SPECIFICATIONS FOR

LEVEL SWITCHES –VIBRATING FORK TYPE

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

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1.0 SCOPE

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 aboveground storage tanks.

2.0 Technical Requirement's

2.1   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.

2.2   Top mounted level switches are used the vessel connection shall be 3″ of required rating.

2.3   The head shall be rotatable with ½″ NPT (f) conduit connections, dual, 1800 apart with one side supplied with SS conduit plug.

2.4   Gaskets, nuts and bolts on the rotatable head shall be suitable for the service conditions specified.

2.5   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.

2.6   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.

2.7   The enclosure shall also be weather-proof to IP 65 as a minimum.

2.8   All the switches shall perform satisfactorily when subjected to violent pulsations and severe mechanical vibrations.

2.9   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.

2.10   "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.

2.11   The bid shall be duly supported by product / technical catalogues, brochures, etc.

2.12   "Contractor" to ensure that all units referred to in his quote shall be to the same standards as those in Tender Specification / data sheet.

2.13   "Contractor" shall submit an item wise deviation list.

2.14   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.

2.15   Level switch should meet SIL2 and complies with IEC61508/11 requirements.

3.0 Level Switch – Vibrating Fork Type

3.1 The Level Switch shall be in accordance with this specification & the relevant latest National & International Standards

3.2 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.

3.3 Equipment shall be selected to suit the intended environment with due consideration of:

   a) Electrical area classification.
   b) Ambient temperature variations Thermal radiation.
   c) Humidity
   d) Dust.
   e) Vibration. Atmospheric pollutants

3.4 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

3.5 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

3.6 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.

3.7 Cable entries shall be via isometric threaded entries ISO M20 x 1.5mm or ½" NPT female whichever mentioned in the datasheet.

3.8 The minimum degree of ingress protection for switch shall be IP65 and temperature class T6.

3.9 Float operated /Vibrating fork type level switch shall be side or top mounted as per requirement.

3.10 Direct acting level switches shall be external cage float type with magnetically operated (glandless) transmission of float movement to the switching element.

3.11 Switch shall be supplied with engraved labels stating tag number

3.12 Level switches shall be provided with a positive means of protection against process fluids entering the electrical housing in the event of element failure

3.13 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.

3.14 Level switch shall have external test option using test magnet.

3.15   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

3.16   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

3.17   Supplier shall be responsible for obtaining all statutory approvals, as applicable for all instruments and systems

3.18   In addition, equipment's / 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.

3.19   For all intrinsically safe/explosion proof / flameproof equipment/instruments/systems or equipment's 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

3.20   Protection shall be preferably Ex 'd' ex-proof, Temperature class T6, Ingress Protection IP65 minimum and intrinsically safe, if required

3.21   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.

4.0   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.

4.1   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.

4.2   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.

5.0 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.

5.1 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.

5.2 Documentation

"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

6.0 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.

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Annexure -A - General requirements of Level Switch- Vibrating Fork Type-High-High Level Switch

Description	Requirement
Tag No.	Later
PID No.	Refer P&ID Drawing
Make	Vendor To Advise
Model No	Vendor To Advise
Service	
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)
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.
Electrical Connection Size	1/2" NPT (F)
Cable Gland	Ex proof, Double compression required
Pressure data	
Fluid	
Specific .Gravity (UPPER/LOWER)	
Specific Gravity Min .Difference	
Operating Pressure	Atmospheric
Operating Temperature	- 2.2° C to 60°C
Safe Feeling Height	Refer Tank Datasheet
Others	
Hydro test Pressure Chamber/Float Kg/cm2	N/A
Vacuum test	N/A
Approvals, if Any	Yes SIL-2 and complies with IEC61508/11 requirements- Approvals from TUV/ EXIDA
Supply	24V DC Namur Type
Contact Type	SPDT micro, 2A
Inputs required for overall SIL calculations	SFF, HFT, PFD

SPECIFICATIONS FOR

SERVO GAUGE LEVEL TRANSMITTER

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

General

1.0 New TFMS requirement is for the two types of TFMS measurement system enumerated below.

2.0 Primary TFMS Measurement system-

2.1 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.

2.2 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).

2.3 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.

2.4 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.

2.5 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.

2.6 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.

2.7 Tender includes the requirements of Primary TFMS measurement system referred above.

3.0 Secondary TFMS Measurement will be done by Servo Type Level Tx.

3.1 Secondary TFMS Measurement systems consist of Servo Type Level Tx. as field instrumentation for individual product storage tanks provided by the bidder.

3.2 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)

3.3 The Communication Interface Unit will be interfaced with Safety PLC over Serial Communication i.e. MODBUS RTU.

3.4 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.

3.5 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.

4.0 Requirements of Secondary TFMS measurement system referred above as below;

4.1 The servo device shall use a minimum of moving parts (drum, shaft, stepper motor).

4.2 The device shall be able to constantly measure level, interface layers and density profiles (optional).

4.3 The servo ATG accuracy of the measurement shall not be influenced by any product characteristics (vapor, heavy turbulence and / or foam).

4.4 The servo ATG shall be suitable for installation through a 4-inch or bigger inch nozzle or still pipe.

4.5 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.

4.6 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).

4.7 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

4.8 The servo ATG must be able to detect the water level in the tank as well as interface layers

4.9 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).

4.10 The servo ATG shall be suitable for connection of an optional density measurement for online density measurement

4.11 There shall be no wearing parts, such as contact brushes or slip-rings.

4.12 The displacer shall have a submersion of less than 10 mm in order to minimize the density sensitivity.

4.13 It shall be possible to password protect the gauge against configuration changes.

4.14 It shall be possible to make each password unique.

4.15 The Servo sub parts (displacer, transmitter boards, housing etc.) shall be designed such that they can be freely exchanged between gauges.

4.16 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.

4.17 The Servo ATG is required to have a SIL 2 it shall have been certified by an external accredited laboratory such as TUV.

4.18 The SIL certificate shall be a real certification and include the assessment report describing the limitations.

4.19 The SIL certificate shall cover the all relevant components.

4.20 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.

4.21 Accuracy of Servo ATG should be +/- 0.4 mm at ref conditions.

4.22 Periodic density measurement command scheduling shall be possible from the TFMS software.

4.23 Design should be such that with a single screw cap all electronic boards can be accessed.

4.24 Servo ATG should have programmable wave integration time with three set points.

4.25 The servo ATG shall be able to operate on stilling wells of 4″ and larger, using flanges of 2″ and larger.

4.26 For Servo ATG maintenance supply of Calibration chamber is mandatory and integral calibration chamber is not acceptable

4.27 Servo ATG shall have motor high and motor low limits to restrict displacer travel within measurement ranges.

4.28 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

4.29 The servo shall be able to measure the spot density and the average density and the density profile

4.30 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.

SPECIFICATIONS FOR

AVERAGE TEMPERATURE ASSEMBLY

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

1.0 SCOPE

The scope includes complete design, engineering, supply, testing, calibration and commissioning of Averaging Temp. Sensor / Spot Temp. Sensor (to be connected to Primary Level Gauge) including necessary interface with Terminal Automation system.

2.0 Average Temperature Assembly

The Average Temperature assembly shall meet the parameters Not Limited to the following:

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".

3.0 Technical Requirements

3.1 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.

3.2   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

d) 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.

e) 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.

f) 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.

g) The process connection shall be 1 ½ "flanged to ANSI B16.5.

3.3 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.

SPECIFICATIONS FOR

PRESSURE TRANSMITTER

1.0 SCOPE

The scope includes complete design, engineering, supply, testing, calibration and commissioning of Pressure Transmitter including necessary interface with Terminal Automation system.

2.0 PRESSURE TRANSMITTER

The Pressure Transmitter shall meet the parameters Not Limited to the following:

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/cm2 (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.

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SPECIFICATIONS FOR RADAR GUAGE

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Contents

1.0 SCOPE

The scope includes complete design, engineering, supply, testing, calibration and commissioning of Radar based Tank Farm Management System including interface with Terminal Automation system.

2.0 STANDARDS & CODES

The storage tank monitoring system shall meet applicable standards and regulatory agency requirements including, but not limited to, the standards and requirements of the following.

2.1 SAFETY STANDARDS

- Applicable Safety Standards CCOE – Nagpur and ATEX is mandatory, FM
- Vendor to specify the design classifications of the field equipment for operation in continuous hazardous area according to one of applicable standards above mentioned.

2.2 APPLICATION STANDARDS

1	OIML	International Organization for Legal Measurements
i	R852008	Automatic level gauges for measuring the level of liquid in fixed storage tanks
ii	R125	Measuring systems for mass of liquids in tanks
2	API	American Petroleum Institute
i	API MPMS ch. 1	Vocabulary
ii	API MPMS ch. 3.I A	Standard Practice for Manual Gauging of Petroleum and Petroleum Products in Stationary Tanks
iii	API MPMS ch. 3.I B	Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging
iv	API MPMS ch. 3.3	Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Pressurized Storage Tanks by Automatic Tank Gauging
v	API MPMS ch. 3.6	Measurement of Liquid Hydrocarbons by Hybrid Tank Measuring Systems
vi	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.

2.3 DESIGN STANDARDS

ANSI	American National Standards Institute
DIN	Deutsche Industry Norm "German Industry Standards"
NFPA 70	National Fire Protection Agency National Electrical Code (NEC)
IEC 529	Classification of degrees of protection provided
IEC 79	Electrical apparatus for explosive gas atmospheres
NEMA ICS.6	Enclosures for industrial controls and systems

2.4 WEIGHTS & MEASUREMENT APPROVALS

- Approvals according to OIML R852008 / API Ch 3.1B
- German PTB / equivalent
- Netherlands Measuring Institute, NMI / equivalent
- Indian W & M
- All calculations, conversions and corrections shall be API / ASTM compliant

2.5 QUALITY ASSURANCE

- The vendor's organization shall have ISO 9001 certification
- CE Mark Equipment shall conform to EMC directive and LVD directive.

3.0 GENERAL

3.1 The Tank Farm Management Systems (TFMS) shall be a complete inventory management gauging system for the entire Tank farm. The Tank farm system shall get real time accurate measurement of the basic parameters like Gross level, Water level, Product temperature & Product density for all the product tanks.

3.2 The TFMS system shall consist of following components

   a. Primary Radar level gauge
   b. Averaging Temp. Sensor and Spot Temp. Sensor with water bottom interface.
   c. Pressure transmitter for density measurement

d. Tank side indicators
e. Secondary Radar Level Gauge
f. Automatic Overfill Protection System (AOPS)
g. Redundant Communication interface units (FCU/CIU)
h. Redundant TFMS Computer
i. OEM Software – Shall Comply to the OPC Foundation DA 2.0 specifications
j. Cable, Junction boxes etc

3.3 The radar gauges and AOPS shall be minimum SIL2 certified by TUV / Exida as per IEC 61511 / 61508. The radar gauging system shall also have relay / signal output, which are controlled by customer-selected variables like product level. The SIL2 relay / signal output of Secondary Radar Gauges to be connected to TAS Safety PLC for alarm indication (HH) and control of pumps, valves etc.

3.4 TFM software shall Calculate Real time gauging data (tank product levels, Average product temperature, water levels and average product density) and inventory calculations as per latest API Standard & ASTM tables 54 A & 54 B.

3.5 Tank Farm Software shall be interfaced with Loading Rack Computer System (LRCS) of Terminal Automation System (TAS) in order to receive online / real time information from all tanks.

3.6 The readings of primary radar gauges shall be available in TAS and TFMS along with other parameters as stated below.

- Product level measurement
- Volume calculation according to ASTM / API tables, which includes Total Observed Volume (TOV), Gross Observed Volume (GOV), Gross Standard Volume (GSV). Available (Pump able) Volume and Available Space.
- Product Flow calculation based on change in Level
- High, high-high, low, low-low software generated alarms
- Operators Low, Operators Hi level Alarm
- Gauge diagnostics and status information
- Average Product temperature & spot temperature at different levels inside the tank

- Ambient & Standard Density of the product of the tank.
- Level of water in the tank & its volume.
- Inventory of each product

3.7 The readings of Secondary radar gauges shall be available in TAS and TFMS along with other parameters as stated below.

- Product level measurement
- Product Flow calculation based on change in Level
- High, high-high, low, low-low software generated alarms
- Operators Low, Operators Hi level Alarm
- Gauge diagnostics and status information
- However, Secondary Radar Gauge shall have all the features of primary Radar Gauge and both shall be inter changeable.

3.8 SIL certified (Min SIL2) relay output of Primary and Secondary Radar gauge shall be connected to Safety PLC.

3.9 AOPS relay output shall be connected to Safety PLC.

3.10 The LRCS shall interface with our SAP to transfer the TFMS data to SAP as per the SAP-TAS protocol.

3.11 All the interlocks with respect to readings of Primary and Secondary Radar Gauges and AOPS output shall be made available in TAS.

3.12 Both primary and secondary radar gauges shall have provision for both "Hi" and "Hi-Hi" alarms. Both the alarms of Primary and Secondary radar gauges shall be configured in OR gate PLC logic.

3.13 Provision shall be made in TAS / TFMS for selecting the mode of operation of Radar Gauges. (Normal mode and maintenance mode). Under normal mode, all the interlocks of respective gauges shall function as per Cause & Effect matrix.

3.14 When Primary Radar Gauge is put under maintenance mode, functionalities linked to Primary Radar gauge shall be based on level reading of Secondary Radar gauge of that particular tank. System shall ask to enter the Product average temperature, Average Raw Density and Water level of that tank. The data so entered manually and level reading from Secondary Radar Gauge shall be used for inventory calculations and posting of data in SAP till the primary radar gauge is rectified and put to Normal Mode.

3.15 Whenever Radar Gauge is put in maintenance mode, alarm shall be generated and should persist till the same is put in normal mode.

3.16 The storage monitoring for the tank farm shall be carried out by the Radar level gauges on the tanks, local indicators by the side of the tank at ground level (Tank Side Indicator for Primary Radar Gauges) and at Operator interface Console located at Control Room and TM room.

3.17 These gauges shall be connected to the redundant communication interface unit in multi-drop mode and in-turn connected to tank farm management system and Terminal Automation System. Maximum 8 tanks shall be multi dropped in a loop connected from field to control room subject to meeting the Functional Requirement and min 25% Spare capacity of Loop.

3.18 The system shall provide for certain levels of redundancy. Critical system devices such as the field data concentrators shall operate in hot stand-by / parallel redundancy mode. Switching to redundant stand-by units shall be automatic.

3.19 The gauge shall operate in a stand-alone mode (single gauge installation) or in a network of at least 50 gauges with an operator interface workstation in the control room. Level update time shall not exceed3 seconds in the field data concentrator.

3.20 The gauges shall have Indian Weights & Measure Approval, Custody transfer approval, including OIML certificate etc. as stated above.

3.21 The system shall meet applicable safety, design and specification standards as specified in API.

3.22 The gauges shall be designed for Electro-Magnetic and Radio Frequency immunity.

3.23 To avoid excessive temperature cycling, the internal electronics in the level gauge shall be temperature stabilized. The radar gauge shall have a digital reference to ensure accuracy and stability. Analog delay lines suffer from temperature and aging effects and shall not be used.

3.24 For high performance measurement the drift of measured level value shall be less than one (1) mm for the entire temperature range.

3.25 The standard bus communication shall have a baud rate of at least 2400 Baud.

3.26 Level alarms shall be configurable from the software residing in the operator interface unit in the control room.

3.27 The system shall be able to perform alarm and error handling for all system components.

3.28 Applicable peripherals shall be equipped with electrical circuitry for lightening protection & surge protection at interface cabling to level gauge

3.29 All commissioning, calibration equipment like HART / FF Calibrator etc. as applicable shall be brought by the Vendor at no extra cost during commissioning and as & when required during stabilization & post commissioning period.

3.30 Installation certification & Tuning of the Gauges shall be done by the Radar Gauge manufacturer. Multipoint calibration of the Radar is a must.

3.31 The antenna for still pipe gauges shall operate in Circular transmission mode to prevent loss of accuracy due to slots, holes, rust and deposits.

3.32 The vendor shall identify any potential RTG accuracy or reliability effects associated with still pipe slot area, rust or hydrocarbon deposits, as well as still pipes inconsistencies or lack of straightness.

3.33 In floating roof tank (FRVT / IFRVT), mounting arrangement for Radar level gauge shall be provided by Client Installation of Radar gauge including nut, bolt, gasket, reducer/ expander / extension of mounting nozzle (if required), mounting accessories etc. shall be in scope of bidder.

3.34 In cone roof Radar level gauge shall be installed on existing Man hole on top of the tank. Modification of man hole including supply of accessories required for mounting of Radar gauge shall be in scope of bidder.

4.0 ELECTRICAL

4.1 Radar type of level gauge and the control room field interface shall have full galvanic isolation by means of diversion type of electrical circuitry for lightning protection at communication and power cabling entries.

4.2 Radar type of level gauge shall have the capability to digitally integrate peripherals with 2-wire intrinsically safe power and communication wiring. Digital integration is a must to prevent Analog to Digital and Digital to Analog conversion tolerances.

4.3 Radar type of level gauge shall have the capability to integrate peripherals without the need for separate barrier circuitry units.

4.4 Applicable peripherals shall be equipped with electrical circuitry for lightning protection at interface cabling to level gauge.

5.0   FIELD INSTRUMENTS

5.1   RADAR GAUGE (PRIMARY & SECONDARY)

5.1.1   The gauge shall utilize Frequency Modulated Continuous Wave (FMCW) / synthesized pulse radar to meet custody transfer level accuracy.

5.1.2   Signal frequency shaping before broadcast shall be fully processed. Provisions for temperature control of the high frequency electronics are not acceptable due to significant temperature changes.

5.1.3   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 antenna contamination monitoring and signaling.

5.1.4   The gauge should verify each level measure with an internal reference check.

5.1.5   For free space close to the tank wall installation vendor should provide antenna version by which installed accuracy is not influenced by the so-called "multi-path" effect.

5.1.6   The display shall facilitate providing the possibility for level, temperature, density and gauge status information.

PRIMARY & SECONDARY RADAR GAUGE FOR PRODUCT TANK

Sr. No.	Parameters	Minimum Requirements
1	Instrument factory accuracy	+/ - 1 mm
2	Field / Installed Accuracy	Within +/- 4mm as per OIML
3	Measuring Range	0.5 m to 30 m
4	Measuring resolution	1 mm
5	Product temperature range	-5 to 55 deg C
6	Repeatability	+/-1 mm
7	Antenna type	Parabolic / Horn / Planar / Array / Lens as per OEM's standards
8	Antenna size	As per site condition
9	Measuring principle	Frequency Modulation / Synthesized Pulse Radar

Sr. No.	Parameters	Minimum Requirements
10	Signal processing	Digital signal processing (DSP)
11	Operating frequency	X-band (9.15 to 10.85 GHz) / (70 to 80 GHz) / 6 GHz / 10 GHz / 26 GHz or as per OEM's standards
12	Ambient temperature range	-5 to 55 deg C
13	Protection Class	IP 65 (NEMA 4) or better
14	Relay output	SIL2 certified relay for Hi-Hi level required
15	Safety Approval / Certification	Explosion proof / Intrinsic safe & PESO, SIL2 certified by TUV / EXIDA
16	Certification	ATEX, CENELEC, FM, BASEEFA
17	Other Approvals	Department of legal metrology, custody transfer approval, OIML certificate etc.
18	Housings	Cast aluminum
19	Finishing	Chromatised / hard anodized / polyurethane paint
20	Antenna material	AISI 316 (acid resistant SS) and PTFE
21	Process connection	On the Roof Top of the tank either on Still well pipe or Manhole cover as per site condition
22	Power Supply	230 V ±10% AC 50Hz +/- 5% / 24 V DC
23	Rating	Vendor to specify
24	Lightning protection	Full galvanic separation
	Transmission	
25.	Field communication	Vendor to specify
26.	Protocol	Vendor to specify
27.	Common mode rejection	> 150 dB
28.	Communication distance	• 4-Km min • Maximum 8 tanks shall be multi dropped in a loop connected from field to control room subject to meeting the Functional Requirement and min 25% Spare capacity of Loop

Note:

Both primary and secondary Radar Gauging System shall have provision for integration of PT for density calculation, MSTW for average temperature and water level measurement irrespective of whether the same is required or not in the current design.

Sr. No.	Parameters	Minimum Requirements
1	Humidity	0-99% non-condensing
2	Local display	Back lit LCD display

Tank side Indicator

Sr. No.	Parameters	Minimum Requirements
1	Local Display	Back Lit LCD display
2	Design temperature	-5 to 60deg C
3	Protection	IP 65 or better
4	Safety	Explosion proof / Intrinsic safe
5	Power Supply	Loop powered / Bus powered / 230 VAC +/- 10%
6	Communication	Digital
7	Material	Cast aluminum
8	Finish	Powder coated/hard anodized/polyurethane paint
9	Cable entry	Vendor to specify
10	Parameters to be displayed	Product Level, Temperature, water interface, density and alarm / other diagnostics information (as a minimum).

5.2   AVERAGING TEMPERATURE SENSOR / PROBE ASSEMBLY

5.2.1   The temperature sensor shall be of multiple spot type. The sensor shall be connected via a digital transmitter with the tank gauging system (as per vendor's design) to enable the gauge to provide for average vapor temperature as well as temperature profiling.

5.2.2   The vendor should be able to provide only SS sheathing material for the average indicated. Mounting shall be site specific.

Spot and averaging temperature elements shall be of PT 100 3/4 wire type / Thermo couple. The system measurement accuracy shall be ± 0.25° C or better with resolution of 0.1 °C. The field electronics shall be capable of automatically determining a true average from the submerged temperature measuring elements. In the case of non-cylindrical tanks, it shall be possible to use weighing factors for correct average product temperature calculations. Averaging temperature elements shall include a specified number of elements of graduated lengths housed in a common flexible metal thermo-well. No. of temp. Elements shall be min. 8 Nos. for above ground vertical tank and min 2 nos. for underground/ horizontal tank. The temperature sensors shall also be of make same as Radar gauges (i.e., the sensor shall be supplied from OEM only). First Pt 100 / thermocouple shall be at maximum 300 mm from the bottom so that real time temperature is given even at low product levels. In case the Product level goes below 300 mm last healthy reading shall be shown in the Control room operator console. Maximum inter distance between two consecutive temperature elements should not exceed 2.0 m.

5.3 WATER INTERFACE PROBE (WIP) ASSEMBLY

5.3.1 WIP assembly integrated along with temperature sensor assembly is to be offered meeting process requirements.

5.3.2 Water Level sensor offset shall be calibrated for each Tank. The 4-20 mA / Field bus output level shall be configured in order to obtain correct water level reading from the Water Interface probe. The Distance between the Water Zero level & Tank Datum shall be considered while configuring the WIP.

Sr. No.	Parameters	Minimum Requirements
1	Principle	Capacitive / Equivalent
2	Instrument Accuracy	+/- 2 mm over a probe length of 500 mm
3	Field / Installed Accuracy	+/- 4 mm over a probe length of 500 mm
4	Product temperature	-5 to 55 deg C
5	Design temperature	-5 to 60 deg C
6	Probe material	SS sheathing
7	Protection	Probe IP 68 or better and WIP converter IP 65 / NEMA4 or better
8	Power supply	Vendor to specify
9	Output / transmission	4-20 mA / Field bus
10	Probe mounting	• Integrated to multipoint temperature sensor. • The sensitive length for water interface probe measurement shall be minimum 500-mm.

5.4 PRESSURE TRANSMITTER FOR DENSITY MEASUREMENT

5.4.1 Pressure Transmitter shall be installed on nozzle provided on side wall of the Tank and shall be used for calculation of average density of the product.

5.4.2 Pressure Transmitter setting like Zero trim, Calibration Range setting shall be done at site for each tank.

5.4.3 The reading of pressure transmitter shall also be available in the Tank farm management software and TAS with historical trends and time strap.

5.4.4 In case the desired accuracy of density could not be achieved when product level goes below H(min) level, then TAS / TFMS software shall calculate the raw density of the product based on the hold value of density at 15 deg at H(min) and real time temperature reading through MSTW.

Specification of Pressure Transmitter

Sr. No.	Parameters	Minimum Requirements
1	Type	Electronic microprocessor based, smart transmitter
2	Output	• 4-20 mA, HART output / Modbus / Field Bus • (To be selected as per the communication protocol of TFMS equipment for taking pressure inputs for density calculation.)
3	Range	0-2 bar
4	Accuracy of PT	+/- 0.025%of Calibrated Span
5	Accuracy for density measurement	+/- 0.5% of the actual density value for product level above H (min) (i.e., 4 m) from datum plate of the tank as per API
6	Protection	IP 65 or better
7	Method of measurement	Hydrostatic
8	Service	Tank density measurement for ATF
9	Material of construction	SS 316 for wetted parts
10	Calibration Range	As per Tank Height
11	Over range protection	150%
12	Power	24 VDC/loop powered
13	Area classification	Zone II grade II A/II B
14	Protection	Protection required against surges, lightning, reverse polarity
15	Nozzle size in tank side wall for PT	2″ / 3″ flanged connection with isolation ball valves (provided by Client)
16	Process Connection	Flange type
17	Electrical Connection	½″ NPT(F)
18	Mounting Kit	Necessary accessories suitable for 2″/3″ NB pipe mounting. Tapping from tank shall be horizontal.
19	Tag Plate	Metal tag plate to be provided
20	Model No	VENDOR TO SPECIFY
21	Approval	CCOE

Note:

For displaying of density below 4 M of product level in OIC, system shall automatically calculate the density at Real Time temperature as sensed by MSTW assuming the converted density 15 deg C is same as that just above 4m and no fresh product has been taking into receipt. Once the product reaches the 4m height, system shall display the real time density automatically.

5.5   AUTOMATIC OVERFILL PROTECTION SYSTEM (AOPS)

Sr. No.	Parameters	Minimum Requirements
1	Application	Tank overfill protection
2	Service	ATF
3	Type	Vibrating fork type
4	Location	On tank roof / tank top
5	Area classification	ZONE 1, Gr IIA / IIB, T3
6	Process connection	2″ ANSI 150 class RF / Site specific
7	SIL requirement	SIL 2 as per IEC 61508 / 61511
8	Built in diagnostic / self-testing	Required
9	Orientation	TOP
10	Sensor material	SS 316/ SS 316 L
11	Other wetted parts	SS 316/ SS 316 L
12	Enclosure housing	IP 65 min, Exd
13	Power supply	24 V DC / 230 V AC
14	Output	2 X SPST or 1 X SPDT
15	Switch rating	230 V AC, 2 Amp
16	Contact open on level	Safe filling height of the tank
17	Lightning protection	Yes
19	Certification	ATEX, FM, CMRI
20	CCOE / PESO approval	Yes
21	Documents	Specification with catalogue, GA drawing, Installation / Mounting drawing, test certificates, calibration certificates, CCOE / PESO & CMRI certificates, Conformity Certificate from OEM, Operation & Installation manual

5.5.1   Periodic Proof Testing: Operators shall test the Overfill device using the push buttons, or through remote test facility of the TFMS.

5.5.2   Overfill protection system shall be de-energized to trip the Solenoid Valve of ROSOV through SIL 3 Safety PLC.

5.5.3   For AOPS length calculation, vendor to consider an extra length of 500 mm above tank nozzle so that the length of the spool piece can be

adjusted incase SFH of the tank changes in future without changing AOPS. The required Spool piece to be provided by the TAS vendor.

6.0 COMMUNICATIONS

This section specifies the functionality requirements for a tank inventory system which captures and provides inventory and gauge status data / information for display, reporting, trouble shooting and / or further data handling to perform inventory management.

6.1 GENERAL

6.1.1 Radar type tank gauge field instruments should be capable to communicate over 2-wire via the system interface to the operator interface at a distance of maximum 4 Kilometers.

6.1.2 The field bus protocol should provide maximum resistance to interference.

6.1.3 Dedicated Windows based (Latest version) Tank Farm Software / Dedicated Inventory System based on standard browser and independent of proprietary software shall run on any Tank Farm Computer on a distributed architecture of LAN. This TFMS Computer / CIU shall be connected to the LRC system through OPC/Serial Modbus connectivity for exchange of critical information.

6.1.4 The system interface shall provide serial communication links for operations, alarming and (remote) trouble shooting.

6.1.5 The operator interface shall provide network capabilities using standard LAN.

6.2 SYSTEM INTERFACE (COMMUNICATION INTERFACE UNIT)

6.2.1 The system interface shall convert 2-wire field communication to serial data link to enable digital data handling.

6.2.2 The system interface shall have full galvanic isolation on all field ports and host ports.

6.2.3 The system interface shall have configurable MODBUS memory mapping & scaling per port.

6.2.4 The system interface shall have independently supported and microprocessor-controlled communications on all ports.

6.2.5 Vendor to provide separate commissioning / trouble shooting / diagnostic software which will independently communicate with field instruments via the system interface without disturbing operations

6.2.6 The system and field gauges shall have the ability for local or remote PC configuration by means of a parameter download.

6.2.7 Radar gauge / Integral temperature cum water interfacing probe / tank side indicator shall be from OEM. The successful vendor shall submit original test certificate for all these accessories to Client for verification.

6.2.8 The communication unit shall operate in HOT Stand-by / Parallel dual redundant mode and switchover shall be bump less.

6.3 TFMS SOFTWARE

6.3.1 Enhanced inventory management and tank monitoring functionality shall be available by means of software applications running on Windows platform, designed on industry standard open system architecture based on OPC / OLE industry standard. The software shall have the capacity up to 50 radar tank gauging system.

6.3.2 The system shall be able to accept multiple users with different privileges independently of the Windows operating system. The system shall have freely configurable task related privileges for operators, operator managers, service managers etc.

6.3.3 Logging on and off of different users shall be stored as event for traceability.

6.3.4 The log on period should expire automatically.

6.3.5 The systems database shall be ODBC compliant for maximum data handling flexibility. The system shall provide for open connectivity via OLE e.g., for users to extract appropriate data using commercial off the shelf software e.g., MS Excel or MS Access etc. (i.e., the software shall act as OPC server with Office Link - For connection between TFMS software and Microsoft Office via OPC, including the third part program).

6.3.6 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 or SCADA or other user OPC compliance application programs.

6.3.7 The operator interface shall have full network support over standard LAN, using commercial off the shelf hardware and software.

6.3.8 In case of networking the system shall have clock synchronization for all systems operator stations.

6.3.9 The system shall have the capability to support parallel/hot-stand by redundancy without the need for external switches.

6.3.10 The following modules / views are considered to be required as a minimum for the tank inventory system.

- Alarming audio / visual alarms
- User configurable tank grouping
- Events
- Field commands
- Manual override
- Views- tank related as well as group related
- Tank detail
- Tabular data
- Bar graphs
- Tank icons.
- Trends

6.3.11 The system shall be able to generate reports in a display / printer format as well as a computer format through the communication interface using an industry standard report generator (such as Crystal Report). It shall be possible to format the report forms to include station header, product label, date, starting and ending time, starting and ending volumes, temperature of the fuel as well as the net volume increase, etc.

6.3.12 All reports may be retrieved through local communications.

6.3.13 The system shall have the possibility for a calculator for conversion of volume or any other TFMS parameters to equivalent level, mass, estimated time and flow or vice-versa for the operator.

6.3.14 The system shall have configurable static and dynamic grouping of tanks.

6.3.15 The system shall have the capability to set alarms on all calculated entities, e.g., level, volume, mass, flow, temperature.

6.3.16 The system shall fully support all diagnostics and commands of radar gauge.

6.3.17 The system shall have the capability for historical and real-time trending analysis.

6.3.18 The system shall have the capability to store data and reports on hard disk for later analysis, documentation and traceability.

6.3.19 TFMS / TAS shall have continuous comparison of level measurement between Primary RTG and Secondary RTG to allow for continuous status check of level measurement.

6.3.20 The system shall be capable of printing reports automatically.

6.3.21 The remote display shall provide an 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.

6.3.22 The system shall provide the operator with the ability to disable the audible portion of an alarm but the visual alarm shall not be disabled until the alarm condition has been corrected.

6.3.23 The Operator interface graphics shall be designed for normal plant operation information and shall have the following functionality

- All standard windows shall have the ability to be customized on demand.
- The HMI software shall be able to act as a master for other types of tank gauging system.
- An alarm log shall be provided which displays all current acknowledged and cleared alarms. An alarm inhibit function shall be provided by which a single or group of associated alarms could be de-activated. The ability to inhibit any alarm shall be multi-level password-protected.

- A group configuration function shall be provided which permits the plant operator(s) to define the groupings of tanks for display on the group view screen and the group inventory screen. A similar function shall be available for alarms.
- A value entry function shall be provided which permits the plant operator(s) to manually enter process values and operating parameters for each tank. It shall be possible to configure tanks in the system, which is not equipped with RTGs.
- An engineering function interface shall be provided for system configuration and set-up. All configuration changes shall be password-protected.

6.4 TANK INVENTORY MANAGEMENT

6.4.1 The HMI shall be able to calculate tank inventory values according to the API. All values in the calculation process shall be displayed.

6.4.2 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.

6.4.3 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.

6.4.4 The System shall display last healthy reading of density when the product falls below "H min" level.

6.4.5 All tank level alarms are to be repeated as signals to LRC and to Pipeline Division.

6.4.6 Separate screen / function shall be available for Pipeline Transfer (both receipt & dispatch) with the following details

- Tank No.
- Safe Filling Height
- Tank Gross Volume (Before PLT Start in KL in TAS / TFMS)
- Ullage Available (Dynamic in KL)
- PLT quantity (Location to put this figure in KL Ullage > PLT qty else alarm in TAS / TFMS)
- Tank Level (Dynamic)
- Tank Vol (Dynamic)
- Tank Level (Expected at the end of PLT)
- Tank Vol (Expected at the end of PLT)
- Expected Time of PLT completion (Dynamic)
- Alert @ 90% PLT Qty (Configurable)
- Alert @ 15 mins before Completion (Configurable in TAS/TFMS)

6.5 LEAKAGE ALARM

The system shall generate leak alarms based on the change in level or the Net Standard Volume of the products in the storage tanks.

6.6 RATE OF CHANGE COMPUTATIONS (FLOW)

The system shall provide a calculated volume rate of change based on the true level rate from the RTG and the tank capacity table.

6.7 ALARM CAPABILITIES

The system shall generate multiple High, Low and Safe alarms for level, temperature, pressure and water interface level. Configurable time delays shall be provided for each process variable to minimize nuisance alarms.

6.8   BATCH HANDLING

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 sources. The Batch function shall generate printable batch reports. TFMS software will send Dynamic data to LRC, LRC shall be handling Batching functions.

6.9   REPORT FUNCTIONS

The system shall be able to generate reports in different formats. All reports shall be publishable on printers, via e-mail or as a file. All reports shall be generated manually or automatically by user-defined schedules. Minimum required reports are

- Tank reports
- Inventory balance reports
- Alarm reports

6.10   SYSTEM DIAGNOSTICS

The system diagnostics shall be capable of performing self-checks on each tank gauge and data collection / control units. As a minimum, the following features shall be included.

All field inputs, including level, temperature, pressure and water bottom signals, shall be monitored for faults. All faults shall be annunciated and logged. The error indications shall be categorized, such as communication failure, gauge failure or software failure.

All diagnostic information shall be displayed, alarmed, stored in historical files and included in reports. This diagnostic information shall include details of all types of failures, system status and configuration modifications. All diagnostic alarms shall be presented locally and can be distributed via e-mail.

6.11 SYSTEM SECURITY

It shall be possible to prevent unauthorized tampering of the system.

The HMI and resident application software shall have a minimum of four levels of password protection. It shall be possible to change the security level of certain function. All functions shall have a pre-set security password level.

It shall be possible to set up individual user accounts with unique passwords and security levels for each operator. This shall enable tracking of system changes recorded in a log-file. The system administrator with the highest level of authority and password handles the assigning of user accounts.

6.12 SYSTEM AND DATA RECOVERY

The tank gauging software shall be capable of data backup of all system configuration and process parameters. The system shall also be capable of retrieving all configuration parameters once a system failure has cleared.

The system should be connected via OPC server link to

- Remote station.
- SAP / LRCS Interface.

6.13 INTEGRATION WITH OTHER TANK GAUGING SYSTEM

The Radar Gauge shall communicate with the Tank Farm Server via a vendor-supplied field-buses. It shall have the ability to connect to other types of existing Tank gauging systems using communication adapters and protocol drivers.

SPECIFICATIONS FOR

TANK SIDE INDICATOR

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

Project Name:		
Document No.:	Rev.:	

1.0   SCOPE

The scope includes complete design, engineering, supply, testing, calibration and commissioning of Tank Side Indicator including necessary interface with Terminal Automation system.

The scope of supply shall broadly include the following.

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.

Project Name:			
Document No.:		Rev.:	

DATASHEET FOR

LEVEL SWITCH – VIBRATING FORK TYPE

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

1.0   DATA SHEET FOR LEVEL SWITCH – VIBRATING FORK TYPE

Tag No.	Later
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
Quantity	As per Bill of Quantity
Supply	24V DC Namur Type
Contact Type	SPDT micro , 2A
Inputs required for overall SIL calculations	SFF, HFT, PFD

DATASHEET FOR

MULTI – POINT TEMPERATURE ELEMENT

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

1.0   DATA SHEET FOR MULTI – POINT TEMPERATURE ELEMENT

Tag No.	Later
Service	ATF
Range	Vendor to Specify
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 Point	Throughout the tank with minimum 1-meter interval
Sheet 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	Vendor to Specify
Cable Glands	Required: ex-proof, double compression of brass, Ni coated 1/2" NPT
Others	
Make	Vendor to Specify
Model No.	Vendor to Specify
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

2.0   Notes:

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".

DATASHEET FOR

PRESSURE TRANSMITTER

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

1.0 DATA SHEET FOR PRESSURE TRANSMITTER

Description	Electronic Indicating Transmitter
Type	2 wire , Electronic (Smart) with Foundation field bus Protocol
Tag no.	Later
Mounting	1/2" NPT
Case	Manufacturer Standard
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 STAINLESS STEEL
Zero/Span	From front pad of instrument / By Hand-held terminal , non-interactive
Self-Diagnostic facility	Required
Measuring Unit	
Service	Hydrostatic Head Measurement
Element	Piezo resistive /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	Vendor to Specify
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	Vendor to Specify
Armour Flexible Material	Vendor to Specify

Flushing / Filling Connection	Vendor to Specify
ACCESERIOS	
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

DATASHEET FOR

RADAR TYPE LEVEL TRANSMITTER

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

1.0 DATA SHEET FOR RADAR TYPE TRANSMITTER

Type	Radar type to measure the tank level with local indication
Tag No.	Later
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	Carbon Steel
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	By Vendor
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	By Vendor; 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	By Vendor
Common Mode Rejection Ratio	>150dB
Communication Distance	1.0 Km Min.
Baud Rate	4800 min
Others	
Make	By Vendor
Model No.	By Vendor
Cable Glands	Required : ex-proof, double compression of brass, Ni coated 1/2" NPT
Make	Honeywell-Enraf / SAAB / E & H.

Project Name:		
Document No.:	Rev.:	

DATASHEET FOR

SERVO GAUGE LEVEL TRANSMITTER

Rev.	Date	Description	Prepared	Reviewed	Approved	ClientReview

1.0 DATA SHEET FOR SERVO GAUGE LEVEL TRANSMITTER

SERVICE				DESCRIPTION			
Tag No.				Later			
Service				ATF			
Tank No.				VF 207			
Process Data :							
Fluid							
Temperature	Min	Normal	Max	15^0 C	40^0C		50^0C
Pressure	Min	Normal	Max	ATM	ATM + FOL		
Specific Gravity @ Op. Temp							
Viscosity @ Min.Op.Temp (cP)							
Design Pressure							
Design Temperature Min/Max							
Transmitter							
Type				Indicating Transmitter			
Tank Type				Conceal roof Vertical Tank			
Tank Height							
Location				Tank Overhead			
Area Classification	Enclosure			Zone 1, Gr IIA/IIB, T3		Flameproof	
Process Connection				*Existing Vendor to visit at site			
Vent Connection				VTS			
Stilling well	Size		Material	Required	VTS		VTS
Transmitter Mounting Orientation				Tank Overhead			
Flange Size	Rating as per ANSI B 16.5			VTS		150#	
Servo Housing Material				Cast aluminium			
Drum Compartment Material				SS 316 or better			
Measuring drum, drum shaft				SS 316 or better			
Measuring Wire Material	Instrument Range			SS 316 or better		VTS	
Calibration Chamber				Required			
Measuring Range				0 - 20000 mm			
Accuracy	Repeatability			_+ mm		0.1 mm	
Output	Transmission Protocol			VTS		VTS	
Electrical power supply				230V AC, 50 Hz			
Power Consumption				VTS			
Ingress Protection	Lighting Protection			IP 65		Yes	

Cable Entries	Cable Entry size	At least 4 nos.	1/2" NPT (F)
Output Signal		4-20mA, 2nos Alarm Contact	
Signal Compatibility		Honeywell-Enraf / SAAB / E & H (Refer note 10)	
Tag Plate		SS 316 with engraved letters	
Function		Measurement of Level	
Level Alarms	Remote Alarm Indication	2, Programmable	Required
Alarms Relay Output	Contact Rating	2 x SPDT Galvanically Isolated	24 VDC, 3 Amp
Options			
Local Display		LCD type Required with Density indication	
Portable Communication Terminal/Device		Required - VTS (One common for all Servo Gauges)	
Tank Side Indicator		LCD type with backlit, Required	
Manufacturer		As Per Approved Vendor's List	
Model		VTS	
Temperature Sensor		N.A	
Tag No.		N.A	
Type	Quantity	N.A	N.A
Element Spacing		N.A	
Measuring Range	Accuracy	N.A	N.A
Mounting	Sheath	N.A	N.A
Electrical Connection	Wiring Connection	N.A	N.A

2.0   Note:

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"

DATASHEET FOR

TANK SIDE INDICATOR

Rev.	Date	Description	Prepared	Reviewed	Approved	Client Review

1.0 DATA SHEET FOR TANK SIDE INDICATOR

Tag No.	Later
PID No.	Refer P&ID
Service	
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.	*
Note	* bidder to specify

2.0 Notes:

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.