Fuel	Liquid	Tank	VF-203	40	-	PIA-0002-01	NHD-13	

Sr. No	Tag No.	Process Variable	Instrument	Type	Service	State	Location	Line / Vessel no.	Line Size / Vessel Nozzle size NB	Piping spec.	PID No.	Hook Up No.	Remark
22	LT-VF-203	Level	Transmitter	Radar	Fuel	Liquid	Tank	VF-203	XX	-	PIA-0002-01	NHD-21	
23	LT-VF-203 A	Level	Transmitter	Servo Type	Fuel	Liquid	Tank	VF-203	150	-	PIA-0002-01	NHD-22	
24	ROSOV-VF -203A	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0232-20"-A21A	500	A21A	PIA-0002-01	NHD-20	
25	ROSOV-VF -203B	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0230-10"-A21A	250	A21A	PIA-0002-01	NHD-20	
26	TRV-VF-203A	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0206-20"-A21A	500	A21A	PIA-0002-01	NHD-100	
27	TRV-VF-203B	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-100	
28	PT-VF 204B	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Tank	VF-204	50	-	PIA-0002-01	NHD-18	
29	TE-VF-204	Temperature	Element	Multi Point	Fuel	Liquid	Tank	VF-204	50	-	PIA-0002-01	NHD-28	
30	LS- VF 204	Level	Switch	Vibrating Fork	Fuel	Liquid	Tank	VF-204	40	-	PIA-0002-01	NHD-13	
31	LT-VF-204	Level	Transmitter	Radar	Fuel	Liquid	Tank	VF-204	XX	-	PIA-0002-01	NHD-21	
32	LT-VF-204 A	Level	Transmitter	Servo Type	Fuel	Liquid	Tank	VF-204	150	-	PIA-0002-01	NHD-22	
33	ROSOV-VF -204A	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0242-20"-A21A	500	A21A	PIA-0002-01	NHD-20	
34	ROSOV-VF -204B	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0240-10"-A21A	250	A21A	PIA-0002-01	NHD-20	
35	ROSOV-VF -204C	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0239-6"-A21A	150	A21A	PIA-0002-01	NHD-20	
36	TRV-VF-204A	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0206-20"-A21A	500	A21A	PIA-0002-01	NHD-100	
37	TRV-VF-204B	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-100	
38	TRV-VF-204C	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-100	
39	PT-VF 205B	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Tank	VF-205	50	-	PIA-0002-01	NHD-18	
40	TE-VF-205	Temperature	Element	Multi Point	Fuel	Liquid	Tank	VF-205	50	-	PIA-0002-01	NHD-28	
41	LS- VF 205	Level	Switch	Vibrating Fork	Fuel	Liquid	Tank	VF-205	40	-	PIA-0002-01	NHD-13	
42	LT-VF-205	Level	Transmitter	Radar	Fuel	Liquid	Tank	VF-205	XX	-	PIA-0002-01	NHD-21	

Sr. No	Tag No.	Process Variable	Instrument	Type	Service	State	Location	Line / Vessel no.	Line Size / Vessel Nozzle size NB	Piping spec.	PID No.	Hook Up No.	Remark
43	LT-VF-205 A	Level	Transmitter	Servo Type	Fuel	Liquid	Tank	VF-205	150	-	PIA-0002-01	NHD-22	
44	ROSOV-VF -205A	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0253-20"-A21A	500	A21A	PIA-0002-01	NHD-20	
45	ROSOV-VF -205B	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0251-10"-A21A	250	A21A	PIA-0002-01	NHD-20	
46	ROSOV-VF -205C	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0250-6"-A21A	150	A21A	PIA-0002-01	NHD-20	
47	TRV-VF-205A	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0206-20"-A21A	500	A21A	PIA-0002-01	NHD-100	
48	TRV-VF-205B	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-100	
49	TRV-VF-205C	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0282-1"-A1M	25	A1M	PIA-0002-01	NHD-100	
50	PT-VF 206B	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Tank	VF-206	50	-	PIA-0002-01	NHD-18	
51	TE-VF-206	Temperature	Element	Multi Point	Fuel	Liquid	Tank	VF-206	50	-	PIA-0002-01	NHD-28	
52	LS- VF 206	Level	Switch	Vibrating Fork	Fuel	Liquid	Tank	VF-206	40	-	PIA-0002-01	NHD-13	
53	LT-VF-206	Level	Transmitter	Radar	Fuel	Liquid	Tank	VF-206	XX	-	PIA-0002-01	NHD-21	
54	LT-VF-206 A	Level	Transmitter	Servo Type	Fuel	Liquid	Tank	VF-206	150	-	PIA-0002-01	NHD-22	
55	ROSOV-VF -206A	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0261-20"-A21A	500	A21A	PIA-0002-01	NHD-20	
56	ROSOV-VF -206B	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0263-10"-A21A	250	A21A	PIA-0002-01	NHD-20	
57	ROSOV-VF -206C	Flow	ROSOV	Electro-Hydraulic	Fuel	Liquid	Line	ATF-0265-6"-A21A	150	A21A	PIA-0002-01	NHD-20	
58	TRV-VF-206A	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0206-20"-A21A	500	A21A	PIA-0002-01	NHD-100	
59	TRV-VF-206B	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0210-10"-A21A	250	A21A	PIA-0002-01	NHD-100	
60	TRV-VF-206C	Temperature	Relief Valve	Thermal	Fuel	Liquid	Line	ATF-0265-6"-A21A	150	A21A	PIA-0002-01	NHD-100	
61	GD-VF-201	Gas	Detector	Toxic	Fuel	Liquid	-	Tank Farm	-	-	PIA-0002-01	NHD-30	
62	PG- PF -214	Pressure	Gauge	Bourdon	Fuel	Liquid	Line	DATF-0304- A21A-3"	80	A21A	PIC-0003-01	NHD-11	
63	TSV-PF-214	Temperature	Safety Valve	Conventional	Fuel	Liquid	Line	DATF-0304- A21A-3"	80	A21A	PIC-0003-01	NHD-29	

Sr. No	Tag No.	Process Variable	Instrument	Type	Service	State	Location	Line / Vessel no.	Line Size / Vessel Nozzle size NB	Piping spec.	PID No.	Hook Up No.	Remark
64	PT-401	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Line	ATF-0448-24"-A21A	600	A21A	PIA-0004-01	NHD-18	
65	PT-402	Pressure	Transmitter	Diaphragm	Fuel	Liquid	Line	ATF-0447-32"-A21A	800	A21A	PIA-0004-01		Exisiting
66	DPT-301	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-301	15	A21A	PIA-0004-01	NHD-19	
67	DPT-302	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-302	15	A21A	PIA-0004-01	NHD-19	
68	DPT-303	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-303	15	A21A	PIA-0004-01	NHD-19	
69	DPT-304	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-304	15	A21A	PIA-0004-01	NHD-19	
70	DPT-305	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-305	15	A21A	PIA-0004-01	NHD-19	
71	DPT-306	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-306	15	A21A	PIA-0004-01	NHD-19	
72	DPT-307	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-307	15	A21A	PIA-0004-01	NHD-19	
73	DPT-308	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-308	15	A21A	PIA-0004-01	NHD-19	
74	DPT-309	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-309	15	A21A	PIA-0004-01	NHD-19	
75	DPT-310	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-310	15	A21A	PIA-0004-01	NHD-19	
76	DPT-300 A	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-JKA	15	A21A	PIA-0004-01	NHD-19	
77	DPT-300 B	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-JKB	15	A21A	PIA-0004-01	NHD-19	
~~78~~	~~FT-301~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0410-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~79~~	~~FT-302~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0414-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~80~~	~~FT-303~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0418-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~81~~	~~FT-304~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0422-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~82~~	~~FT-305~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0426-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~83~~	~~FT-306~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0430-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~84~~	~~FT-307~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0434-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		

Sr. No	Tag No.	Process Variable	Instrument	Type	Service	State	Location	Line / Vessel no.	Line Size / Vessel Nozzle size NB	Piping spec.	PID No.	Hook Up No.	Remark
~~85~~	~~FT-308~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0438-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~86~~	~~FT-309~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0442-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~87~~	~~FT-310~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0446-10"-A21A~~	~~250~~	~~A21A~~	~~PIA-0004-01~~		
~~88~~	~~FT-300 A~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0403-6"-A21A~~	~~150~~	~~A21A~~	~~PIA-0004-01~~		
~~89~~	~~FT-300 B~~	~~Flow~~	~~Transmitter~~	~~Ultra Sonic(Clamp Type)~~	~~Fuel~~	~~Liquid~~	~~Filter~~	~~ATF-0406-6"-A21A~~	~~150~~	~~A21A~~	~~PIA-0004-01~~		
90	GD-401	Gas	Detector	Toxic	Fuel	Liquid	-	Pump House	-	-	PIA-0004-01	NHD-30	
91	DPT-311	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-311	15	A21A	PIA-0005-01	NHD-19	
92	DPT-312	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-312	15	A21A	PIA-0005-01	NHD-19	
93	DPT-313	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-313	15	A21A	PIA-0005-01	NHD-19	
94	DPT-314	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	FWS-314	15	A21A	PIA-0005-01	NHD-19	
95	DPT-MF-11	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	MF-11	-	A21A	PIA-0005-01	NHD-19	
96	DPT-MF-12	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	MF-12	-	A21A	PIA-0005-01	NHD-19	
97	DPT-MF-13	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	MF-13	-	A21A	PIA-0005-01	NHD-19	
98	DPT-MF-14	Pressure	Differential Transmitter	Diaphragm	Fuel	Liquid	Filter	MF-14	-	A21A	PIA-0005-01	NHD-19	
99	FT-501	Flow	Transmitter	Mass	Fuel	Liquid	Line	ATF-0504-8"-A21A	200	A21A	PIA-0005-01	NHD-24	Already Procured.
~~100~~	~~FT-502~~	~~Flow~~	~~Transmitter~~	~~Mass~~	~~Fuel~~	~~Liquid~~	~~Line~~	~~ATF-0507-8"-A21A~~	~~200~~	~~A21A~~	~~PIA-0005-01~~		Revised casue already existing installed
101	LS-701	Level	Switch	Magnetic Type	Oily Water	Liquid	Pit	UG-215	-	-	PIA-0007-01	NHD-02	
102	LT-T-1(FW)	level	Transmitter	DP type	Water	Liquid	Tank	-	15	-	-	NHD-23	
103	LT-T-2(FW)	level	Transmitter	DP type	Water	Liquid	Tank	-	15	-	-	NHD-23	
104	LT-T-3(FW)	level	Transmitter	DP type	Water	Liquid	Tank	-	15	-	-	NHD-23	

Sr. No	Tag No.	Process Variable	Instrument	Type	Service	State	Location	Line / Vessel no.	Line Size / Vessel Nozzle size NB	Piping spec.	PID No.	Hook Up No.	Remark
105	LT-HSD-1	level	Transmitter	Guidede Wave	Diesel	Liquid	Tank	-	-	-	-	NHD-25	
106	TE/TT-2001	Temperature	Transmitter	RTD	Fuel	Liquid	Line	ATF-0448-24"-A21A	600	A21A	PIA-0004-01	NHD-254	
NEW ADDED													
107	LT-T-211	Level	Transmitter	Guidede Wave	Fuel	Fuel	Tank	T-211	-	Note:1	PIB-0006-01	NHD-25	
108	LT-T-212	Level	Transmitter	Guidede Wave	Fuel	Fuel	Tank	T-212	-	Note:1	PIB-0006-01	NHD-25	
109	LT-T-213	Level	Transmitter	Guidede Wave	Fuel	Fuel	Tank	T-213	-	Note:1	PIB-0006-01	NHD-25	

Note:

Revised as per client Comment

1 Guided wave radar instrumentation Connection shall as per exisiting site condition. Same shall take care by DAFFPL Team

P2	14.12.15	Issued for approval	HVM	KBT	VST	AKS/GDS
P1	18.09.15	Issued for approval	HVM	KBT	VST	AKS/GDS
Rev	Date	Description	Prepared	Checked	Co'nation	App'ved

JB and Cable Schedule

Client M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Shahbad,Muhammad pur
IGI Airport ,New Delhi-110061

Title JB and Cable Schedule

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Date	Prepared	Checked	Co'nation	App'ved	Document No	Sheet	Rev	Status
14.12.15	HVM	KBT	VST	AKS/GDS	322538-NJD-0001	1 of 53	P2	APR

Sr. No.	Plant Area	Cable Type												Junction Box				
		1 Pair X 1.5 sq.mm	2 Pair X 1.5 sq.mm	6 Pair X 1.5 sq.mm	12 Pair X 1.5 sq.mm	2 Core X 1.5 sq.mm	12 Core X 1.5 sq.mm	24 Core X 1.5 sq.mm	37 Core X 1.5 sq.mm	3 Core X 2.5 sq.mm	6 Core X 2.5 sq.mm	24 Core X 2.5 sq.mm	1 Traid X 1.0 sq.mm	4 Wire	DIJB	DOJB	AIJB	AOJB	PJB
		Signal Cable	Signal Cable	Multi Pair Cable	Multi Pair Cable	Control Cable	Multi Core Cable	Multi Core Cable	Multi Core Cable	Power Cable	Power Cable	Multi Core Power Cable	Triad Cable	Modbus Cable					
1	PJB-01	-	-	-	-	-	-	-	-	340	-	180	-	-	-	-	-	-	1
2	PJB-02	-	-	-	-	-	-	-	-	340	-	190	-	-	-	-	-	-	1
3	PJB-03	-	-	-	-	-	-	-	-	50	50	-	-	-	-	-	-	-	1
4	DI-DJB(S)-001	-	-	-	-	530	-	160	-	-	-	-	-	-	1	-	-	-	-
5	DI-DJB(S)-002	-	-	-	-	530	-	130	-	-	-	-	-	-	1	-	-	-	-
6	DI-DJB(S)-003	-	-	-	-	530	-	160	-	-	-	-	-	-	1	-	-	-	-
7	DI-DJB(S)-004	-	-	-	-	630	-	-	190	-	-	-	-	-	1	-	-	-	-
8	DI-DJB(S)-005	-	-	-	-	630	-	-	220	-	-	-	-	-	1	-	-	-	-
9	DI-DJB(S)-006	-	-	-	-	630	-	-	210	-	-	-	-	-	1	-	-	-	-
10	DI-DJB-008	-	-	-	-	135	180	-	-	-	-	-	-	-	1	-	-	-	-
11	DI-DJB-009	-	-	-	-	135	185	-	-	-	-	-	-	-	1	-	-	-	-
12	DI-DJB-010	-	-	-	-	180	-	40	-	-	-	-	-	-	1	-	-	-	-
13	DI-DJB-011	-	-	-	-	360	-	-	40	-	-	-	-	-	1	-	-	-	-
14	DI-DJB-012	-	-	-	-	360	-	-	40	-	-	-	-	-	1	-	-	-	-
15	DI-DJB-013	-	-	-	-	300	-	-	40	-	-	-	-	-	1	-	-	-	-
16	DI-DJB-014	-	-	-	-	240	-	-	40	-	-	-	-	-	1	-	-	-	-
17	DI-DJB-015	-	-	-	-	225	-	-	40	-	-	-	-	-	1	-	-	-	-
18	DI-DJB-016	-	-	-	-	225	-	-	40	-	-	-	-	-	1	-	-	-	-
19	DO-DJB(S)-001	-	-	-	-	300	-	190	-	-	-	-	-	-	-	1	-	-	-
20	DO-DJB(S)-002	-	-	-	-	210	-	190	-	-	-	-	-	-	-	1	-	-	-
21	DO-DJB(S)-003	-	-	-	-	175	-	190	-	-	-	-	-	-	-	1	-	-	-
22	DO-DJB(S)-004	-	-	-	-	210	-	195	-	-	-	-	-	-	-	1	-	-	-
23	DO-DJB(S)-005	-	-	-	-	245	-	195	-	-	-	-	-	-	-	1	-	-	-
24	DO-DJB(S)-006	-	-	-	-	245	-	195	-	-	-	-	-	-	-	1	-	-	-
25	DO-DJB-008	-	-	-	-	300	-	-	40	-	-	-	-	-	-	1	-	-	-
26	DO-DJB-009	-	-	-	-	120	-	40	-	-	-	-	-	-	-	1	-	-	-
27	DO-DJB-010	-	-	-	-	200	-	40	-	-	-	-	-	-	-	1	-	-	-
28	DO-DJB(S)-011	-	-	-	-	200	-	40	-	-	-	-	-	-	-	1	-	-	-
29	AI-AJB-0001	195	-	180	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
30	AI-AJB-0002	340	-	-	160	-	-	-	-	-	-	-	-	-	-	-	1	-	-
31	AI-AJB-0003	300	-		180	-	-	-	-	-	-	-	-	-	-	-	1	-	-

32	AI-AJB-0004	120	-	135	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
33	AI-AJB-0005	30	-	50	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
34	AI-AJB-0006	110	-	290	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
35	AI-AJB-0007	250	-	-	180	-	-	-	-	-	-	-	-	-	-	-	1	-	-
36	AI-AJB-0008	80	-	180	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
37	AI-AJB-0009	100	-	40	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
38	AI-AJB-0010	100	-	40	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
39	AI-AJB-0011	195	-	190	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
40	AO-AJB-001	100	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
41	AO-AJB-002	100	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
42	SJB-01	1410	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	Gas Detector	-	-	-	-	-	-	-	-	-	-	-	700	-	-	-	1	-	-
44	Free Run	150	-	-	-	630	50	-	-	-	-	-	-	-	-	-	-	-	-
45	ROSOV Modbus	-	-	-	-	-	-	-	-	-	-	-	-	690	-	-	-	-	-
46	VFD Comm.	-	-	-	-	-	-	-	-	-	-	-	-	128	-	-	-	-	-

Total	**3580**	**300**	**1185**	**520**	**8475**	**415**	**1765**	**900**	**730**	**50**	**370**	**700**	**818**	**15**	**10**	**12**	**2**	**3**

Digital Junction Box No.	DI-DJB-001	**Junction Box Location**	Nr. Tank 201	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-001	Length	**160** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LS- VF-201	DI-01	1	2 Core X 1.5 sq.mm	65	**24 Core X 1.5 sq.mm**									
			2												
2	LT- VF-201-HI_HI	DI-02	3	2 Core X 1.5 sq.mm	65										
			4												
3	ROSOV-VF - 201A_FB_NC	DI-03	5	2 Core X 1.5 sq.mm	50										
			6												
4	ROSOV-VF - 201A_FB_NO	DI-04	7	2 Core X 1.5 sq.mm	50										
			8												
5	ROSOV-VF - 201B_FB_NC	DI-05	9	2 Core X 1.5 sq.mm	50										
			10												
6	ROSOV-VF - 201B_FB_NO	DI-06	11	2 Core X 1.5 sq.mm	50										
			12												
7	MOV-VF - 201A_FB_NC	DI-07	13	2 Core X 1.5 sq.mm	50										
			14												
8	MOV-VF - 201A_FB_NO	DI-08	15	2 Core X 1.5 sq.mm	50										
			16												
9	MOV-VF - 201B_FB_NC	DI-09	17	2 Core X 1.5 sq.mm	50										
			18												
10	MOV-VF - 201B_FB_NO	DI-10	19	2 Core X 1.5 sq.mm	50										
			20												
11	Spare	DI-11	21	2 Core X 1.5 sq.mm	-										
			22												
12	Spare	DI-12	23	2 Core X 1.5 sq.mm	-										
			24												
				Total	**530**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-002	**Junction Box Location**	Nr. Tank 202	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-002	Length	**130** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LS- VF-202	DI-01	1	2 Core X 1.5 sq.mm	65	**24 Core X 1.5 sq.mm**									
			2												
2	LT- VF-202-HI_HI	DI-02	3	2 Core X 1.5 sq.mm	65										
			4												
3	ROSOV-VF - 202A_FB_NC	DI-03	5	2 Core X 1.5 sq.mm	50										
			6												
4	ROSOV-VF - 202A_FB_NO	DI-04	7	2 Core X 1.5 sq.mm	50										
			8												
5	ROSOV-VF - 202B_FB_NC	DI-05	9	2 Core X 1.5 sq.mm	50										
			10												
6	ROSOV-VF - 202B_FB_NO	DI-06	11	2 Core X 1.5 sq.mm	50										
			12												
7	MOV-VF - 202A_FB_NC	DI-07	13	2 Core X 1.5 sq.mm	50										
			14												
8	MOV-VF - 202A_FB_NO	DI-08	15	2 Core X 1.5 sq.mm	50										
			16												
9	MOV-VF - 202B_FB_NC	DI-09	17	2 Core X 1.5 sq.mm	50										
			18												
10	MOV-VF - 202B_FB_NO	DI-10	19	2 Core X 1.5 sq.mm	50										
			20												
11	Spare	DI-11	21	2 Core X 1.5 sq.mm	-										
			22												
12	Spare	DI-12	23	2 Core X 1.5 sq.mm											
			24												
		Total		Total	**530**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-003	**Junction Box Location**	Nr. Tank 203	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-003	Length	**160** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabin		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LS- VF-203	DI-01	1 2	2 Core X 1.5 sq.mm	65	**24 Core X 1.5 sq.mm**									
2	LT- VF-203-HI_HI	DI-02	3 4	2 Core X 1.5 sq.mm	65										
3	ROSOV-VF - 203A_FB_NC	DI-03	5 6	2 Core X 1.5 sq.mm	50										
4	ROSOV-VF - 203A_FB_NO	DI-04	7 8	2 Core X 1.5 sq.mm	50										
5	ROSOV-VF - 203B_FB_NC	DI-05	9 10	2 Core X 1.5 sq.mm	50										
6	ROSOV-VF - 203B_FB_NO	DI-06	11 12	2 Core X 1.5 sq.mm	50										
7	MOV-VF - 203A_FB_NC	DI-07	13 14	2 Core X 1.5 sq.mm	50										
8	MOV-VF - 203A_FB_NO	DI-08	15 16	2 Core X 1.5 sq.mm	50										
9	MOV-VF - 203B_FB_NC	DI-09	17 18	2 Core X 1.5 sq.mm	50										
10	MOV-VF - 203B_FB_NO	DI-10	19 20	2 Core X 1.5 sq.mm	50										
11	Spare	DI-11	21 22	2 Core X 1.5 sq.mm	-										
12	Spare	DI-12	23 24	2 Core X 1.5 sq.mm	-										
		Total		Total	**530**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-004	**Junction Box Location**	Nr. Tank 204	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-004	Length	**190** mtr.	Size 37 Core X 1.5 sq.mm	Overall Dia 29 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LS- VF-204	DI-01	1 2	2 Core X 1.5 sq.mm	65	**37 Core X 1.5 sq.mm**									
2	LT- VF-204-HI_HI	DI-02	3 4	2 Core X 1.5 sq.mm	65										
3	ROSOV-VF - 204A_FB_NC	DI-03	5 6	2 Core X 1.5 sq.mm	50										
4	ROSOV-VF - 204A_FB_NO	DI-04	7 8	2 Core X 1.5 sq.mm	50										
5	ROSOV-VF - 204B_FB_NC	DI-05	9 10	2 Core X 1.5 sq.mm	50										
6	ROSOV-VF - 204B_FB_NO	DI-06	11 12	2 Core X 1.5 sq.mm	50										
7	ROSOV-VF - 204C_FB_NC	DI-07	13 14	2 Core X 1.5 sq.mm	50										
8	ROSOV-VF - 204C_FB_NO	DI-08	15 16	2 Core X 1.5 sq.mm	50										
9	MOV-VF - 204A_FB_NC	DI-09	17 18	2 Core X 1.5 sq.mm	50										
10	MOV-VF - 204A_FB_NO	DI-10	19 20	2 Core X 1.5 sq.mm	50										
11	MOV-VF - 204B_FB_NC	DI-11	21 22	2 Core X 1.5 sq.mm	50										
12	MOV-VF - 204B_FB_NO	DI-12	23 24	2 Core X 1.5 sq.mm	50										
13	Spare	DI-13	25 26	2 Core X 1.5 sq.mm	-										
14	Spare	DI-14	27 28	2 Core X 1.5 sq.mm	-										
15	Spare	DI-15	29 30	2 Core X 1.5 sq.mm	-										
16	Spare	DI-16	31 32	2 Core X 1.5 sq.mm	-										
17	Spare	DI-17	33 34	2 Core X 1.5 sq.mm	-										
18	Spare	DI-18	35 36	2 Core X 1.5 sq.mm	-										
		Total		Total	**630**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-005	**Junction Box Location**	Nr. Tank 205	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-005	Length	**220** mtr.	Size 37 Core X 1.5 sq.mm	Overall Dia 29 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LS- VF-205	DI-01	1	2 Core X 1.5 sq.mm	65	**37 Core X 1.5 sq.mm**									
			2												
2	LT- VF-205-HI_HI	DI-02	3	2 Core X 1.5 sq.mm	65										
			4												
3	ROSOV-VF - 205A_FB_NC	DI-03	5	2 Core X 1.5 sq.mm	50										
			6												
4	ROSOV-VF - 205A_FB_NO	DI-04	7	2 Core X 1.5 sq.mm	50										
			8												
5	ROSOV-VF - 205B_FB_NC	DI-05	9	2 Core X 1.5 sq.mm	50										
			10												
6	ROSOV-VF - 205B_FB_NO	DI-06	11	2 Core X 1.5 sq.mm	50										
			12												
7	ROSOV-VF - 205C_FB_NC	DI-07	13	2 Core X 1.5 sq.mm	50										
			14												
8	ROSOV-VF - 205C_FB_NO	DI-08	15	2 Core X 1.5 sq.mm	50										
			16												
5	MOV-VF - 205A_FB_NC	DI-09	17	2 Core X 1.5 sq.mm	50										
			18												
6	MOV-VF - 205A_FB_NO	DI-10	19	2 Core X 1.5 sq.mm	50										
			20												
7	MOV-VF - 205B_FB_NC	DI-11	21	2 Core X 1.5 sq.mm	50										
			22												
8	MOV-VF - 205B_FB_NO	DI-12	23	2 Core X 1.5 sq.mm	50										
			24												
7	Spare	DI-13	25	2 Core X 1.5 sq.mm	-										
			26												
8	Spare	DI-14	27	2 Core X 1.5 sq.mm	-										
			28												
9	Spare	DI-15	29	2 Core X 1.5 sq.mm	-										
			30												
10	Spare	DI-16	31	2 Core X 1.5 sq.mm	-										
			32												
11	Spare	DI-17	33	2 Core X 1.5 sq.mm	-										
			34												
12	Spare	DI-18	35	2 Core X 1.5 sq.mm	-										
			36												
		Total		Total	**630**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-006	**Junction Box Location**	Nr. Tank 206	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-006	Length	**210** mtr.	Size 37 Core X 1.5 sq.mm	Overall Dia 29 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LS- VF-206	DI-01	1	2 Core X 1.5 sq.mm	65	**37 Core X 1.5 sq.mm**									
			2												
2	LT- VF-206-HI_HI	DI-02	3	2 Core X 1.5 sq.mm	65										
			4												
3	ROSOV-VF - 206A_FB_NC	DI-03	5	2 Core X 1.5 sq.mm	50										
			6												
4	ROSOV-VF - 206A_FB_NO	DI-04	7	2 Core X 1.5 sq.mm	50										
			8												
5	ROSOV-VF - 206B_FB_NC	DI-05	9	2 Core X 1.5 sq.mm	50										
			10												
6	ROSOV-VF - 206B_FB_NO	DI-06	11	2 Core X 1.5 sq.mm	50										
			12												
7	ROSOV-VF - 206C_FB_NC	DI-07	13	2 Core X 1.5 sq.mm	50										
			14												
8	ROSOV-VF - 206C_FB_NO	DI-08	15	2 Core X 1.5 sq.mm	50										
			16												
9	MOV-VF - 206A_FB_NC	DI-09	17	2 Core X 1.5 sq.mm	50										
			18												
10	MOV-VF - 206A_FB_NO	DI-10	19	2 Core X 1.5 sq.mm	50										
			20												
11	MOV-VF - 206B_FB_NC	DI-11	21	2 Core X 1.5 sq.mm	50										
			22												
12	MOV-VF - 206B_FB_NO	DI-12	23	2 Core X 1.5 sq.mm	50										
			24												
13	Spare	DI-13	25	2 Core X 1.5 sq.mm	-										
			26												
14	Spare	DI-14	27	2 Core X 1.5 sq.mm	-										
			28												
15	Spare	DI-15	29	2 Core X 1.5 sq.mm	-										
			30												
16	Spare	DI-16	31	2 Core X 1.5 sq.mm	-										
			32												
17	Spare	DI-17	33	2 Core X 1.5 sq.mm	-										
			34												
18	Spare	DI-18	35	2 Core X 1.5 sq.mm	-										
			36												
		Total			**630**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-008	**Junction Box Location**	Nr Tank-202	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-008	Length	**180** mtr.	Size 12Core X 1.5 sq.mm	Overall Dia 21 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	MOV-VF -201A_Trip	DI-01	1	2 Core X 1.5 sq.mm	15	**12 Core X 1.5 sq.mm**									
			2												
2	MOV-VF -202A_Trip	DI-02	3	2 Core X 1.5 sq.mm	55										
			4												
3	MOV-VF -206A_Trip	DI-03	5	2 Core X 1.5 sq.mm	65										
			6												
4	Spare	DI-08	17	2 Core X 1.5 sq.mm	-										
			18												
5	Spare	DI-09	19	2 Core X 1.5 sq.mm	-										
			20												
6	Spare	DI-10	21	2 Core X 1.5 sq.mm	-										
			22												
				Total	**135**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-009	**Junction Box Location**	Nr Tank-204	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DI-DJB-009	Length	**185** mtr.	Size 12 Core X 1.5 sq.mm Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	MOV-VF -203A_Trip	DI-01	1	2 Core X 1.5 sq.mm	15	**12 Core X 1.5 sq.mm**									
			2												
2	MOV-VF -204A_Trip	DI-02	3	2 Core X 1.5 sq.mm	55										
			4												
3	MOV-VF -205A_Trip	DI-03	5	2 Core X 1.5 sq.mm	65										
			6												
4	Spare	DI-08	17	2 Core X 1.5 sq.mm	-										
			18												
5	Spare	DI-09	19	2 Core X 1.5 sq.mm	-										
			20												
6	Spare	DI-10	21	2 Core X 1.5 sq.mm	-										
			22												
				Total	**135**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB(S)-001	**Junction Box Location**	Nr. Tank 201	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DO-DJB-001	Length	**190** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	ROSOV-VF - 201A_Open/Close	DO-01	1	2 Core X 1.5 sq.mm	50	**24 Core X 1.5 sq.mm**									
			2												
2	ROSOV-VF - 201B_Open/Close	DO-02	3	2 Core X 1.5 sq.mm	50										
			4												
3	MOV-VF - 201A_Open	DO-03	5	2 Core X 1.5 sq.mm	50										
			6												
4	MOV-VF - 201A_Close	DO-04	7	2 Core X 1.5 sq.mm	50										
			8												
5	MOV-VF - 201B_Open	DO-05	9	2 Core X 1.5 sq.mm	50										
			10												
6	MOV-VF - 201B_Close	DO-06	11	2 Core X 1.5 sq.mm	50										
			12												
7	Spare	DO-13	25	2 Core X 1.5 sq.mm	-										
			26												
8	Spare	DO-14	27	2 Core X 1.5 sq.mm	-										
			28												
9	Spare	DO-15	29	2 Core X 1.5 sq.mm	-										
			30												
10	Spare	DO-16	31	2 Core X 1.5 sq.mm	-										
			32												
11	Spare	DO-17	33	2 Core X 1.5 sq.mm	-										
			34												
12	Spare	DO-18	35	2 Core X 1.5 sq.mm	-										
			36												
				Total	**300**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB(S)-002	**Junction Box Location**	Nr. Tank 202	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DO-DJB-002	Length	**190** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	ROSOV-VF - 202A_Open/Close	DO-04	7	2 Core X 1.5 sq.mm	35	**24 Core X 1.5 sq.mm**									
			8												
2	ROSOV-VF - 202B_Open/Close	DO-04	7	2 Core X 1.5 sq.mm	35										
			8												
3	MOV-VF - 202A_Open	DO-05	9	2 Core X 1.5 sq.mm	35										
			10												
4	MOV-VF - 202A_Close	DO-06	11	2 Core X 1.5 sq.mm	35										
			12												
5	MOV-VF - 202B_Open	DO-05	9	2 Core X 1.5 sq.mm	35										
			10												
6	MOV-VF - 202B_Close	DO-06	11	2 Core X 1.5 sq.mm	35										
			12												
7	Spare	DO-07	13	2 Core X 1.5 sq.mm	-										
			14												
8	Spare	DO-08	15	2 Core X 1.5 sq.mm	-										
			16												
9	Spare	DO-09	17	2 Core X 1.5 sq.mm	-										
			18												
10	Spare	DO-10	19	2 Core X 1.5 sq.mm	-										
			20												
11	Spare	DO-11	21	2 Core X 1.5 sq.mm	-										
			22												
12	Spare	DO-12	23	2 Core X 1.5 sq.mm	-										
			24												
				Total	**210**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB(S)-003	**Junction Box Location**	Nr. Tank 206	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DO-DJB-003	Length	**190** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	ROSOV-VF - 206A_Open/Close	DO-01	1	2 Core X 1.5 sq.mm	35	**24 Core X 1.5 sq.mm**									
			2												
2	ROSOV-VF - 206B_Open/Close	DO-02	3	2 Core X 1.5 sq.mm	35										
			4												
3	ROSOV-VF - 206C_Open/Close	DO-03	5	2 Core X 1.5 sq.mm	35										
			6												
4	MOV-VF - 206A_Open	DO-04	7	2 Core X 1.5 sq.mm	35										
			8												
5	MOV-VF - 206A_Close	DO-05	9	2 Core X 1.5 sq.mm	35										
			10												
6	MOV-VF - 206B_Close	DO-06	11	2 Core X 1.5 sq.mm	35										
			12												
7	MOV-VF - 206B_Close	DO-07	13	2 Core X 1.5 sq.mm	35										
			14												
8	Spare	DO-08	15	2 Core X 1.5 sq.mm	-										
			16												
9	Spare	DO-09	17	2 Core X 1.5 sq.mm	-										
			18												
10	Spare	DO-10	19	2 Core X 1.5 sq.mm	-										
			20												
11	Spare	DO-11	21	2 Core X 1.5 sq.mm	-										
			22												
12	Spare	DO-12	23	2 Core X 1.5 sq.mm	-										
			24												
				Total	**175**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB-002	**Junction Box Location**	Nr. Tank 203	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DO-DJB-002	Length	**195** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	ROSOV-VF - 203A_Open/Close	DO-01	1	2 Core X 1.5 sq.mm	35	**24 Core X 1.5 sq.mm**									
			2												
2	ROSOV-VF - 203B_Open/Close	DO-02	3	2 Core X 1.5 sq.mm	35										
			4												
3	MOV-VF - 203A_Open	DO-03	5	2 Core X 1.5 sq.mm	35										
			6												
4	MOV-VF - 203A_Close	DO-04	7	2 Core X 1.5 sq.mm	35										
			8												
5	MOV-VF - 203B_Open	DO-05	9	2 Core X 1.5 sq.mm	35										
			10												
6	MOV-VF - 203B_Close	DO-06	11	2 Core X 1.5 sq.mm	35										
			12												
7	Spare	DO-07	13	2 Core X 1.5 sq.mm	-										
			14												
8	Spare	DO-08	15	2 Core X 1.5 sq.mm	-										
			16												
9	Spare	DO-09	17	2 Core X 1.5 sq.mm	-										
			18												
10	Spare	DO-10	19	2 Core X 1.5 sq.mm	-										
			20												
11	Spare	DO-11	21	2 Core X 1.5 sq.mm	-										
			22												
12	Spare	DO-12	23	2 Core X 1.5 sq.mm	-										
			24												
				Total	**210**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB(S)-005	**Junction Box Location**	Nr. Tank 204	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DO-DJB-005	Length	**195** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	ROSOV-VF - 204A_Open/Close	DO-01	1	2 Core X 1.5 sq.mm	35	**24 Core X 1.5 sq.mm**									
			2												
2	ROSOV-VF - 204B_Open/Close	DO-02	3	2 Core X 1.5 sq.mm	35										
			4												
3	ROSOV-VF - 204C_Open/Close	DO-03	5	2 Core X 1.5 sq.mm	35										
			6												
4	MOV-VF - 204A_Open	DO-04	7	2 Core X 1.5 sq.mm	35										
			8												
5	MOV-VF - 204A_Close	DO-05	9	2 Core X 1.5 sq.mm	35										
			10												
6	MOV-VF - 204B_Open	DO-06	11	2 Core X 1.5 sq.mm	35										
			12												
7	MOV-VF - 204B_Close	DO-07	13	2 Core X 1.5 sq.mm	35										
			14												
8	Spare	DO-08	15	2 Core X 1.5 sq.mm	-										
			16												
9	Spare	DO-09	17	2 Core X 1.5 sq.mm	-										
			18												
10	Spare	DO-10	19	2 Core X 1.5 sq.mm	-										
			20												
11	Spare	DO-11	21	2 Core X 1.5 sq.mm	-										
			22												
12	Spare	DO-12	23	2 Core X 1.5 sq.mm	-										
			24												
				Total	**245**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB(S)-006	**Junction Box Location**	Nr. Tank 205	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-DO-DJB-006	Length	**195** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	ROSOV-VF - 205A_Open/Close	DO-01	1	2 Core X 1.5 sq.mm	35	**24 Core X 1.5 sq.mm**									
			2												
2	ROSOV-VF - 205B_Open/Close	DO-02	3	2 Core X 1.5 sq.mm	35										
			4												
3	ROSOV-VF - 205C_Open/Close	DO-03	5	2 Core X 1.5 sq.mm	35										
			6												
4	MOV-VF - 205A_Open	DO-04	7	2 Core X 1.5 sq.mm	35										
			8												
5	MOV-VF - 205A_Close	DO-05	9	2 Core X 1.5 sq.mm	35										
			10												
6	MOV-VF - 205B_Open	DO-06	11	2 Core X 1.5 sq.mm	35										
			12												
7	MOV-VF - 205B_Close	DO-07	13	2 Core X 1.5 sq.mm	35										
			14												
8	Spare	DO-08	15	2 Core X 1.5 sq.mm	-										
			16												
9	Spare	DO-09	17	2 Core X 1.5 sq.mm	-										
			18												
10	Spare	DO-10	19	2 Core X 1.5 sq.mm	-										
			20												
11	Spare	DO-11	21	2 Core X 1.5 sq.mm	-										
			22												
12	Spare	DO-12	23	2 Core X 1.5 sq.mm	-										
			24												
				Total	**245**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	Direct Run	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	Length	mtr.	Size / Overall Dia

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	GD-VF-201	AI-01	1	1 Triad X 1.5 sq.mm	200										
			2												
2	GD-VF-202	AI-02	3	1 Triad X 1.5 sq.mm	200										
			4												
3	GD-401	AI-03	5	1 Triad X 1.5 sq.mm	150										
			6												
4	GD-402	AI-04	7	1 Triad X 1.5 sq.mm	150										
			8												
5	Spare	AI-05	9	1 Triad X 1.5 sq.mm	-										
			10												
6	Spare	AI-06	11	1 Triad X 1.5 sq.mm	-										
			12												
				Total	**700**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-001	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-001	Length **180** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 20 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LT-VF-201A	AI-01	1	1 Pair X 1.5 sq.mm	40	**6 Pair X 1.5 sq.mm**									
			2												
2	LT-VF-202A	AI-02	3	1 Pair X 1.5 sq.mm	75										
			4												
3	LT-VF-206A	AI-03	5	1 Pair X 1.5 sq.mm	80										
			6												
4	Spare	AI-04	7	1 Pair X 1.5 sq.mm	-										
			8												
5	Spare	AI-05	9	1 Pair X 1.5 sq.mm	-										
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm	-										
			12												
				Total	**195**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-011	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-011	Length **190** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 20 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LT-VF-203A	AI-01	1	1 Pair X 1.5 sq.mm	40	**6 Pair X 1.5 sq.mm**									
			2												
2	LT-VF-204A	AI-02	3	1 Pair X 1.5 sq.mm	75										
			4												
3	LT-VF-205A	AI-03	5	1 Pair X 1.5 sq.mm	80										
			6												
4	Spare	AI-04	7	1 Pair X 1.5 sq.mm	-										
			8												
5	Spare	AI-05	9	1 Pair X 1.5 sq.mm	-										
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm	-										
			12												
				Total	**195**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-002	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-002	Length **160** mtr.	Size 12 Pair X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	FT-301	AI-01	1	1 Pair X 1.5 sq.mm	40	**12 Pair X 1.5 sq.mm**									
			2												
2	DPT-301	AI-02	3	1 Pair X 1.5 sq.mm	40										
			4												
3	FT-302	AI-03	5	1 Pair X 1.5 sq.mm	30										
			6												
4	DPT-302	AI-04	7	1 Pair X 1.5 sq.mm	30										
			8												
4	FT-303	AI-05	9	1 Pair X 1.5 sq.mm	30										
			10												
5	DPT-303	AI-06	11	1 Pair X 1.5 sq.mm	30										
			12												
5	FT-304	AI-07	13	1 Pair X 1.5 sq.mm	30										
			14												
6	DPT-304	AI-08	15	1 Pair X 1.5 sq.mm	30										
			16												
6	FT-305	AI-09	17	1 Pair X 1.5 sq.mm	40										
			18												
7	DPT-305	AI-10	19	1 Pair X 1.5 sq.mm	40										
			20												
8	Spare	AI-11	21	1 Pair X 1.5 sq.mm	-										
			22												
9	Spare	AI-12	23	1 Pair X 1.5 sq.mm	-										
			24												
				Total	**340**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-003	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-003	Length **180** mtr.	Size 12 Pair X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	FT-306	AI-01	1	1 Pair X 1.5 sq.mm	40	**12 Pair X 1.5 sq.mm**									
			2												
2	DPT-306	AI-02	3	1 Pair X 1.5 sq.mm	40										
			4												
3	FT-307	AI-03	5	1 Pair X 1.5 sq.mm	30										
			6												
4	DPT-307	AI-04	7	1 Pair X 1.5 sq.mm	30										
			8												
4	FT-308	AI-05	9	1 Pair X 1.5 sq.mm	30										
			10												
5	DPT-308	AI-06	11	1 Pair X 1.5 sq.mm	30										
			12												
5	FT-309	AI-07	13	1 Pair X 1.5 sq.mm	30										
			14												
6	DPT-309	AI-08	15	1 Pair X 1.5 sq.mm	30										
			16												
6	FT-3010	AI-09	17	1 Pair X 1.5 sq.mm	40										
			18												
7	DPT-310	AI-10	19	1 Pair X 1.5 sq.mm	40										
			20												
8	Spare	AI-11	21	1 Pair X 1.5 sq.mm	-										
			22												
9	Spare	AI-12	23	1 Pair X 1.5 sq.mm	-										
			24												
				Total	**300**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-004	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-004	Length **135** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 20 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	FT-300A	AI-01	1	1 Pair X 1.5 sq.mm	30	**6 Pair X 1.5 sq.mm**									
			2												
2	DPT-300A	AI-02	3	1 Pair X 1.5 sq.mm	30										
			4												
3	FT-300B	AI-03	5	1 Pair X 1.5 sq.mm	30										
			6												
4	DPT-300B	AI-04	7	1 Pair X 1.5 sq.mm	30										
			8												
5	Spare	AI-05	9	1 Pair X 1.5 sq.mm	-										
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm	-										
			12												
				Total	**120**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-005	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-005	Length **50** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 20 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	FT-501	AI-01	1	1 Pair X 1.5 sq.mm	15	**6 Pair X 1.5 sq.mm**									
			2												
2	FT-502	AI-02	3	1 Pair X 1.5 sq.mm	15										
			4												
3	Spare	AI-03	5	1 Pair X 1.5 sq.mm	-										
			6												
4	Spare	AI-04	7	1 Pair X 1.5 sq.mm	-										
			8												
5	Spare	AI-05	9	1 Pair X 1.5 sq.mm	-										
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm	-										
			12												
				Total	**30**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-006	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-006	Length **290** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 20 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LT-T-1	AI-01	1	1 Pair X 1.5 sq.mm	45	**6 Pair X 1.5 sq.mm**									
			2												
2	LT-T-2	AI-02	3	1 Pair X 1.5 sq.mm	20										
			4												
3	LT-T-3	AI-03	5	1 Pair X 1.5 sq.mm	45										
			6												
4	Spare	AI-04	7	1 Pair X 1.5 sq.mm											
			8												
5	Spare	AI-05	9	1 Pair X 1.5 sq.mm											
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm											
			12												
				Total	**110**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-007	**Junction Box Location**	-	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-007	Length	**180** mtr.	Size 12 Pair X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	DPT-311	AI-01	1	1 Pair X 1.5 sq.mm	20	**12 Pair X 1.5 sq.mm**									
			2												
2	DPT-312	AI-02	3	1 Pair X 1.5 sq.mm	20										
			4												
3	DPT-313	AI-03	5	1 Pair X 1.5 sq.mm	35										
			6												
4	DPT-314	AI-04	7	1 Pair X 1.5 sq.mm	35										
			8												
5	DPT-MF-11	AI-05	9	1 Pair X 1.5 sq.mm	35										
			10												
6	DPT-MF-12	AI-06	11	1 Pair X 1.5 sq.mm	35										
			12												
7	DPT-MF-13	AI-07	13	1 Pair X 1.5 sq.mm	35										
			14												
8	DPT-MF-14	AI-08	15	1 Pair X 1.5 sq.mm	35										
			16												
9	Spare	AI-09	17	1 Pair X 1.5 sq.mm	-										
			18												
10	Spare	AI-10	19	1 Pair X 1.5 sq.mm	-										
			20												
11	Spare	AI-11	21	1 Pair X 1.5 sq.mm	-										
			22												
12	Spare	AI-12	23	1 Pair X 1.5 sq.mm	-										
			24												
				Total	**250**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-008	**Junction Box Location**	At pump header Discharge	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-008	Length	**180** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 20 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PT-401	AI-01	1	1 Pair X 1.5 sq.mm	20	**6 Pair X 1.5 sq.mm**									
			2												
2	FT-401	AI-02	3	1 Pair X 1.5 sq.mm	20										
			4												
3	PT-402	AI-03	5	1 Pair X 1.5 sq.mm	20										
			6												
4	FT-402	AI-04	7	1 Pair X 1.5 sq.mm	20										
			8												
5	Spare	AI-05	9	1 Pair X 1.5 sq.mm	-										
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm	-										
			12												
				Total	**80**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.			**Junction Box Location(Direct Run-Safety PLC)**												M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No				Length	-	mtr.		Size						Overall Dia	mm (Approx.)
Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	HS-207	-	-	2 Core X 1.5 sq.mm	20	'									
			-												
2	XS-01	-	-	2 Core X 1.5 sq.mm	165	'									
			-												
3	XS-02	-	-	2 Core X 1.5 sq.mm	50	'									
			-												
4	HS-1	-	-	2 Core X 1.5 sq.mm	60	'									
			-												
5	HS-2	-	-	2 Core X 1.5 sq.mm	60	'									
			-												
6	HS-3	-	-	2 Core X 1.5 sq.mm	60	'									
			-												
7	HS-4	-	-	2 Core X 1.5 sq.mm	60	'									
			-												
8	HS-5	-	-	2 Core X 1.5 sq.mm	60	'									
			-												
9	HS-6	-	-	2 Core X 1.5 sq.mm	60	'									
			-												

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.			**Junction Box Location(Direct Run-Process PLC)**								M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.			
Multicore Cable No				Length	-	mtr.	Size					Overall Dia		mm (Approx.)
Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	CP-T1	-	-	2 Core X 1.5 sq.mm	5	'									
			-												
2	CP-T2	-	-	2 Core X 1.5 sq.mm	5	'									
			-												
3	CP-T3	-	-	2 Core X 1.5 sq.mm	5	'									
			-												
4	PC-1	-	-	2 Core X 1.5 sq.mm	5	'									
			-												
5	PC-2	-	-	2 Core X 1.5 sq.mm	5	'									
			-												
6	PC-3	-	-	2 Core X 1.5 sq.mm	5	'									
			-												
7	PC-4	-	-	2 Core X 1.5 sq.mm	5	'									
			-												
8	LT-HSD-1	-	-	1 Pair X 1.5 sq.mm	150	'									
			-												

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

ROSOV COMMUNICATION						M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.			
	Equip Tag	Location	Mtr.	Equip Tag	Location		Size	Type	Application
1	PLC	Contro Room	180	ROSOV-VF -202A	Tank 202	NC/PLC/ROSOV-VF-202A	2Px1.5	COMM.	-
1	ROSOV-VF -202A	Tank 202	35	ROSOV-VF -201A	Tank 201	NC/ROSOV-VF-202A/ROSOV-VF-201A	2Px1.5	COMM.	4-Wirer Modbus Communication
2	ROSOV-VF -201A	Tank 201	35	ROSOV-VF -206A	Tank 206	NC/ROSOV-VF-201A/ROSOV-VF-206A	2Px1.5	COMM.	4-Wirer Modbus Communication
3	ROSOV-VF -206A	Tank 206	150	ROSOV-VF -205A	Tank 205	NC/ROSOV-VF-206A/ROSOV-VF-205A	2Px1.5	COMM.	4-Wirer Modbus Communication
4	ROSOV-VF -205A	Tank 205	35	ROSOV-VF -204A	Tank 204	NC/ROSOV-VF-205A/ROSOV-VF-204A	2Px1.5	COMM.	4-Wirer Modbus Communication
5	ROSOV-VF -204A	Tank 204	35	ROSOV-VF -203A	Tank 203	NC/ROSOV-VF-204A/ROSOV-VF-203A	2Px1.5	COMM.	4-Wirer Modbus Communication
6	ROSOV-VF -203A	Tank 203	220	PLC	Control Room	NC//ROSOV-VF-203A/PLC	2Px1.5	COMM.	4-Wirer Modbus Communication
		Total	**690**						

Note:

1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Power Junction Box No.	PJB-001	**Junction Box Location**	Nr.Tank 201	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MC-PJB-001	Length	**180** mtr.	Size 24 Core X 2.5 sq.mm	Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Core No.	Terminal Box			Cable type From JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	HUB-VF-201	1	1	3 Core X 2.5 sq.mm	30	**24 Core X 2.5 Sq.mm**									
		2	2												
		3	3												
2	HUB-VF-202	4	4	3 Core X 2.5 sq.mm	50										
		5	5												
		6	6												
3	HUB-VF-206	7	7	3 Core X 2.5 sq.mm	50										
		8	8												
		9	9												
4	LT-VF-201A	10	10	3 Core X 2.5 sq.mm	60										
		11	11												
		12	12												
5	LT-VF-202A	13	13	3 Core X 2.5 sq.mm	75										
		14	14												
		15	15												
6	LT-VF-206A	16	16	3 Core X 2.5 sq.mm	75										
		17	17												
		18	18												
7	Spare	19	19	3 Core X 2.5 sq.mm	-										
		20	20												
		21	21												
8	Spare	22	22	3 Core X 2.5 sq.mm	-										
		23	23												
		24	24												

Total **340**

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

2) JB Schedule philosophy made based by Selecting radar mode make is Emerson , it may be change as finalized Vendor.

Power Junction Box No.	PJB-002	**Junction Box Location**	Nr.Tank 204	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MC-PJB-002	Length	**190** mtr.	Size 24 Core X 2.5 sq.mm	Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Core No.	Terminal Box			Cable type From JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	HUB-VF-203	1	1	3 Core X 2.5 sq.mm	30	**24 Core X 2.5 Sq.mm**									
		2	2												
		3	3												
2	HUB-VF-204	4	4	3 Core X 2.5 sq.mm	50										
		5	5												
		6	6												
3	HUB-VF-205	7	7	3 Core X 2.5 sq.mm	50										
		8	8												
		9	9												
4	LT-VF-203A	10	10	3 Core X 2.5 sq.mm	60										
		11	11												
		12	12												
5	LT-VF-204A	13	10	3 Core X 2.5 sq.mm	75										
		14	11												
		15	12												
6	LT-VF-205A	16	10	3 Core X 2.5 sq.mm	75										
		17	11												
		18	12												
7	Spare	19	10	3 Core X 2.5 sq.mm	-										
		20	11												
		21	12												
8	Spare	22	10	3 Core X 2.5 sq.mm	-										
		23	11												
		24	12												

Total **340**

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

2) JB Schedule philosophy made based by Selecting radar mode make is Emerson , it may be change as finalized Vendor.

Power Junction Box No.	PJB-003	**Junction Box Location**	Nr. Tank Lorry Decanting Tank	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.

Multicore Cable No	MC-PJB-003	Length	**50** mtr.	Size	6 Core X 2.5 sq.mm	Overall Dia	21 mm (Approx.)

Ref. Sr.No.	From Field	Core No.	Terminal Box			Cable type From JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	FT-501	1	1	3 Core X 2.5 sq.mm	25	**6 C X 1.5 sq.mm**									
		2	2												
		3	3												
2	FT-502	4	4	3 Core X 2.5 sq.mm	25										
		5	5												
		6	6												

Total **50**

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-10	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DI-DJB-10	Length	**40** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	JK-P-1	DI-01	1	2 Core X 1.5 sq.mm	20	**24 Core X 1.5 sq.mm**									Auto/Manual
			2												
		DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			4												
		DI-03	5	2 Core X 1.5 sq.mm	20										Trip
			6												
2	JK-P-2	DI-04	7	2 Core X 1.5 sq.mm	20										Auto/Manual
			8												
		DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			10												
		DI-06	11	2 Core X 1.5 sq.mm	20										Trip
			12												
3	JK-P-3	DI-07	13	2 Core X 1.5 sq.mm	20										Auto/Manual
			14												
		DI-08	15	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			16												
		DI-09	17	2 Core X 1.5 sq.mm	20										Trip
			18												
4	Spare	DI-10	19	2 Core X 1.5 sq.mm	-										Auto/Manual
			20												
5	Spare	DI-11	21	2 Core X 1.5 sq.mm	-										Start/Stop Indication
			22												
6	Spare	DI-12	23	2 Core X 1.5 sq.mm	-										Trip
			24												
				Total	**180**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-11	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DI-DJB-11	Length	**40** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	JK-P-4	DI-01	1	2 Core X 1.5 sq.mm	20	37 Core X 1.5 sq.mm									Auto/Manual
			2												
		DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			4												
		DI-03	5	2 Core X 1.5 sq.mm	20										Trip
			6												
2	TT-P-1	DI-04	7	2 Core X 1.5 sq.mm	20										Auto/Manual
			8												
		DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			10												
		DI-06	11	2 Core X 1.5 sq.mm	20										Trip
			12												
3	TT-P-2	DI-07	13	2 Core X 1.5 sq.mm	20										Auto/Manual
			14												
		DI-08	15	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			16												
		DI-09	17	2 Core X 1.5 sq.mm	20										Trip
			18												
4	TT-P-3	DI-10	19	2 Core X 1.5 sq.mm	20										Auto/Manual
			20												
		DI-11	21	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			22												
		DI-12	23	2 Core X 1.5 sq.mm	20										Trip
			24												
5	TW-P-1	DI-13	25	2 Core X 1.5 sq.mm	20										Auto/Manual
			26												
		DI-14	27	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			28												
		DI-15	29	2 Core X 1.5 sq.mm	20										Trip
			30												
6	Spare	DI-16	31	2 Core X 1.5 sq.mm	20										Auto/Manual
			32												
7	Spare	DI-17	33	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			34												
8	Spare	DI-18	35	2 Core X 1.5 sq.mm	20										Trip
			36												
				Total	**360**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-12	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.

Multicore Cable No: MC-DI-DJB-12 Length **40** mtr. Size 37Core X 1.5 sq.mm Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	TW-P-2	DI-01	1	2 Core X 1.5 sq.mm	20	37 Core X 1.5 sq.mm									Auto/Manual
			2												
		DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			4												
		DI-03	5	2 Core X 1.5 sq.mm	20										Trip
			6												
2	TW-P-3	DI-04	7	2 Core X 1.5 sq.mm	20										Auto/Manual
			8												
		DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			10												
		DI-06	11	2 Core X 1.5 sq.mm	20										Trip
			12												
3	HSD-P-1	DI-07	13	2 Core X 1.5 sq.mm	20										Auto/Manual
			14												
		DI-08	15	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			16												
		DI-09	17	2 Core X 1.5 sq.mm	20										Trip
			18												
4	P-0016	DI-10	19	2 Core X 1.5 sq.mm	20										Auto/Manual
			20												
		DI-11	21	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			22												
		DI-12	23	2 Core X 1.5 sq.mm	20										Trip
			24												
5	P-0017	DI-13	25	2 Core X 1.5 sq.mm	20										Auto/Manual
			26												
		DI-14	27	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			28												
		DI-15	29	2 Core X 1.5 sq.mm	20										Trip
			30												
6	Spare	DI-16	31	2 Core X 1.5 sq.mm	20										Auto/Manual
			32												
7	Spare	DI-17	33	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			34												
8	Spare	DI-18	35	2 Core X 1.5 sq.mm	20										Trip
			36												
				Total	**360**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-13	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DI-DJB-13	Length	**40** mtr.	Size 37 Core X 1.5 sq.mm	Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	P-0018	DI-01	1	2 Core X 1.5 sq.mm	20	**37 Core X 1.5 sq.mm**									Auto/Manual
			2												
		DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			4												
		DI-03	5	2 Core X 1.5 sq.mm	20										Trip
			6												
2	PLT-P-1	DI-04	7	2 Core X 1.5 sq.mm	20										Auto/Manual
			8												
		DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			10												
		DI-06	11	2 Core X 1.5 sq.mm	20										Trip
			12												
3	P-3	DI-07	13	2 Core X 1.5 sq.mm	20										Auto/Manual
			14												
		DI-08	15	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			16												
		DI-09	17	2 Core X 1.5 sq.mm	20										Trip
			18												
4	P-4	DI-10	19	2 Core X 1.5 sq.mm	20										Auto/Manual
			20												
		DI-11	21	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			22												
		DI-12	23	2 Core X 1.5 sq.mm	20										Trip
			24												
5	P-5	DI-13	25	2 Core X 1.5 sq.mm	20										Auto/Manual
			26												
		DI-14	27	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			28												
		DI-15	29	2 Core X 1.5 sq.mm	20										Trip
			30												
				Total	**300**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No. DI-DJB-14 **Junction Box Location** MCC Room M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.

Multicore Cable No: MC-DI-DJB-14 Length **40** mtr. Size 37 Core X 1.5 sq.mm Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	P-6	DI-01	1	2 Core X 1.5 sq.mm	20	**37 Core X 1.5 sq.mm**									Auto/Manual
			2												
		DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			4												
		DI-03	5	2 Core X 1.5 sq.mm	20										Trip
			6												
2	P-7	DI-04	7	2 Core X 1.5 sq.mm	20										Auto/Manual
			8												
		DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			10												
		DI-06	11	2 Core X 1.5 sq.mm	20										Trip
			12												
3	PF-251A	DI-07	13	2 Core X 1.5 sq.mm	20										Auto/Manual
			14												
		DI-08	15	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			16												
		DI-09	17	2 Core X 1.5 sq.mm	20										Trip
			18												
4	PF-251B	DI-10	19	2 Core X 1.5 sq.mm	20										Auto/Manual
			20												
		DI-11	21	2 Core X 1.5 sq.mm	20										Start/Stop Indication
			22												
		DI-12	23	2 Core X 1.5 sq.mm	20										Trip
			24												
				Total	**240**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-15	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DI-DJB-15	Length	**40** mtr.	Size 37 Core X 1.5 sq.mm	Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-301	DI-01	-	2 Core X 1.5 sq.mm	15	**37 Core X 1.5 sq.mm**									Auto/Manual
			-												
		DI-02	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-03	-	2 Core X 1.5 sq.mm	15										Trip
			-												
2	PF-302	DI-04	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-05	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-06	-	2 Core X 1.5 sq.mm	15										Trip
			-												
3	PF-303	DI-07	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-08	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-09	-	2 Core X 1.5 sq.mm	15										Trip
			-												
4	PF-304	DI-10	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-11	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-12	-	2 Core X 1.5 sq.mm	15										Trip
			-												
5	PF-305	DI-13	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-14	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-15	-	2 Core X 1.5 sq.mm	15										Trip
			-												
				Total	**225**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DI-DJB-16	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DI-DJB-16	Length	**40** mtr.	Size 37 Core X 1.5 sq.mm	Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-306	DI-01	-	2 Core X 1.5 sq.mm	15	**37 Core X 1.5 sq.mm**									Auto/Manual
			-												
		DI-02	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-03	-	2 Core X 1.5 sq.mm	15										Trip
			-												
2	PF-307	DI-04	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-05	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-06	-	2 Core X 1.5 sq.mm	15										Trip
			-												
3	PF-308	DI-07	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-08	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-09	-	2 Core X 1.5 sq.mm	15										Trip
			-												
4	PF-309	DI-10	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-11	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-12	-	2 Core X 1.5 sq.mm	15										Trip
			-												
5	PF-310	DI-13	-	2 Core X 1.5 sq.mm	15										Auto/Manual
			-												
		DI-14	-	2 Core X 1.5 sq.mm	15										Start/Stop Indication
			-												
		DI-15	-	2 Core X 1.5 sq.mm	15										Trip
			-												
				Total	**225**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB-008	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DO-DJB-008	Length	**40** mtr.	Size 37 Core X 1.5 sq.mm	Overall Dia 30 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	JK-P-1	DI-01	1	2 Core X 1.5 sq.mm	20	**37 Core X 1.5 sq.mm**									Start/Stop
			2												
2	JK-P-2	DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop
			4												
3	JK-P-3	DI-03	5	2 Core X 1.5 sq.mm	20										Start/Stop
			6												
4	JK-P-4	DI-04	7	2 Core X 1.5 sq.mm	20										Start/Stop
			8												
5	TT-P-1	DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop
			10												
6	TT-P-2	DI-06	11	2 Core X 1.5 sq.mm	20										Start/Stop
			12												
7	TT-P-3	DI-07	13	2 Core X 1.5 sq.mm	20										Start/Stop
			14												
8	TW-P-1	DI-08	15	2 Core X 1.5 sq.mm	20										Start/Stop
			16												
9	TW-P-2	DI-09	17	2 Core X 1.5 sq.mm	20										Start/Stop
			18												
10	TW-P-3	DI-10	19	2 Core X 1.5 sq.mm	20										Start/Stop
			20												
11	HSD-P-1	DI-11	21	2 Core X 1.5 sq.mm	20										Start/Stop
			22												
12	P-0016	DI-12	23	2 Core X 1.5 sq.mm	20										Start/Stop
			24												
13	P-0017	DI-13	25	2 Core X 1.5 sq.mm	20										Start/Stop
			26												
14	P-0018	DI-14	27	2 Core X 1.5 sq.mm	20										Start/Stop
			28												
15	PLT-P-1	DI-15	29	2 Core X 1.5 sq.mm	20										Start/Stop
			30												
				Total	**300**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No. DO-DJB-009 **Junction Box Location** MCC Room M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.

Multicore Cable No: MC-DO-DJB-009 Length **40** mtr. Size 24 Core X 1.5 sq.mm Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	P-3	DI-01	1	2 Core X 1.5 sq.mm	20	**24 Core X 1.5 sq.mm**									Start/Stop
			2												
2	P-4	DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop
			4												
3	P-5	DI-03	5	2 Core X 1.5 sq.mm	20										Start/Stop
			6												
4	P-6	DI-04	7	2 Core X 1.5 sq.mm	20										Start/Stop
			8												
5	P-7	DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop
			10												
6	PF-251A	DI-06	11	2 Core X 1.5 sq.mm	20										Start/Stop
			12												
7	PF-251B	DI-07	13	2 Core X 1.5 sq.mm	-										Start/Stop
			14												
8	Spare	DI-08	15	2 Core X 1.5 sq.mm	-										Start/Stop
			16												
9	Spare	DI-09	17	2 Core X 1.5 sq.mm	-										Start/Stop
			18												
10	Spare	DI-10	19	2 Core X 1.5 sq.mm	-										Start/Stop
			20												
11	Spare	DI-11	21	2 Core X 1.5 sq.mm	-										Start/Stop
			22												
12	Spare	DI-12	23	2 Core X 1.5 sq.mm	-										Start/Stop
			24												
				Total	**120**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB-010	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DO-DJB-010	Length	**40** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-301	DI-01	1	2 Core X 1.5 sq.mm	20	**24 Core X 1.5 sq.mm**									Start/Stop
			2												
2	PF-302	DI-02	3	2 Core X 1.5 sq.mm	20										Start/Stop
			4												
3	PF-303	DI-03	5	2 Core X 1.5 sq.mm	20										Start/Stop
			6												
4	PF-304	DI-04	7	2 Core X 1.5 sq.mm	20										Start/Stop
			8												
5	PF-305	DI-05	9	2 Core X 1.5 sq.mm	20										Start/Stop
			10												
6	PF-306	DI-06	11	2 Core X 1.5 sq.mm	20										Start/Stop
			12												
7	PF-307	DI-07	13	2 Core X 1.5 sq.mm	20										Start/Stop
			14												
8	PF-308	DI-08	15	2 Core X 1.5 sq.mm	20										Start/Stop
			16												
9	PF-309	DI-09	17	2 Core X 1.5 sq.mm	20										Start/Stop
			18												
10	PF-310	DI-10	19	2 Core X 1.5 sq.mm	20										Start/Stop
			20												
11	Spare	DI-11	21	2 Core X 1.5 sq.mm	-										Start/Stop
			22												
12	Spare	DI-12	23	2 Core X 1.5 sq.mm	-										Start/Stop
			24												
				Total	**200**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	DO-DJB(S)-011	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No:	MC-DO-DJB(S)-011	Length	**40** mtr.	Size 24 Core X 1.5 sq.mm	Overall Dia 25 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-301	DI-01	-	2 Core X 1.5 sq.mm	20	**24 Core X 1.5 sq.mm**									ESD Trip
			-												
2	PF-302	DI-02	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
3	PF-303	DI-03	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
4	PF-304	DI-04	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
5	PF-305	DI-05	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
6	PF-306	DI-06	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
7	PF-307	DI-07	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
8	PF-308	DI-08	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
9	PF-309	DI-09	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
10	PF-310	DI-10	-	2 Core X 1.5 sq.mm	20										ESD Trip
			-												
11	Spare	DI-11	-	2 Core X 1.5 sq.mm	-										ESD Trip
			-												
12	Spare	DI-12	-	2 Core X 1.5 sq.mm	-										ESD Trip
			-												
				Total	**200**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-09	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-09	Length	**40** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 21 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-301	AI-01	1	1 Pair X 1.5 sq.mm	20	**6 Pair X 1.5 sq.mm**									VFD Speed Indication
			2												
2	PF-302	AI-02	3	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			4												
3	PF-303	AI-03	5	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			6												
4	PF-304	AI-04	7	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			8												
5	PF-305	AI-05	9	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			10												
				Total	**100**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AI-AJB-011	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AI-AJB-011	Length	**40** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 21 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-306	AI-01	1	1 Pair X 1.5 sq.mm	20	**6 Pair X 1.5 sq.mm**									VFD Speed Indication
			2												
2	PF-307	AI-02	3	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			4												
3	PF-308	AI-03	5	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			6												
4	PF-309	AI-04	7	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			8												
5	PF-310	AI-05	9	1 Pair X 1.5 sq.mm	20										VFD Speed Indication
			10												
				Total	**100**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AO-AJB-1	**Junction Box Location**	MCC Room	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AO-AJB-1	Length	**40** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 21 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-301	AI-01	1	1 Pair X 1.5 sq.mm	20	**6 Pair X 1.5 sq.mm**									VFD Speed Control
			2												
2	PF-302	AI-02	3	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			4												
3	PF-303	AI-03	5	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			6												
4	PF-304	AI-04	7	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			8												
5	PF-305	AI-05	9	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm											VFD Speed Control
			12												
				Total	**100**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.	AO-AJB-2	**Junction Box Location**	M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.
Multicore Cable No	MP-AO-AJB-2	Length **40** mtr.	Size 6 Pair X 1.5 sq.mm	Overall Dia 21 mm (Approx.)

Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	PF-306	AI-01	1	1 Pair X 1.5 sq.mm	20	**6 Pair X 1.5 sq.mm**									VFD Speed Control
			2												
2	PF-307	AI-02	3	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			4												
3	PF-308	AI-03	5	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			6												
4	PF-309	AI-04	7	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			8												
5	PF-310	AI-05	9	1 Pair X 1.5 sq.mm	20										VFD Speed Control
			10												
6	Spare	AI-06	11	1 Pair X 1.5 sq.mm	-										VFD Speed Control
			12												
				Total	**100**										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

Digital Junction Box No.			**Junction Box Location**				M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.							
Multicore Cable No			Length	**50** mtr.		Size	12 Core X 1.5 sq.mm			Overall Dia	25 mm (Approx.)			
Ref. Sr.No.	From Field	Digital Cable No.	Terminal Box			Cable type JB to CR	Marshalling/RTP Cabinet		Barrier / Relay			I / O Module			Remarks
			Teminal No.	Cable Type	Length Mtr.		Cabinet / RTP No.	Terminal No.	Barrier Tag	Input terminal	Output terminal	Module No.	Channel No.	Terminal No.	
1	LT- Feeder	DI-01	1	2 Core X 1.5 sq.mm	-	**12 Core X 1.5 sq.mm**									
			2		-										
		DI-02	3	2 Core X 1.5 sq.mm	-										
			4		-										
		DI-03	5	2 Core X 1.5 sq.mm	-										
			6		-										
		DI-04	7	2 Core X 1.5 sq.mm	-										
			8		-										
		DI-05	9	2 Core X 1.5 sq.mm	-										
			10		-										
				Total	-										

Notes- 1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

VFD COMMUNICATION

M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.

Sr. No.	Equip Tag	Location	Mtr.	Equip Tag	Location		Size	Type	Application
1	PLC	Contro Room	50	VFD-PF-301	MCC Room	NC/PLC/VFD-PF-301	2Px1.5	COMM.	Pump P-115 VFD Soft signals
2	VFD-PF-301	MCC Room	2	VFD-PF-302	MCC Room	NC/VFD-PF-301/VFD-PF-302	2Px1.5	COMM.	Pump P-116 VFD Soft signals
3	VFD-PF-302	MCC Room	2	VFD-PF-303	MCC Room	NC/VFD-PF-302/VFD-PF-303	2Px1.5	COMM.	Pump P-117 VFD Soft signals
4	VFD-PF-303	MCC Room	2	VFD-PF-304	MCC Room	NC/VFD-PF-303/VFD-PF-304	2Px1.5	COMM.	Pump P-118 VFD Soft signals
5	VFD-PF-304	MCC Room	2	VFD-PF-305	MCC Room	NC/VFD-PF-304/VFD-PF-305	2Px1.5	COMM.	Pump P-119 VFD Soft signals
6	VFD-PF-305	MCC Room	2	VFD-PF-306	MCC Room	NC/VFD-PF-305/VFD-PF-306	2Px1.5	COMM.	Pump P-120 VFD Soft signals
7	VFD-PF-306	MCC Room	2	VFD-PF-307	MCC Room	NC/VFD-PF-306/VFD-PF-307	2Px1.5	COMM.	Pump P-121 VFD Soft signals
8	VFD-PF-307	MCC Room	2	VFD-PF-308	MCC Room	NC/VFD-PF-307/VFD-PF-308	2Px1.5	COMM.	Pump P-122 VFD Soft signals
9	VFD-PF-308	MCC Room	2	VFD-PF-309	MCC Room	NC/VFD-PF-308/VFD-PF-309	2Px1.5	COMM.	Pump P-123 VFD Soft signals
10	VFD-PF-309	MCC Room	2	VFD-PF-310	MCC Room	NC/VFD-PF-309/VFD-PF-310	2Px1.5	COMM.	Pump P-124 VFD Soft signals
11	VFD-PF-310	MCC Room	60	PLC	Control Room	NC/VFD-PF-310/PLC	2Px1.5	COMM.	Pump P-125 VFD Soft signals
		Total	**128**						

Note:

1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

HUB COMMUNICATION

M/s Delhi Fuel Aviation Fuel Facility Pvt.Ltd.

Sr.No.	Equip Tag	Location	Mtr.	Equip Tag	Location	Tag Name	Size	Type	Remark
1	NWP-1	Contro Room	130	SJB-01	Nr.Tank - 201	CC/NWP/SJB-01	1Px1.5	SIGNAL	
2	SJB-01	Nr.Tank - 201	35	HUB-VF-201	Nr.Tank - 201	SC/SJB-01/HUB-201	1Px1.5	COMM.	
3	HUB-VF-201	Nr.Tank - 201	10	TSI-201	Nr.Tank - 201	SC/HUB-201/TSI-201	1Px1.5	COMM.	
4	TSI-201	Nr.Tank - 201	35	PT-VF-201B	Tank-201	SC/TSI-201/PT-201B	1Px1.5	COMM.	
5	PT-VF-201B	Tank-201	50	JS-201	Nr.Tank - 201	SC/PT-201B/JS-201	2Px1.5	COMM.	
6	JS-201	Nr.Tank - 201	90	HUB-VF-201	Nr.Tank - 201	SC/JS-201/HUB-VF-201	1Px1.5	COMM.	
7	JS-201	Nr.Tank - 201	10	RTG-201	Tank - 201	SC/JS-201/RTG-201	1Px1.5	COMM.	
8	RTG-201	Tank - 201	5	MST-VF-201	Tank - 201	SC/RTG-201/MST-VF-201	1Px1.5	COMM.	
9	SJB-01	Nr.Tank - 202	55	HUB-VF-202	Nr.Tank - 202	SC/SJB-01/HUB-202	1Px1.5	COMM.	
10	HUB-VF-202	Nr.Tank - 202	10	TSI-202	Nr.Tank - 202	SC/HUB-202/TSI-202	1Px1.5	COMM.	
11	TSI-202	Nr.Tank - 202	35	PT-VF-202B	Tank-202	SC/TSI-202/PT-202B	1Px1.5	COMM.	
12	PT-VF-202B	Tank-202	50	JS-202	Nr.Tank - 202	SC/PT-202B/JS-202	2Px1.5	COMM.	
13	JS-202	Nr.Tank - 202	90	HUB-VF-202	Nr.Tank - 202	SC/JS-202/HUB-VF-202	1Px1.5	COMM.	
14	JS-202	Nr.Tank - 202	10	RTG-202	Tank - 202	SC/JS-202/RTG-202	1Px1.5	COMM.	
15	RTG-202	Tank - 202	5	MST-VF-202	Tank - 202	SC/RTG-202/MST-VF-202	1Px1.5	COMM.	
16	SJB-01	Nr.Tank - 206	75	HUB-VF-206	Nr.Tank - 206	SC/SJB-01/HUB-206	1Px1.5	COMM.	
17	HUB-VF-206	Nr.Tank - 206	10	TSI-206	Nr.Tank - 206	SC/HUB-206/TSI-206	1Px1.5	COMM.	

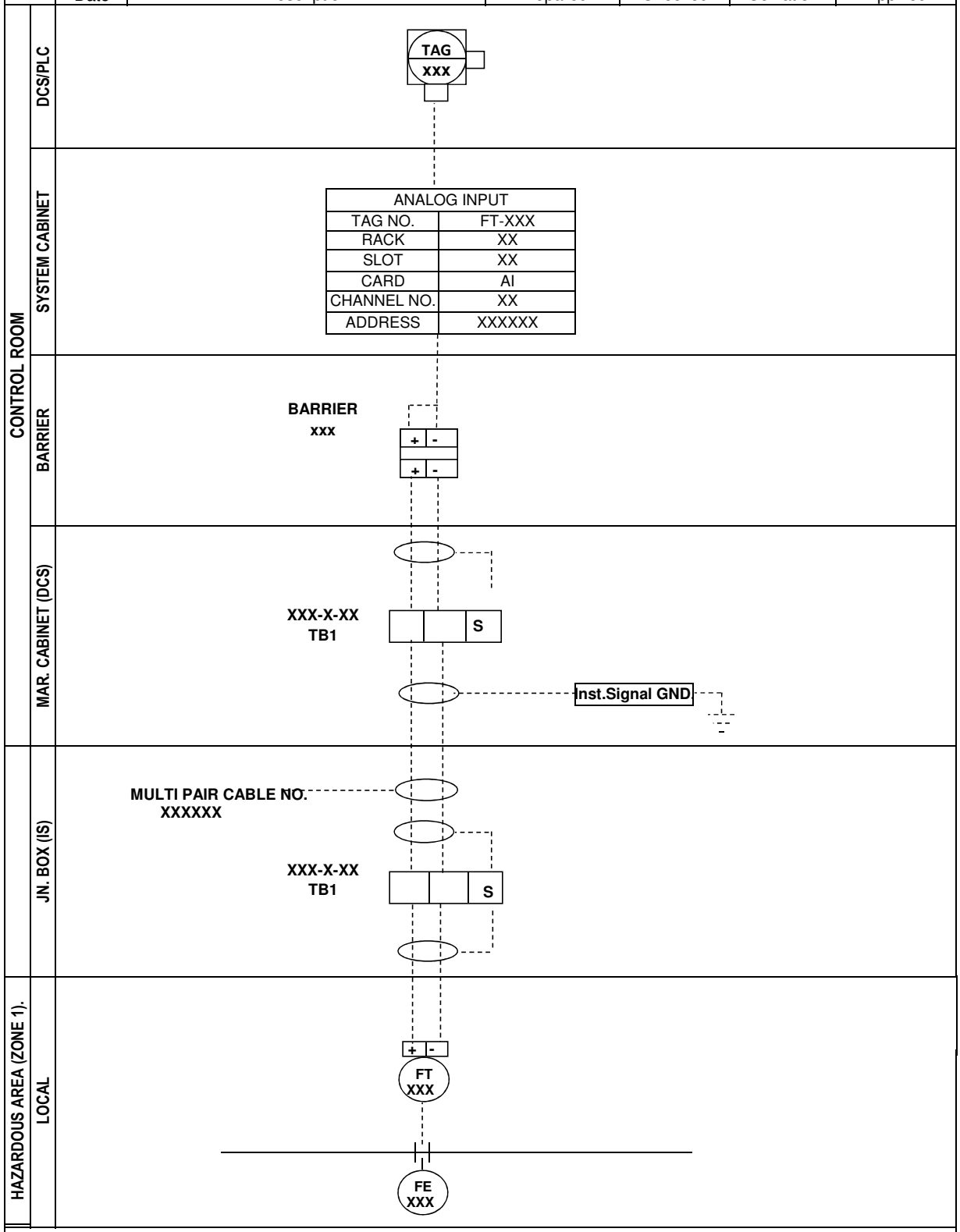
18	TSI-206	Nr.Tank - 206	35	PT-VF-206B	Tank-206	SC/TSI-206/PT-206B	1Px1.5	COMM.	
19	PT-VF-206B	Tank-206	50	JS-206	Nr.Tank - 206	SC/PT-206B/JS-206	2Px1.5	COMM.	
20	JS-206	Nr.Tank - 206	90	HUB-VF-206	Nr.Tank - 206	SC/JS-206/HUB-VF-206	1Px1.5	COMM.	
21	JS-206	Nr.Tank - 206	10	RTG-206	Tank - 206	SC/JS-206/RTG-206	1Px1.5	COMM.	
22	RTG-206	Tank - 206	5	MST-VF-206	Tank - 206	SC/RTG-206/MST-VF-206	1Px1.5	COMM.	
23	SJB-01	Nr.Tank - 203	70	HUB-VF-203	Nr.Tank - 203	SC/SJB-01/HUB-203	1Px1.5	COMM.	
24	HUB-VF-203	Nr.Tank - 203	10	TSI-203	Nr.Tank - 203	SC/HUB-203/TSI-203	1Px1.5	COMM.	
25	TSI-203	Nr.Tank - 203	35	PT-VF-203B	Tank-203	SC/TSI-203/PT-203B	1Px1.5	COMM.	
26	PT-VF-203B	Tank-203	50	JS-203	Nr.Tank - 203	SC/PT-203B/JS-203	2Px1.5	COMM.	
27	JS-203	Nr.Tank - 203	90	HUB-VF-203	Nr.Tank - 203	SC/JS-203/HUB-VF-203	1Px1.5	COMM.	
28	JS-203	Nr.Tank - 203	10	RTG-203	Tank - 203	SC/JS-203/RTG-203	1Px1.5	COMM.	
29	RTG-203	Tank - 203	5	MST-VF-203	Tank - 203	SC/RTG-203/MST-VF-203	1Px1.5	COMM.	
30	SJB-01	Nr.Tank - 204	65	HUB-VF-204	Nr.Tank - 204	SC/SJB-01/HUB-204	1Px1.5	COMM.	
31	HUB-VF-204	Nr.Tank - 204	10	TSI-204	Nr.Tank - 204	SC/HUB-204/TSI-204	1Px1.5	COMM.	
32	TSI-204	Nr.Tank - 204	35	PT-VF-204B	Tank-204	SC/TSI-204/PT-204B	1Px1.5	COMM.	
33	PT-VF-204B	Tank-204	50	JS-204	Nr.Tank - 204	SC/PT-204B/JS-204	2Px1.5	COMM.	
34	JS-204	Nr.Tank - 204	90	HUB-VF-204	Nr.Tank - 204	SC/JS-204/HUB-VF-204	1Px1.5	COMM.	
35	JS-204	Nr.Tank - 204	10	RTG-204	Tank - 204	SC/JS-204/RTG-204	1Px1.5	COMM.	
36	RTG-204	Tank - 204	5	MST-VF-204	Tank - 204	SC/RTG-204/MST-VF-204	1Px1.5	COMM.	

37	SJB-01	Nr.Tank - 205	80	HUB-VF-205	Nr.Tank - 205	SC/SJB-02/HUB-205	1Px1.5	COMM.	
38	HUB-VF-205	Nr.Tank - 205	10	TSI-205	Nr.Tank - 205	SC/HUB-205/TSI-205	1Px1.5	COMM.	
39	TSI-205	Nr.Tank - 205	35	PT-VF-205B	Tank-205	SC/TSI-205/PT-205B	1Px1.5	COMM.	
40	PT-VF-205B	Tank-205	50	JS-205	Nr.Tank - 205	SC/PT-205B/JS-205	2Px1.5	COMM.	
41	JS-205	Nr.Tank - 205	90	HUB-VF-205	Nr.Tank - 205	SC/JS-205/HUB-VF-205	1Px1.5	COMM.	
42	JS-205	Nr.Tank - 205	10	RTG-205	Tank - 205	SC/JS-205/RTG-205	1Px1.5	COMM.	
43	RTG-205	Tank - 205	5	MST-VF-205	Tank - 205	SC/RTG-205/MST-VF-205	1Px1.5	COMM.	

Note:

1) Length indicated is tentative, Contractor shall measure exact length of cable required before cutting the cable

REV.	Date	Description	Prepared	Checked	Co'nation	App'ved
P2	03.11.15	Issued for Approval	HVM	KBT	VST	AKS
P1	16.10.15	Issued for Approval	HVM	KBT	VST	AKS



I = INDICATION

Note : That is applicable for All analouge Input instrument like PT,FT,TE/TT,LT .. Etc. Pls. ref. Follow sheet for Tag Nos.

Client Delhi Fuel Avialtion
Aviation Fuel Station
Shahbad, Muhammad Pur
IGI Airport - New Delhi - 110061

Title Typical instrumnet Loop Drawings
Analog Input

Mott MacDonald
501
Sakar II, Near Ellisbridge
Ahmedabad, 380006
India
T +91(0) 79 2657 5550/99
F +91(0) 79 2657 5558
W www.mottmac.com

P2	03.011.15	Issued for Approval	HVM	KBT	VST	AKS
P1	16.10.15	Issued for Approval	HVM	KBT	VST	AKS
REV.	Date	Description	Prepared	Checked	Co'nation	App'ved

ANALOG INPUT - TAG NOS.

Sr No.	Tag No.	Sr No.	Tag No.
1	FT-301	25	LT-VF-205 A
2	FT-302	26	LT-VF-206 A
3	FT-303	27	LT-HSD-1
4	FT-304	28	DPT-301
5	FT-305	29	DPT-302
6	FT-306	30	DPT-303
7	FT-307	31	PT-402
8	FT-308	32	FT-402
9	FT-309	33	DPT-MF-11
10	DPT-311	34	DPT-304
11	DPT-312	35	DPT-305
12	DPT-313	36	DPT-306
13	FT-310	37	DPT-307
14	FT-300 A	38	DPT-308
15	FT-300 B	39	DPT-309
16	FT-501	40	DPT-310
17	FT-502	41	DPT-300 A
18	LT-VF-201 A	42	DPT-300 B
19	LT-VF-202 A	43	DPT-MF-12
20	LT-VF-203 A	44	DPT-MF-13
21	LT-VF-204 A	45	DPT-MF-14
22	DPT-314	46	LT-T-1(FW)
23	PT-401	47	LT-T-1(FW)
24	FT-401	48	LT-T-1(FW)

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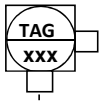
P1	03.11.15	Issued for Approval	HVM	KBT	VST	AKS
P1	16.10.15	Issued for Approval	HVM	KBT	VST	AKS

CONTROL ROOM

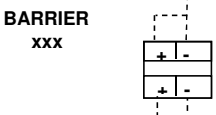
DCS/PLC



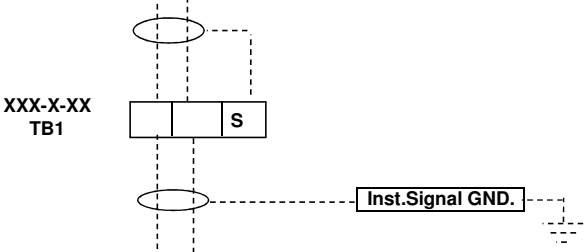
SYSTEM CABINET

ANALOG OUTPUT	
TAG NO.	XX-XXX
RACK	XX
SLOT	XX
CARD	AI
CHANNEL NO.	XX
ADDRESS	XXXXXX

BARRIER

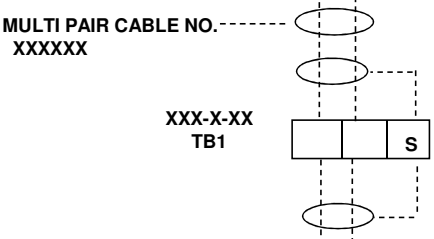


MAR. CABINET (DCS/PLC)

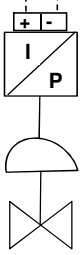


HAZARDOUS AREA (ZONE 1)

JN. BOX (IS)



LOCAL



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IGI Airport - New Delhi - 110061

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w www.mottmac.com

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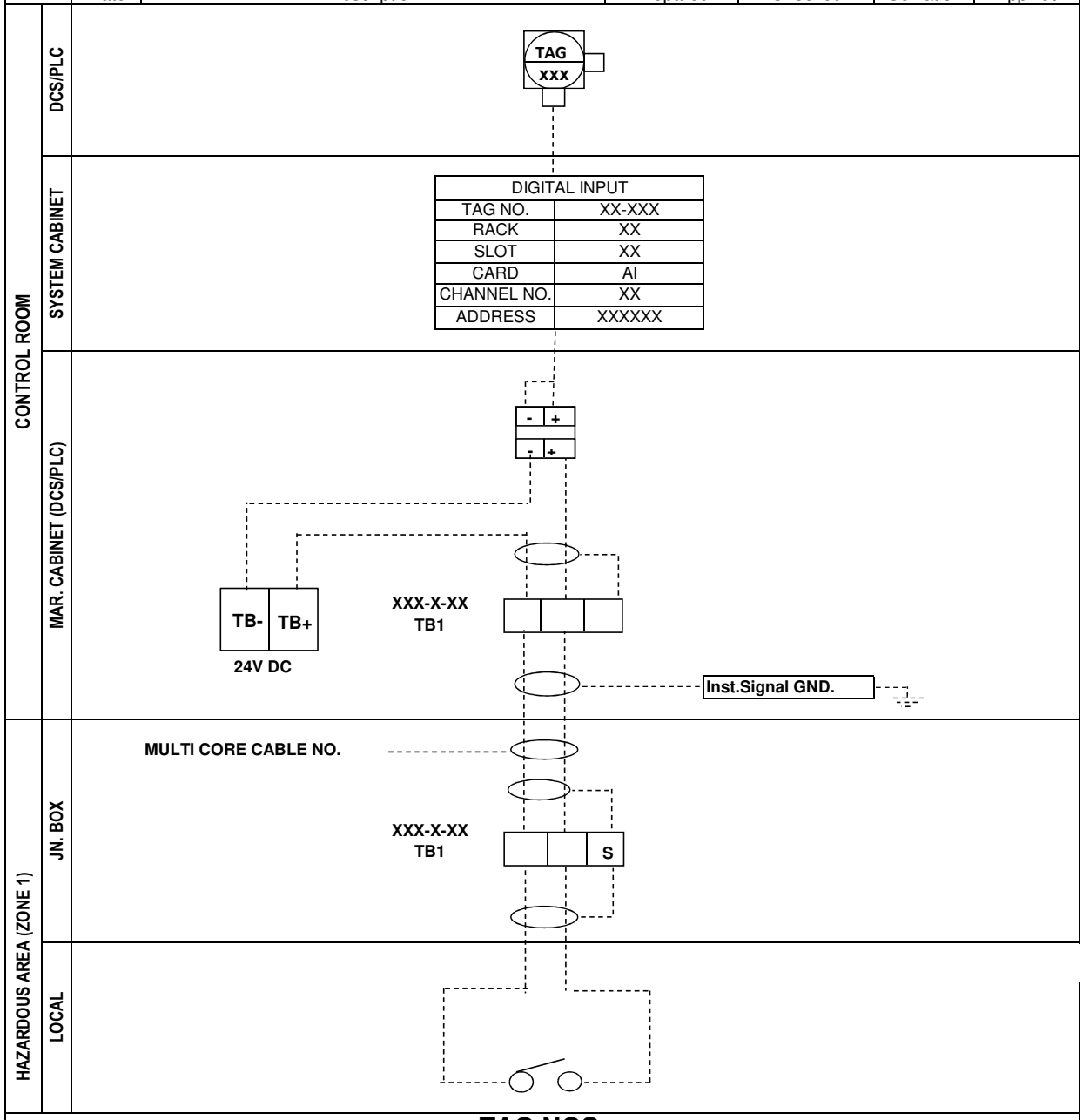
P1	16.10.15	Issued for Approval	HVM	KBT	VST	AKS



TAG NOS.

Sr. No.	Tag No.	Sr. No.	Tag No.
1	LS-701	5	Photo Cell-1
2	CP-T1	6	Photo Cell-1
3	CP-T2	7	Photo Cell-1
4	CP-T3	8	Photo Cell-1

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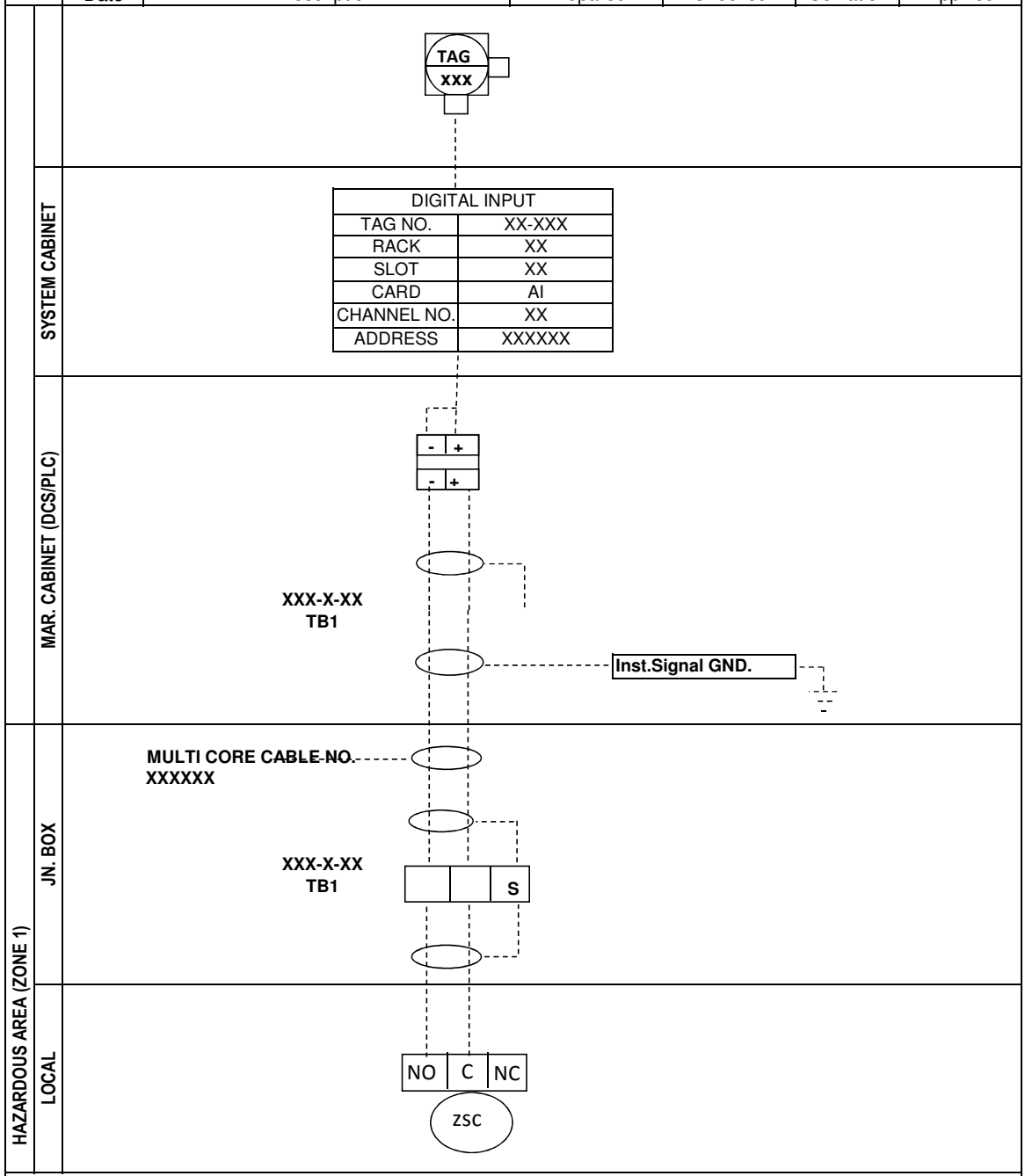

TAG NOS.

Sr. No.	Tag No.	Sr. No.	Tag No.
1	MOV-VF-201A	7	MOV-VF-204A
2	MOV-VF-201B	8	MOV-VF-204B
3	MOV-VF-202A	9	MOV-VF-205A
4	MOV-VF-202B	10	MOV-VF-205B
5	MOV-VF-203A	11	MOV-VF-206A
6	MOV-VF-203B	12	MOV-VF-206B

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P1	16.10.15	Issued for Approval	HVM	KBT	VST	AKS

CONTROL ROOM

DCS/PLC

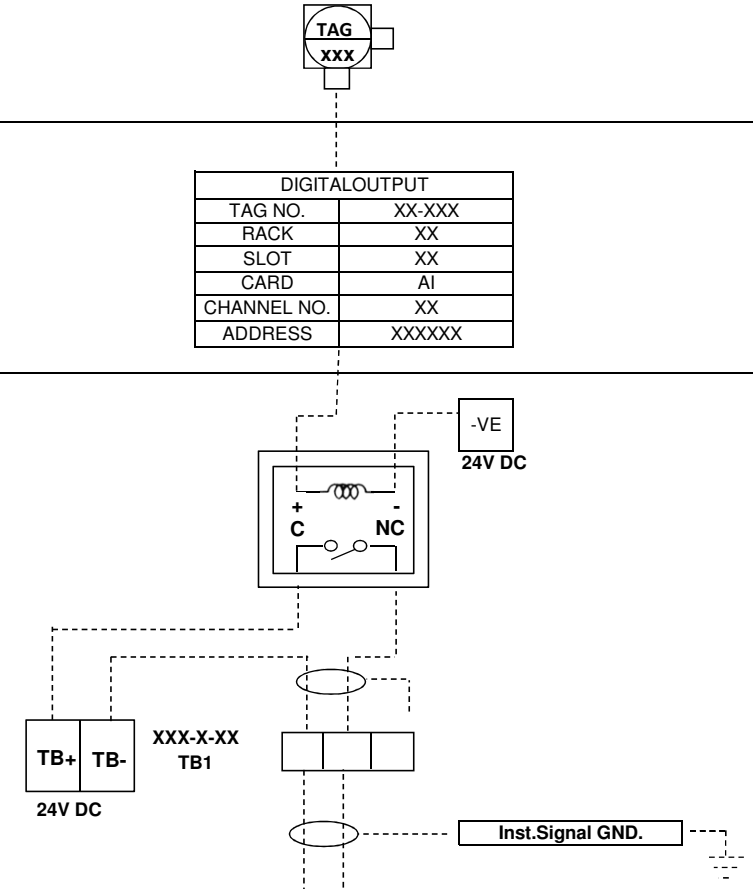
SYSTEM CABINET

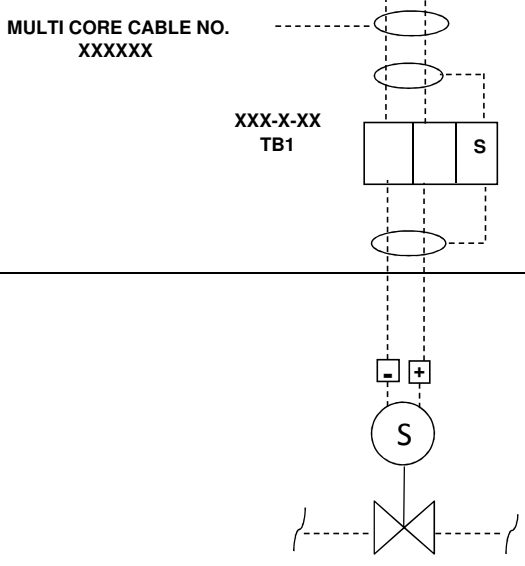
MAR. CABINET (DCS/PLC)

HAZARDOUS AREA (ZONE 1)

JN. BOX

LOCAL





I = INDICATION

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DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE II – DEVIATION SHEET

EXCEPTION AND DEVIATIONS STATEMENT				
S.NO.	PAGE NO. OF TENDER DOCUMENT	CLAUSE NO.	SUBJECT	DEVIATIONS

Bidder shall list all the deviations in the following given format only on their Letterhead. The Deviation sheet should be submitted along with technical bid.

In case no deviation sheet is submitted along with technical bid, it would be concluded that bidder has accepted all specifications, terms and conditions.

_____

Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE III – DECLARATION SHEET

Date:

DECLARATION

We, M/s hereby, unconditionally accept all terms & conditions of TENDER NO.: DAFFPL/MOD/FF/2017-18/21 (JOB: TERMINAL AUTOMATION) including Scope of job, quantities, completion period, terms & condition without any deviations.

Sign & Stamp of Bidder

Note: In case of deviations (whether technical or commercial) the above declaration should not be submitted and the deviations should be mentioned separately on bidders letter head with the heading "DEVIATION SHEET". In absence of "DEVIATION SHEET", it would be concluded that bidder has submitted his offer as per tender specifications, terms & conditions. Corrections in tender booklet will not be accepted.

_____

Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE-IV

PROFORMA OF BANK GUARANTEE
(EARNEST MONEY DEPOSIT)
(On Non-Judicial Stamp paper for appropriate value)

BANK GUARANTEE NO. :
BANK GUARANTEE AMOUNT:
CLAIM:
(Till 120 days from date of submission of Proposal)
TENDER NO. /DATE:
JOB DESCRIPTION/
LOCATION:

Tender Security No. [*]

Name and Address of the Beneficiary: Delhi Aviation Fuel Facility (Private) Limited
Aviation Fuelling Station, Shahabad Mohammadpur, IGI Airport, New Delhi – 110 061, India

We [*name and address of the issuing bank*] have been informed that [*Name of the Interested party*] (hereinafter called the "Interested Party") is submitting a proposal for the Award of the Works in response to a Request for Proposal ("RFP") by Delhi Aviation Fuel Facility (P.) Ltd. ("DAFFPL" or 'Beneficiary") for [*Insert description of work*] ("Works"). The conditions of the RFP, which are set out in a documents entitled Request for Proposal dated [*Please insert*] require its offer to be supported by a Tender Security.

At the request of the Interested Party, we hereby irrevocably undertake to pay you without demur, the Beneficiary, any sum or sums not exceeding Rs. _____ [*Please insert*].

Upon receipt by us of your demand in writing and your written statement (in the demand) stating that:

1) The Interested Party has, without written consent of DAFFPL, withdrawn its offer after the latest time specified for its submission and before the expiry of its period of validity; or
2) The Interested Party has refused to accept the correction of errors in nits offer in accordance with the instructions to Interested parties contained in the RFP; or

_____
Sign & Stamp of Bidder

3) DAFFPL entered in to the contract with the Interested party but the Interested party has failed to deliver the **COMPOSITE BANK GUARANTEE (SECURITY DEPOSIT & PERFORMANCE**) in compliance with the Contract conditions; or

4) The Interested Party has failed to enter into the Contract within 30 (Thirty) days of being required to do so by the Tender Officer.

Any demand for payment must contain your signature(s). The demand must be received by us at this office on or before the expiry of the earliest of the following dates, when this security guarantee shall expire and shall be returned to us:

a) Date of issue of letter communicating to the Interested Party that it has not qualified for the contract or the Proposal submitted by the Interested Party is unsuccessful or the TENDER is withdrawn and/or cancelled by the Beneficiary; or

b) 7 (seven) days after the date of delivery of an acceptable performance bond complying with the Contract conditions and execution of the Contract after the award of the works to the Interested Party; or

c) 120 (One hundred twenty) days from the last date of submission of Proposal in accordance with the TENDER.

Date:

Signature:

Designation:

Name of the Branch

_____

Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE-V

PROFORMA OF COMPOSITE BANK GUARANTEE (SECURITY DEPOSIT & PERFORMANCE)

(On Non-Judicial paper of Rs. 100/-value)

To,

DAFFPL

Dear Sirs,

M/s ……..have taken tender for the work ……for DAFFPL,.

The tender Conditions of Contract provide that the Contractor shall pay a sum of Rs. …….. (Rupees ……..) as security deposit & performance guarantee in the form therein mentioned. The form of payment of security deposit & performance guarantee includes guarantee executed by Scheduled Bank at New Delhi, undertaking full responsibility to indemnify DAFFPL, in case of default. The said party …….. have approached us at and their request and in consideration of the premises we …….. having our office at …….. have agreed to give such guarantees as hereinafter mentioned.

1. We ----------hereby undertake and agree with you that if default shall be made by M/s. ----------in performing any of the terms and conditions of the tender or in payment of any money payable to Daffpl. We shall on demand pay to you, without demur, protest or requiring you to seek recourse to M/s _____, in such matter as to you may direct the said amount of Rupees ---------- ----only or such portion thereof not exceeding the said sum as you may from time to time require.
2. You will have the full liberty without reference to us and without effecting this guarantee, postpones for any time or from time to time the exercise of any of the powers and rights conferred on you under the contract with the said ---------- ----------and to enforce or to forbear from endorsing any powers of rights or by reason of time being given to the said ----------which under law relating to the sureties would but for provision have the effect of releasing us.
3. Your right to recover the said sum of Rs. ---------- (Rupees ----------) from us in manner aforesaid will not be affected or suspended by reason of the fact that any

_____
Sign & Stamp of Bidder

dispute or disputes have been raised by the said M/s. ----------and/or that any dispute or disputes are pending before any officer, tribunal or court.

4. The guarantee herein contained shall not be determined or affected by the liquidation or winding up dissolution or change of constitution or insolvency of the said ----------but shall in all respect and for all purposes be binding operative units payment of all money due to you in respect of such liabilities is paid.
5. Our liability under this guarantee is restricted to Rupees ----------our guarantee shall remain in force until ----------unless a suit or action to enforce a claim under Guarantee is filed against us within six months from ----------(which is date of expiry of guarantee) all our rights under the said guarantee shall be forfeited and we shall be relieved and discharged from all liabilities there under.
6. NOT WITHSTANDING anything hereinbefore contained our liability under this Bank Guarantee is restricted to Rupees ----------(Rupees ----------).This Bank Guarantee shall be valid up to ----------and we are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before.
7. This guarantee is to be returned to us within fifteen (15) days from the date it ceases to be in force. If the guarantee is not returned to us within the date of aforementioned it shall be automatically cancelled.
8. We have power to issue this guarantee in your favour under Memorandum and Articles of Association and the undersigned has full power to do under the Power of Attorney dated ----------granted to him by the Bank.

Yours faithfully

----------Bank
By its Constituted Attorney
Signature of a person duly
Authorized to sign on behalf of the bank

_____
Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

Annexure- VI

Form of Letter of Undertaking

[On the letterhead of the Interested Party]

Letter of Undertaking

Date:

Delhi Aviation Fuel Facility (Private) Limited
Aviation Fuelling Station, Shahabad Mohammadpur,
IGI Airport, New Delhi – 110 061, India

Re:
The undersigned Interested Party acknowledges that the TENDER issued is confidential and personal to the undersigned Interested Party and hereby undertakes and agrees as follows:

1. "**Confidential Information**" means the TENDER and everything contained therein, all documentation, data, particulars of the Works and technical or commercial information made by (or on behalf of) Delhi Aviation Fuel Facility (Private) Limited or obtained directly or indirectly from Delhi Aviation Fuel Facility (Private) Limited or its representatives by the undersigned Interested Party or which is generated by the undersigned Interested Party or any information or data that the undersigned Interested Party receives or has access to, as a result of the TENDER, as being confidential information of Delhi Aviation Fuel Facility (Private) Limited, provided that such term does not include information that (a) was publicly known or otherwise known to undersigned Interested Party prior to the time of such disclosure, (b) subsequently becomes publicly known through no act or omission by undersigned Interested Party or any person acting on its behalf.

2. The undersigned Interested Party shall maintain the confidentiality of Confidential Information in accordance with procedures adopted by the undersigned Interested Party in good faith to protect confidential information of third parties delivered to it, provided that the undersigned Interested Party may deliver or disclose Confidential Information to its authorized representatives who agree to hold confidential the Confidential Information substantially in accordance with the terms of this Undertaking.

3. The undersigned Interested Party shall not at any time whatsoever:

   (i) Disclose, in whole or in part, any Confidential Information received directly or indirectly from the Delhi Aviation Fuel Facility (P) Limited to any third party.

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Sign & Stamp of Bidder

(ii) Reproduce, publish, transmit, translate, modify, compile or otherwise transfer the Confidential Information.

4. In case the Proposal of the undersigned Interested Party is not accepted and immediately upon the acceptance of the Proposal of any of the other Interested Party, the undersigned Interested Party, shall:

(i) Return all Confidential Information including without limitation, all originals, copies, reproductions and summaries of Confidential Information; and

(ii) Destroy all copies of Confidential Information in its possession, power or control, which are present on magnetic media, optical disk or other storage device, in a manner that ensures that the Confidential Information is rendered unrecoverable.

5. The undersigned Interested Party shall certify to Delhi Aviation Fuel Facility (Private) Limited that it has returned or destroyed such Confidential Information to the Delhi Aviation Fuel (Private) Limited within two (2) days of such a request being made by Delhi Aviation Fuel (Private) Limited.

Name of Interested Party's

Signature **of Authorized Representative**

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Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

Annexure VII

DECLARATION to be submitted along with Technical Bid

(M/s.) hereby declare / clarify that we have not been banned or delisted by any government or quasi Government agencies or Public Sector Undertakings.

Stamp & Signature of the bidder

NOTE: If a bidder has been banned by any Government or quasi Government agencies or PSUs, this fact must be clearly stated with details. If this declaration is not given along with the technical bid, the tender will be rejected as non-responsive.

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Sign & Stamp of Bidder

PREAMBLE-AUTOMATION SCOPE OF WORK

SCHEDULE OF QUANTITY FOR MODERNIZATION OF FUEL FARM-IGI AIRPORT,NEW DELHI

1 This document identifies the pertaining to the scope of Bidder for tank farm fuel Aviation - "IGI AIRPORT,NEW DELHI".

2 This document shall be read in conjunction with attachments, Job Standard Specifications, Standard Instrument Specifications, Installation Drawings, Hook-up Drawings attached in this tender document.

3 The Bidder's scope for includes Design, Engineering, Procurement, Manufacture, Integration, Factory/Shop Testing, Packaging, Forwarding, Supply, Insurance, Custom clearance (if any), Unloading at site, Storage, Calibration, Field-testing, Installation/Erection, Pre-commissioning, Commissioning, Stabilisation of the complete system, supply of Spares, Documentation etc.. The complete requirements shall be executed on a turnkey basis with single point responsibility.

4 Bidder shall include all the items as per below mentioned "Schedule of Quantities'. To make the system complete in all respects & to meet the requirements which have not been explicitly identified, but required for the completion and efficient performance of the entire Job.

5 The quantities indicated are tentative, and it is provided to facilitate the bidder for estimate. The quantities of individual item can vary as per site requirement. The payment will be made as per actual certified measurement at site. Unit rates offered by Bidder shall be firm & same rates shall be applicable to any change in total quantity to any extent.

6 All tools & tackles including, PPE, ladders, scaffolding, structural steel or consumables like cable glands, cable ties, lugs, ferules, tag plate etc.. which are not listed below, but required for carrying out the work in uninterrupted manner, shall be provided by the bidder as mention in tender document

7 Service part Includes Erection, Testing & Commissioning & Communication as per tender document

Schedule of Quantity As mentioned in Table on next page

PRICE BID

PRICE SCHEDULE FOR SUPPLY

TERMINAL AUTOMATION SYSTEM

Sr No	Item Description	Size & Specification	Unit	Qty.	MCC	Total	Unit rate in Rs.			Subtotal price of items in Rs.	Total in Rs.	Remarks
							Supply of items, manufactured & completed in all respects, inclusive of necessary testing, packing & forwarding, transportation, handling, storage and safe custody at site & all incidental costs. (Rs.)	GST Applicable				
								%	Amount	(8+10)	(7 X 11)	
1	2	3	4	5	6	7	8	9	10	11	12	
1	**Instruments**											
1.1	Pressure Gauges(Bourdon Type)	As per Tender specification	Nos.	1	-	1						
1.2	Pressure Transmitter for Density Measurement	As per Tender specification	Nos.	7	-	7						
1.3	Diffrential Pressure Transmitter	As per Tender specification	Nos.	20	-	20						
1.4	Level Switch - Vibrating Fork Type	As per Tender specification	Nos.	6	-	6						
1.5	Level Switch -Magnetic Type	As per Tender specification	Nos.	1	-	1						
1.6	Level Transmitter - Radar Type with tank side indicator	As per Tender specification	Nos.	6	-	6						
1.7	Level Transmitter - Servo type	As per Tender specification	Nos.	6	-	6						
1.8	Level Transmitter - DP Type	As per Tender specification	Nos.	3	-	3						
1.9	Level Transmitter- Guided Wave Radar Type	As per Tender specification	Nos.	4	-	4						
1.10	Temperature Element-Multipoint	As per Tender specification	Nos.	6	-	6						
1.11	Temperature Transmitter with Element & Thermowell	As per Tender specification	Nos.	1	-	1						
1.12	Thermal Safety Valve	As per Tender specification	Nos.	16	-	16						
1.13	Flow Transmitter- Mass Type	As per Tender specification	Nos.	U.R	-	U.R						
1.14	Proximity with Ex-proof Housing	As per Tender specification	Nos.	2	-	2						For OWS valve- 2 Nos.
1.15	FCU(Field Communication Unit For TFMS)(Master + Redudent)	As per Tender specification	Nos.	1	-	1						
1.16	Hooter, with Ex d flame proof housing	24 V DC	Nos.	2	-	2						
1.17	Emergency Push Button(with Control room)	As per Tender specification	Nos.	3	-	3						1Nos Each side of dyke wall and one in control room
1.18	Electro Hydaulic Actuator For Remote Operated ROSOV Valve PUSH Button	As Specified in Tender	Nos.	15	-	15	Free Issued					Supplied with ROSOV
1.19	Universal hand held HART Calibrator/Communicator with charger with latest HART protocol	-	Nos.	1	-	1						
2	**Signal , Control & Power Cable**											
2.1	Modbus 2 Pair communication cables	As per Tender specification	Mtr.	1000		1000						
2.2	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	1 Pair X 1.5 mm^2	Mtr.	3800		3800						
2.3	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	2 Pair X 1.5 mm^2	Mtr.	450		450						

2.4	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	6 Pair X 1.5 mm^2	Mtr.	1500		1500							
2.5	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	12 Pair X 1.5 mm^2	Mtr.	650		650							
2.6	Control cable two core copper conductor, steel wire armoured, FR-PVC outer sheathed.(FRLS)	2 Core X 1.5 mm^2	Mtr.	9500		9500							
2.7	Multicore copper conductor, GI round wire armoured, FR-PVC outer sheathed.(FRLS)	12 Core X 1.5 mm^2	Mtr.	525		525							
2.8	Multicore copper conductor, GI round wire armoured, FR-PVC outer sheathed.(FRLS)	24 Core X 1.5 mm^2	Mtr.	1900		1900							
2.9	Multicore copper conductor, GI round wire armoured, FR-PVC outer sheathed.(FRLS)	37 Core X 1.5 mm^2	Mtr.	1000		1000							
2.10	Power Cable of multi stranded annealed tinned copper as per IS 8130/1984 armoured FR-PVC insulated cable (FRLS)	3 Core X 2.5 mm^2	Mtr.	900		900							
2.11	Power Cable of multi stranded annealed tinned copper as per IS 8130/1984 armoured FR- PVC insulated cable (FRLS)	6 Core X 2.5 mm^2	Mtr.	100		100							
2.12	Power Cable of multi stranded annealed tinned copper as per IS 8130/1984 armoured FR- PVC insulated cable (FRLS)	24 Core X 2.5 mm^2	Mtr.	450		450							
2.13	Armored signal cable wt over all shielded for Temp. Element (FRLS)	1 Traid Core X 1.5 mm^2	Mtr.	850		850							
2.14	Single core Copper PVC insulated flexible wires for Inst. Earth(Green with yellow mark)	2.5 sq.mm	Mtr.	1200		1200							
2.15	Single core Copper PVC insulated flexible wires for Inst. Earth(Green with yellow mark)	10 sq.mm	Mtr.	200		200							
2.16	Single core Copper PVC insulated flexible wires for Inst. Earth(Green with yellow mark)	16 sq.mm	Mtr.	300		300							
2.17	communication cable for package item as per below if required (If Applicable)	As per exsiting system	Lot	1		1							
	HT panels, VFD with Energy Management Software, DG Set, ESB System, Cathodic Protection,Smoke Detection System, Fire Water Pump House Panels, Oil Water Seperator and any other equipments									-	-		
2.18	**Cable Glanding and Termination with Shroud, Lugs, Caps and Ferruls etc**												
2.18.1	ET Cable Gland												
		2 Core X 1.5 sq.mm	Nos.	134		134							
		6 PairX1.5 sq.mm	Nos.	10		10							
		12 Pair X 1.5 sq.mm	Nos.	3		3							
		12 Core X 1.5 sq.mm	Nos.	3		3							
		24 Core X 1.5 sq.mm	Nos.	13		13							
		37 Core X 1.5 sq.mm	Nos.	10		10							
		24 Core X 2.5 sq.mm	Nos.	2		2							
2.18.2	Cable Glanding including termination												
		1 Pair X 1.5 sq.mm	Nos.	124		124							
		2 Pair X 1.5 sq.mm	Nos.	2		2							
		6 Pair X 1.5 sq.mm	Nos.	20		20							
		12 Pair X 1.5 sq.mm	Nos.	6		6							
		2 Core X 1.5 sq.mm	Nos.	508		508							
		12 Core X 1.5 sq.mm	Nos.	6		6							

		24 Core X 1.5 sq.mm	Nos.	26		26							
		37 Core X 1.5 sq.mm	Nos.	20		20							
		3 Core X 2.5 sq.mm	Nos.	28		28							
		6 Core X 2.5 sq.mm	Nos.	12		12							
		24 Core X 2.5 sq.mm	Nos.	4		4							
3	**Perforated Cable Tray with Cover, bends, fittings and associated accessories**												
3.1	Perforated Cable tray (FRP)	100mm(W) X 50mm(H) X 3mm(THK)	Mtr.	1500		1500							
3.2	Perforated Cable tray (FRP)	200mm(W) X 50mm(H) X 3mm(THK)	Mtr.	550		550							
3.3	Perforated Cable tray (FRP)	300mm(W) X 100mm(H) X 3mm(THK)	Mtr.	550		550							
3.4	Perforated Cable tray (FRP)	450mm(W) X 100mm(H) X 3mm(THK)	Mtr.	-	100	100							
3.4	Perforated Cable tray (FRP)	600mm(W) X 100mm(H) X 3mm(THK)	Mtr.	200		200							
4	**Aluminium Diecast Ex-proof Junction Box with cable gland, plugs & shrouds**	As per tender specification										-	
4.1	**Process PLC**											-	
4.1.1	Analogue Junction Box	30 Terminal	Nos.	12	4	16							
4.1.2	Digital Junction Box	50 Terminal	Nos.	5	11	16							
	Digital Junction Box	30 Terminal	Nos.	-	3	3							
4.1.3	Power Junction Box	50 Terminal	Nos.	5	-	5							
4.2	**Safety PLC**												
4.2.1	Analogue Junction Box	50 Terminal	Nos.	1	-	1							
4.2.2	Digital Junction Box	50 Terminal	Nos.	3	-	3							
	Digital Junction Box	30 Terminal	Nos.	9	1	10							
4.2.3	Power Junction Box	50 Terminal	Nos.	1	-	1							
5	**Control System**												
5.1	Process Redundant Hotstandby PLC system with required with licensed software & all necessary hardware for input & out put count as mentioned (20% spare IO to be considered)	As per tender specification	Nos.	1	-	1							
5.1.1	Analog Input Count			49	10	59							
5.1.2	Analog Output Count			0	10	10							
5.1.3	Digital Input Count			22	102	124							
5.1.4	Digital Output Count			0	32	32							
5.2	Safety PLC tripple Redundant Hotstandby system with required licensed software & all necessary hardware for input & out put count as mentioned. (20% spare IO to be considered)	As per tender specification	Nos.	1	-	1							
5.2.1	Analog Input Count			4	0	4							
5.2.2	Analog Output Count			0	0	0							
5.2.3	Digital Input Count			78	10	88							
5.2.4	Digital Output Count			45	10	55							
5.3	Spare Card for DI,DO,AI,AO with internal wiring from module to marshelling cabinet	As per 20% philosophy for Process PLC/DCS and Safety PLC	Lot	1	-	1	Inc. In PLC Cost	-	-	-	-		

5.4	Operator Interface Consoles(OIC) with operator work station - Console type -Dual Display at control room,Size 21 " with PDB,Fan,Filters etc.	As per tender specification	Nos.	2	-	2	Inc. In PLC Cost	-	-	-	-	
5.5	TFMS-Operator station cum EWS Compete with all related software,display (Size 21")	As per tender specification	Nos.	1	-	1	Inc. In PLC Cost	-	-	-	-	
5.6	Manged Network Switches (16 port)	As per tender specification	Nos.	2	-	2						
5.7	Comfortable operator chairs with wheels suiting the console colour		Nos.	U.R	-	U.R						
5.8	Laser Jet colour -A3 size for control room for alam ,report, graphic printing	As per tender specification	Nos.	2	-	2						
5.9	Dot Matrix - 24 pin, 300 cps, 136 column	As per tender specification	Nos.	1	-	1						
5.10	Process PLC and Safety PLC System - required software and hardware licenses along with Alarm Management,Historian-5000 Tags,OPC server	As per tender specification	Lot	1	-	1						
5.11	TFMS ,MOV System software licenses along with OPC server licenses with required accessories to communicate any vendor system for proposed control system	As per tender specification	Lot	1	-	1						
5.12	Safety PLC Engineering Work station	As per tender specification	Nos.	1	-	1	Inc. In PLC Cost	-	-	-	-	
6	**Instrument Accessories(As per HOOK UP)**											
6.1	**Nipple (PL X PL)**											
	A21A - Specification	15 NB	Nos.	2		2						
6.2	**Nipple (PL X TH)**											
	A2Z- Specification	15 NB	Nos.	2		2						
	A21A - Specification	15 NB	Nos.	33		33						
6.3	**Nipple (TH X TH)**											
	A25A - Specification	15 NB	Nos.	U/R		U/R						
6.4	**Coupling (SCRD.)**											
	A2Z - Specification	15 NB	Nos.	2		2						
6.5	**Equal Tee (SW)**											
	A21A - Specification	15 NB	Nos.	1		1						
6.6	**Male Connector With Ferrul & Nut**											
	Material- SS 316	1/2" NPT(M) x 1/2" O.D	Nos.	66		66						
6.7	**Seamless Tube**											
	Material- SS 316	1/2"OD x 0.049 THK.	Mtr.	85		85						
6.8	Drain Valve(SW)											
	A21A - Specification	15NB	Nos.	1		1						
6.10	MS Base Plate, 150 X 150 X 6mm thk.	MS	Nos.	29		29						
6.11	2" X 1400 mm Long pipe	MS	Nos.	29		29						
6.12	Anchor Fastners M12 X 125 mm Long	MS	Nos.	116		116						
6.13	Steel Structure		Ton	10		10						
7	**Gas Monitorig System**											
7.1	Hydro Carbon Gas Detecor	As per tender specification	Nos.	2		2						
8	**Fire Alarm Panel**											

	All accessories like cables and others required for communication to Proposed control system. (If required)		Lot	1		1							
9	**MISCALLENIOUS**					0							
9.1	UPS with power distribution panel and necessary cables of required capacity as per specifications. Tenderer to submit actual UPS Capacity based on full load condition.	5 KVA	Nos.	U.R		U.R							
		7.5 KVA	Nos.	U.R		U.R							
		10 KVA	Nos.	U.R		U.R							
9.2	Earthing												
9.2.1	Copper Earthing Pit	As per tender specification	Nos.	4		4							
9.2.2	Copper Earth Bar	Size - 50X6XL250 mm long	Nos.	4		4							
9.2.3	Copper Earthing Busbar	25 X 6 mm	RM	1		1							
	Total Amount including Taxes												
	Total Amount in Words :												

Note:

1	Communicaiton of Fire Alarm Panel to Proposed Control system is in vendor scope if required.
2	All supply and work shall be as per tender specifications.
3	Construction Water, loading and boarding, Site Storage with watch and ward, receipt, unloading, shifting material to store and internal shifting to site shall be included in Vendor's scope.
4	The unit rates as quoted to arrive at above total price shall be firm and exclusive of all taxes, duties, levies and inclusive of transportation, insurance etc. No separate payment shall be made for site mobilization / demobilization, insurance etc.
5	The Schedule of Rates should be read with all the other sections of the tender documents.
6	The tenderer shall be deemed to have studied the drawings, specifications and the details of work to be done within the time schedule and to have acquainted with the conditions prevailing at site. Site visit is mandatory.
7	The quantities shown against the various items are only indicative of the quantum of work and it may vary to any extent. Billing will be done as per actual. Vendor to make measurements at site before dispatch of any material.
8	The rate quoted shall be inclusive of all work as mentioned in the scope of work (Technical Specifications).
9	All the items of work in the schedule of rates shall be carried out as per specifications, drawings and instructions of the Engineer-in-Charge.
10	The rates quoted by tenderers shall be inclusive of all costs for removal and re-installation, should any defects occur or modifications are required during testing, calibration and loop tests and no extra claims for such works shall be entertained.
11	Any Modification work if required in Existing Panels for connecting Control and Signal cables is in the scope of tenderer. No separate payment shall be made in this regard.

Signature of Bidder along with company seal

PRICE BID

PRICE SCHEDULE FOR ERECTION, TESTING & COMMISSIONING

TERMINAL AUTOMATION SYSTEM

S No	Item Description	Size & Specification	Unit	Qty.	MCC	Spare	Total	Unit rate in Rs.			Total in Rs.	Remarks
								For Fabrication, Erection, Installation, Testing, Calibration, Painting, assistance during pre-commissioning and commissioning etc (Rs.)	GST Applicable		Subtotal price of items in Rs.	
									%	Amount	(9+11)	(8 X 12)	
1	2	3	4	5	6	7	8	9	10	11	12	13	
1	**Instruments**												
1.1	Pressure Gauges(Bourdon Type)	As per Tender specification	Nos.	1	-		1						
1.2	Pressure Transmitter for Density Measurement	As per Tender specification	Nos.	7	-		7						
1.3	Diffrential Pressure Transmitter	As per Tender specification	Nos.	20	-		20						
1.4	Level Switch - Vibrating Fork Type	As per Tender specification	Nos.	6	-		6						
1.5	Level Switch -Magnetic Type	As per Tender specification	Nos.	1	-		1						
1.6	Level Transmitter - Radar Type with tank side indicator	As per Tender specification	Nos.	6	-		6						
1.7	Level Transmitter - Servo type	As per Tender specification	Nos.	6	-		6						
1.8	Level Transmitter - DP Type	As per Tender specification	Nos.	3	-		3						
1.9	Level Transmitter- Guided Wave Radar Type	As per Tender specification	Nos.	4	-		4						For UG Tanks
1.10	Temperature Element-Multipoint	As per Tender specification	Nos.	6	-		6						
1.11	Temperature Transmitter with Element & Thermowell	As per Tender specification	Nos.	1	-		1						
1.12	Thermal Safety Valve	As per Tender specification	Nos.	16	-		16						
1.13	Flow Transmitter- Mass Type	As per Tender specification	Nos.	U.R	-		U.R						FT502 in existing Line and FT501 already procured.
1.14	Proximity with Ex-proof Housing	As per Tender specification	Nos.	2	-		2						For OWS valve- 2 Nos.
1.15	FCU(Field Communication Unit For TFMS)(Master + Redudent)	As per Tender specification	Nos.	1	-		1						
1.16	Hooter, with Ex d flame proof housing	24 V DC	Nos.	2	-		2						
1.17	Emergency Push Button(with Control room)	As per Tender specification	Nos.	3	-		3						1Nos Each side of dyke wall and one in control room
1.18	Electro Hydaulic Actuator For Remote Operated ROSOV Valve PUSH Button	As Specified in Tender	Nos.	15	-		15						Free Issue
1.19	Universal hand held HART Calibrator/Communicator with charger with latest HART protocol	-	Nos.	1	-		1						
2	**Signal , Control & Power Cable**												
2.1	Modbus 2 Pair communication cables	As per Tender specification	Mtr.	1000			1000						
2.2	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	1 Pair X 1.5 mm^2	Mtr.	3800			3800						
2.3	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	2 Pair X 1.5 mm^2	Mtr.	450			450						
2.4	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	6 Pair X 1.5 mm^2	Mtr.	1500			1500						

PRICE BID

PRICE SCHEDULE FOR ERECTION, TESTING & COMMISSIONING

TERMINAL AUTOMATION SYSTEM

S No	Item Description	Size & Specification	Unit	Qty.	MCC	Spare	Total	Unit rate in Rs.			Total in Rs.	Remarks
								For Fabrication, Erection, Installation, Testing, Calibration, Painting, assistance during pre-commissioning and commissioning etc (Rs.)	GST Applicable	Subtotal price of items in Rs.		
									% Amount	(9+11)	(8 X 12)	
2.5	Instrument Signal Cable Single pair plain annealed stranded copper conductor, PE insulated, metallic screened, PE bedded, steel wire armoured, FR-PVC outer sheathed(FRLS CABLE) with shielded	12 Pair X 1.5 mm^2	Mtr.	650			650					
2.6	Control cable two core copper conductor, steel wire armoured, FR-PVC outer sheathed.(FRLS)	2 Core X 1.5 mm^2	Mtr.	9500			9500					15 Nos of ROSOV Push Button Wire included
2.7	Multicore copper conductor, GI round wire armoured, FR-PVC outer sheathed.(FRLS)	12 Core X 1.5 mm^2	Mtr.	525			525					
2.8	Multicore copper conductor, GI round wire armoured, FR-PVC outer sheathed.(FRLS)	24 Core X 1.5 mm^2	Mtr.	1900			1900					
2.9	Multicore copper conductor, GI round wire armoured, FR-PVC outer sheathed.(FRLS)	37 Core X 1.5 mm^2	Mtr.	1000			1000					
2.10	Power Cable of multi stranded annealed tinned copper as per IS 8130/1984 armoured FR-PVC insulated cable (FRLS)	3 Core X 2.5 mm^2	Mtr.	900			900					
2.11	Power Cable of multi stranded annealed tinned copper as per IS 8130/1984 armoured FR- PVC insulated cable (FRLS)	6 Core X 2.5 mm^2	Mtr.	100			100					
2.12	Power Cable of multi stranded annealed tinned copper as per IS 8130/1984 armoured FR- PVC insulated cable (FRLS)	24 Core X 2.5 mm^2	Mtr.	450			450					
2.13	Armored signal cable wt over all shielded for Temp. Element (FRLS)	1 Traid Core X 1.5 mm^2	Mtr.	850			850					
2.14	Single core Copper PVC insulated flexible wires for Inst. Earth(Green with yellow mark)	2.5 sq.mm	Mtr.	1200			1200					
2.15	Single core Copper PVC insulated flexible wires for Inst. Earth(Green with yellow mark)	10 sq.mm	Mtr.	200			200					
2.16	Single core Copper PVC insulated flexible wires for Inst. Earth(Green with yellow mark)	16 sq.mm	Mtr.	300			300					
2.17	communication cable for package item as per below if required (If Applicable)	As per exsiting system	Lot	1			1					
	HT panels, VFD with Energy Management Software, DG Set, ESB System, Cathodic Protection,Smoke Detection System, Fire Water Pump House Panels, Oil Water Seperator and any other equipments									-	-	
2.18	**Cable Glanding and Termination with Shroud, Lugs, Caps and Ferruls etc**											
2.18.1	ET Cable Gland											
		2 Core X 1.5 sq.mm	Nos.	134			134					
		6 PairX1.5 sq.mm	Nos.	10			10					
		12 Pair X 1.5 sq.mm	Nos.	3			3					
		12 Core X 1.5 sq.mm	Nos.	3			3					
		24 Core X 1.5 sq.mm	Nos.	13			13					
		37 Core X 1.5 sq.mm	Nos.	10			10					
		24 Core X 2.5 sq.mm	Nos.	2			2					
2.18.2	Cable Glanding including termination											
		1 Pair X 1.5 sq.mm	Nos.	124			124					
		2 Pair X 1.5 sq.mm	Nos.	2			2					
		6 Pair X 1.5 sq.mm	Nos.	20			20					
		12 Pair X 1.5 sq.mm	Nos.	6			6					
		2 Core X 1.5 sq.mm	Nos.	508			508					

PRICE BID

PRICE SCHEDULE FOR ERECTION, TESTING & COMMISSIONING

TERMINAL AUTOMATION SYSTEM

S No	Item Description	Size & Specification	Unit	Qty.	MCC	Spare	Total	Unit rate in Rs.			Total in Rs.	Remarks
								For Fabrication, Erection, Installation, Testing, Calibration, Painting, assistance during pre-commissioning and commissioning etc (Rs.)	GST Applicable	Subtotal price of items in Rs.		
									% Amount	(9+11)	(8 X 12)	
		12 Core X 1.5 sq.mm	Nos.	6			6					
		24 Core X 1.5 sq.mm	Nos.	26			26					
		37 Core X 1.5 sq.mm	Nos.	20			20					
		3 Core X 2.5 sq.mm	Nos.	28			28					
		6 Core X 2.5 sq.mm	Nos.	12			12					
		24 Core X 2.5 sq.mm	Nos.	4			4					
3	**Perforated Cable Tray with Cover, bends, fittings and associated accessories**											
3.1	Perforated Cable tray (FRP)	100mm(W) X 50mm(H) X 3mm(THK)	Mtr.	1500			1500					
3.2	Perforated Cable tray (FRP)	200mm(W) X 50mm(H) X 3mm(THK)	Mtr.	550			550					
3.3	Perforated Cable tray (FRP)	300mm(W) X 100mm(H) X 3mm(THK)	Mtr.	550			550					
3.4	Perforated Cable tray (FRP)	450mm(W) X 100mm(H) X 3mm(THK)	Mtr.	-	100		100					
3.5	Perforated Cable tray (FRP)	600mm(W) X 100mm(H) X 3mm(THK)	Mtr.	200			200					
4	**Aluminium Diecast Ex-proof Junction Box with cable gland, plugs & shrouds**	As per tender specification									-	
4.1	**Prceoss PLC**										-	
4.1.1	Analogue Junction Box	30 Terminal	Nos.	12	4		16					
4.1.2	Digital Junction Box	50 Terminal	Nos.	5	11		16					
	Digital Junction Box	30 Terminal	Nos.	-	3		3					
4.1.3	Power Junction Box	50 Terminal	Nos.	5	-		5					
4.2	**Safety PLC**											
4.2.1	Analogue Junction Box	50 Terminal	Nos.	1	-		1					
4.2.2	Digital Junction Box	50 Terminal	Nos.	3	-		3					
	Digital Junction Box	30 Terminal	Nos.	9	1		10					
4.2.3	Power Junction Box	50 Terminal	Nos.	1	-		1					
5	**Control System**											
5.1	Process Redundant Hotstandby PLC system with required with licensed software & all necessary hardware for input & out put count as mentioned (20% spare IO to be considered)	As per tender specification	Nos.	1	-		1					
5.1.1	Analog Input Count			49	10		59					
5.1.2	Analog Output Count			0	10		10					
5.1.3	Digital Input Count			22	102		124					
5.1.4	Digital Output Count			0	32		32					
5.2	Safety PLC tripple Redundant Hotstandby system with required licensed software & all necessary hardware for input & out put count as mentioned. (20% spare IO to be considered)	As per tender specification	Nos.	1	-		1					
5.2.1	Analog Input Count			4	0		4					
5.2.2	Analog Output Count			0	0		0					

PRICE BID

PRICE SCHEDULE FOR ERECTION, TESTING & COMMISSIONING

TERMINAL AUTOMATION SYSTEM

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								For Fabrication, Erection, Installation, Testing, Calibration, Painting, assistance during pre-commissioning and commissioning etc (Rs.)	GST Applicable				
									%	Amount	(9+11)	(8 X 12)	
5.2.3	Digital Input Count			78	10		88						
5.2.4	Digital Output Count			45	10		55						
5.3	Spare Card for DI,DO,AI,AO with internal wiring from module to marshelling cabinet	As per 20% philosophy for Process PLC/DCS and Safety PLC	Lot	1	-		1	Inc. In PLC Cost	-	-	-	-	
5.4	Operator Interface Consoles(OIC) with operator work station -Console type -Dual Display at control room,Size 21 " with PDB,Fan,Filters etc.	As per tender specification	Nos.	2	-		2	Inc. In PLC Cost	-	-	-	-	
5.5	TFMS-Operator station cum EWS Compete with all related software,display (Size 21")	As per tender specification	Nos.	1	-		1	Inc. In PLC Cost	-	-	-	-	
5.6	Manged Network Switches (16 port)	As per tender specification	Nos.	2	-		2						
5.7	Laser Jet colour -A3 size for control room for alam ,report, graphic printing	As per tender specification	Nos.	2	-		2						
5.8	Dot Matrix - 24 pin, 300 cps, 136 column	As per tender specification	Nos.	1	-		1						
5.90	Process PLC and Safety PLC System - required software and hardware licenses along with Alarm Management,Historian-5000 Tags,OPC server	As per tender specification	Lot	1	-		1						
5.10	TFMS ,MOV System software licenses along with OPC server licenses with required accessories to communicate any vendor system for proposed control system	As per tender specification	Lot	1	-		1						
5.11	Safety PLC Engineering Work station	As per tender specification	Nos.	1	-		1	Inc. In PLC Cost	-	-	-	-	
5.12	Loop Testing		Nos.				345						
6	**Instrument Accessories(As per HOOK UP)**												
6.1	**Nipple (PL X PL)**												
	A21A - Specification	15 NB	Nos.	2			2						
6.2	**Nipple (PL X TH)**												
	A2Z- Specification	15 NB	Nos.	2			2						
	A21A - Specification	15 NB	Nos.	33			33						
6.3	**Nipple (TH X TH)**												
	A25A - Specification	15 NB	Nos.	U/R			U/R						
6.4	**Coupling (SCRD.)**												
	A2Z - Specification	15 NB	Nos.	2			2						
6.5	**Equal Tee (SW)**												
	A21A - Specification	15 NB	Nos.	1			1						
6.6	**Male Connector With Ferrul & Nut**												
	Material- SS 316	1/2" NPT(M) x 1/2" O.D	Nos.	66			66						
6.7	**Seamless Tube**												
	Material- SS 316	1/2"OD x 0.049 THK.	Mtr.	85			85						
6.8	Drain Valve(SW)												
	A21A - Specification	15NB	Nos.	1			1						
6.10	MS Base Plate, 150 X 150 X 6mm thk.	MS	Nos.	29			29						

PRICE BID

PRICE SCHEDULE FOR ERECTION, TESTING & COMMISSIONING

TERMINAL AUTOMATION SYSTEM

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								For Fabrication, Erection, Installation, Testing, Calibration, Painting, assistance during pre-commissioning and commissioning etc (Rs.)	GST Applicable	Subtotal price of items in Rs.		
									% Amount	(9+11)	(8 X 12)	
6.11	2" X 1400 mm Long pipe	MS	Nos.	29			29					
6.12	Anchor Fastners M12 X 125 mm Long	MS	Nos.	116			116					
6.13	Steel Structure		Tonn	10			10					
7	**Gas Monitorig System**											
7.1	Hydro Carbon Gas Detecor	As per tender specification	Nos.	2			2					
8	**Fire Alarm Panel**											
	All accessories like cables and others required for communication to Proposed control system. (If required)		Lot	1			1					
9	**MISCALLENIOUS**						0					
9.1	Installation of UPS based on the load sheet submitted alongwith Panel and associated cable works.	As per Specification	Nos.	1			1					
9.2	Earthing											
9.2.1	Copper Earthing Pit	As per tender specification	Nos.	4			4					
9.2.2	Copper Earth Bar	Size - 50X6XL250 mm long	Nos.	4			4					
9.2.3	Copper Earthing Busbar	25 X 6 mm	RM	1			1					
9.3	Cable Tranches (GI Digging,Back Feeling, and supply New Send IF require and Etc.)	If applicable	Mtr.	50			50					
9.4	Documentation	As per tender specification	Lot	Free Issue								
9.5	Training	As per tender specification	Lot	Lump Sum								
10	**PRICES ONLY (COMPULSORY FOR BID EVALUATION)**											
10.1	Comprehensive AMC year for 1st year after completion of 2 years of warranty period					Lump Sum						
10.2	Comprehensive AMC year for 2nd year					Lump Sum						
10.3	Comprehensive AMC year for 3rd year					Lump Sum						
10.4	Comprehensive AMC year for 4th year					Lump Sum						
10.5	Comprehensive AMC year for 5th year					Lump Sum						
	Total Amount inclusive of Taxes											
	Total Amount in Words :											

Note:

1	Communicaiton of Fire Alarm Panel to Proposed Control system is in vendor scope if required.
2	All supply and work shall be as per tender specifications.
3	Construction Water, loading and boarding, Site Storage with watch and ward, receipt, unloading, shifting material to store and internal shifting to site shall be included in Vendor's scope.
4	The unit rates as quoted to arrive at above total price shall be firm and exclusive of all taxes, duties, levies and inclusive of transportation, insurance etc. No separate payment shall be made for site mobilization / demobilization, insurance etc.
5	The Schedule of Rates should be read with all the other sections of the tender documents.
6	The tenderer shall be deemed to have studied the drawings, specifications and the details of work to be done within the time schedule and to have acquainted with the conditions prevailing at site. Site visit is mandatory.
7	The quantities shown against the various items are only indicative of the quantum of work and it may vary to any extent. Billing will be done as per actual. Vendor to make measurements at site before dispatch of any material.
8	The rate quoted shall be inclusive of all work as mentioned in the scope of work (Technical Specifications).
9	All the items of work in the schedule of rates shall be carried out as per specifications, drawings and instructions of the Engineer-in-Charge.
10	The rates quoted by tenderers shall be inclusive of all costs for removal and re-installation, should any defects occur or modifications are required during testing, calibration and loop tests and no extra claims for such works shall be entertained.
11	Any Modification work if required in Existing Panels for connecting Control and Signal cables is in the scope of tenderer. No separate payment shall be made in this regard.

Signature of Bidder along with company seal