Level Measurement Technologies for Mature Atmospheric Storage Tanks

FIXED ROOF TANK

CONTINUOUS LEVEL MEASUREMENT

Instrument Infrastructure is Existing to Accommodate Additional Signals	Radar (13)	Servo	Float/Type	Other	Notes
Existing Still Pipe in Addition to Manual Gauging Still Pipe	1st	2nd	X	X	
Only Still Pipe is for Manual Gauging	1st? (1)	X	X	Differential Pressure (DP)? (2)	
Spare Connection on Top of the Tank but No Associated Still Pipe	1st? (3)	2nd (4)	X	X	Connection must be accessible and capable of supporting whatever is installed on it
Existing Float/Tape Local Indication Only	X	X	Reuse or Upgrade (5)	X	Add transmitter to local indicator; this provides no independence
All Situations	X	X	X	DP? (2)	Use wireless DP

POINT LEVEL MEASUREMENT

Instrument Infrastructure is Existing to Accommodate Additional Signals	Internal Float/Displacer	External Float	Other (Tuning Fork, RF Probe, etc.)	Notes
Spare Connection on Top of the Tank With or Without Still Pipe	1st (6)(8)	X	2nd (7)(8)	Consider how the instrument will be tested when choosing technology
At Least Two Spare Connections on Side of Tank Located at the Same or Near the Same Radial Angle on the Tank	X	1st (8)	1st (8)	Position of spare connections must accommodate the desired set point; consider access and how instrument will be tested
Single Spare Connection on Side of Tank	X	X	1st	Position of spare connections must accommodate the desired set point; consider access and how instrument will be tested
Existing Float/Tape Local Indication Only	X	X	Reuse or Upgrade (5)	Add transmitter to local indicator and set alarm on analog value; this provides no independence
All Situations	Wireless (5)	Wireless (5)	Wireless (5)	Use wireless point level detection appropriate to the spare connection(s) available on the tank (see above for technology choices)

NOTES

1 Radar only possible if gauge hatch for manual level measurement can be retrofitted for a radar gauge. Radar level measurement will be interrupted any time a manual level measurement is performed. Unlikely this can be used for custody transfer but could be used for operational inventory. Do not use for safety.

2 May be possible to temporarily install a Differential Pressure (DP) referenced to atmosphere if the density and temperature of the liquid in the tank are relatively stable, the vapor space pressure is negligible compared to the static head of the liquid, a connection is available near the bottom of the tank, and solids will not build or form at the point of connection. Consider a diaphragm seal if the connection is of sufficient size. Unlikely this can be used for custody transfer. Do not use for safety.

3 Movement (flexing) of the roof may cause errors in level measurement. Unlikely this can be used for custody transfer but could be used for operational inventory. Do not use for safety.

4 Only possible if the liquid in the tank is not subject to turbulence. Unlikely this can be used for custody transfer but could be used for operational inventory. Do not use for safety.

5 Do not use for safety.

6 If a still pipe does not exist, liquid in the tank must not be subject to turbulence.

7 A probe of sufficient length must be available to achieve the correct level at which the switch will activate. Turbulence may be tolerable but needs to be considered.

8 Either a float/displacer switch or the other point level switch technologies are acceptable depending on owner/operator preference.

9 May be possible to temporarily install a DP referenced to atmosphere if the density and temperature of the liquid in the tank are relatively stable, a connection is available near the bottom of the tank, and solids will not build or form at the point of connection. Consider a diaphragm seal if the connection is of sufficient size. Also consider vapor space pressure for internal floating roof tanks. Unlikely this can be used for custody transfer. Do not use for safety.

10 Install a radar at the top of the tank (e.g., along the top wind girder) and have the reflection bounce off the top of the floating roof. Roughly calibrate the gauge to account for the thickness of the roof and expected displacement. This will only provide a rough, inaccurate level measurement but can be used to determine if the roof is reaching an alarmingly high level. The radar must be installed over an area of the roof that will provide an acceptable reflection free from structural members or other interference. This will likely not meet the accuracy requirements of API MPMS Chapter 3.1B but can provide a temporary solution until permanent modifications can be made to the tank.

11 Attach a tape (no float needed) to the top of the floating roof and run the tape to an indicator at grade. Add a transmitter to the local indicator. Roughly calibrate the gauge to account for the thickness of the roof and expected displacement. This will only provide a rough, inaccurate level measurement but can be used to determine if the roof is reaching an alarmingly high level. The tape will be exposed to the elements including wind and can only be used in a relatively short tank where the length of “free” tape will not be excessive. The reading will also be affected by any rotational movement of the floating roof if there is play around the guide. This will not meet the accuracy requirements of API MPMS Chapter 3.1B but can provide a temporary solution until permanent modifications can be made to the tank.

12 Install a switch with a weight on the end of a chain or cable that will be lifted when the floating roof contacts the weight causing the switch to activate (similar to a float switch). Static electricity may be a consideration.

13 At least one manufacturer of radar gauges offers a “2-in-1” solution where two sets of radar electronics can share the same antenna. This may be a consideration for retrofit of a tank where there is an existing radar level measurement but it is installed on the only available still pipe and two independent level measurements are required. The owner/operator will need to decide if this type of arrangement is sufficient to achieve the desired independence.

LEGEND

1st = first choice
2nd = second choice
X = do not or cannot use
? = may be possible under certain circumstances or constraints
(#) = note number – see notes

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CONTINUOUS LEVEL MEASUREMENT

Instrument Infrastructure is Existing to Accommodate Additional Signals	Radar (13)	Servo	Float/Type	Other	Notes
Existing Still Pipe in Addition to Manual Gauging Still Pipe	1st	2nd	X	X	
Only Still Pipe is for Manual Gauging	1st? (1)	X	X	(DP)? (9)	
EXTERNAL FLOATING ROOF ONLY - No Still Pipe or Still Pipe Used for Manual Gauging Cannot Be Used for Instrumentation	1st? (10)	X	2nd (11)	X	Measure top of floating roof; provides rudimentary inaccurate level measurement
Existing Float/Tape Local Indication Only	X	X	Reuse or Upgrade (5)	X	Add transmitter to local indicator; this provides no independence
All Situations	X	X	X	DP? (2)	Use wireless DP

POINT LEVEL MEASUREMENT

Instrument Infrastructure is Existing to Accommodate Additional Signals	Weighted Switch	External Float	Other (Tuning Fork, RF Probe, etc.)	Notes
INTERNAL FLOATING ROOF ONLY - Spare Connection on Top of the Tank	1st (12)	X	X	Consider how the instrument will be accessed and tested
EXTERNAL FLOATING ROOF ONLY - No Spare Connection Required	1st (12)	X	X	Install a switch at the top of the tank (e.g., along the top wind girder) that is suspended over the floating roof; consider how the instrument will be accessed and tested
At Least Two Spare Connections on Side of Tank	X	1st (8)	1st (8)	It is extremely unlikely that this is a possibility unless the tank was designed with these connections but they were never used; consider how the instrument will be accessed and tested
Existing Float/Tape Local Indication Only	X	X	Reuse or Upgrade (5)	Add transmitter to local indicator and set alarm on analog value; this provides no independence
All Situations	Wireless (5)	Wireless (5)	Wireless (5)	Use wireless point level detection appropriate to the spare connection(s) available on the tank (see above for technology choices)

NOTES

1. Radar only possible if gauge hatch for manual level measurement can be retrofitted for a radar gauge. Radar level measurement will be interrupted any time a manual level measurement is performed. Unlikely this can be used for custody transfer but could be used for operational inventory. Do not use for safety.
2. May be possible to temporarily install a Differential Pressure (DP) referenced to atmosphere if the density and temperature of the liquid in the tank are relatively stable, the vapor space pressure is negligible compared to the static head of the liquid, a connection is available near the bottom of the tank, and solids will not build or form at the point of connection. Consider a diaphragm seal if the connection is of sufficient size. Unlikely this can be used for custody transfer. Do not use for safety.
3. Movement (flexing) of the roof may cause errors in level measurement. Unlikely this can be used for custody transfer but could be used for operational inventory. Do not use for safety.
4. Only possible if the liquid in the tank is not subject to turbulence. Unlikely this can be used for custody transfer but could be used for operational inventory. Do not use for safety.
5. Do not use for safety.
6. If a still pipe does not exist, liquid in the tank must not be subject to turbulence.
7. A probe of sufficient length must be available to achieve the correct level at which the switch will activate. Turbulence may be tolerable but needs to be considered.
8. Either a float/displacer switch or the other point level switch technologies are acceptable depending on owner/operator preference.
9. May be possible to temporarily install a DP referenced to atmosphere if the density and temperature of the liquid in the tank are relatively stable, a connection is available near the bottom of the tank, and solids will not build or form at the point of connection. Consider a diaphragm seal if the connection is of sufficient size. Also consider vapor space pressure for internal floating roof tanks. Unlikely this can be used for custody transfer. Do not use for safety.
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