Addressing API Standard 2350 for Overfill Protection

A Varec, Inc. White Paper

Varec®

Addressing API Standard 2350

for Overfill Protection and Prevention

In the coming months and years, owners and operators of US-based petroleum storage facilities will be required to meet the American Petroleum Institute's Standard 2350 for overfill protection. This white paper explains in layman's terms some of the concepts behind the standard while also providing...

1. What to look for in a control room system when performing a risk assessment.
2. Examples of how to apply the right Varec solution to your chosen API 2350 tank categorization.
3. A dynamic API 2350 Tank Worksheet.

API Standard 2350 provides conceptual overviews to assist in the definition of a facility specific Overfill Prevention Process.

Overfill Prevention Process

The updated API Standard 2350 is intended to encompass bulk storage tanks over 1,320 U.S. gallons (5000 liters) that contain Class I or Class II petroleum liquids and to ensure successful shut-down of a receipt or transfer operation in the event of a possible tank overfill. Standard 2350 provides structured guidance for a facility to identify the steps required to achieve compliance. In summary, API Standard 2350 recommends that facilities should perform the following tasks to define and document an Overfill Prevention Process (OPP).

- Perform a risk assessment and gap analysis of current equipment and operations.
- Re-categorize tanks—identify and define levels of concern and response times for each tank based on the analysis.
- Define the required actions to ensure adequate response to an event.
- Document the entire overfill prevention process.
- Train facility personnel on the new process and manage the process.

API Standard 2350 recognizes facility-specific requirements and places ultimate responsibility for compliance with the owner or operator. For some, performing and documenting these steps in an unbiased manner can be difficult, especially in areas where the Standard is not specific. Therefore, it the wise operator will consult with an external company—one with a wide range of experience in the areas of controls automation, systems integration, tank gauging, and environmental compliance.

Operational assessments conducted by a objective third-party can uncover situations of risk that your facility personnel would not see.

Risk Assessment

When performing and documenting a risk assessment, an operator should focus on the probable loss of containment that could occur under normal and abnormal conditions. Historical operational data—fill times, flow rates, alarm limits, operator awareness, operator communications, responsibilities, ESD actions, logic—should all be available for analysis. If data is not available, then data should be collected over a period of time to estimate future performance. For an optimal analysis, both the recipient's and transporter's operations should be investigated.

Risk assessment is an area where a third-party can provide an unbiased view. A third-party company will ask the questions and help define answers for situations and processes that facility personnel take for granted, situations that they feel everybody on site is aware of and knows how and when to react. A third party can often easily identify these undefined and dangerous situations.

Independent measurement systems on category 3 tanks require uninterrupted power supplies and separate communications wiring (from the primary ATGS) to the point of alarm or AOPS activation.

Alarms and Alerts

Standard 2350 does not go so far as to define or recommend methods or equipment that would fulfill the requirements for redundancy or electronic signal communications for triggering alarms or activating an overfill prevention system. It simply refers to the use of logic-solving systems that output to specific alarms or alert indicators based on the categorization of a tank. An understanding of controls automation and system integration will help align operations and systems within API's tank category structure.

Generally speaking, for category 1 and 2 tanks, alarm outputs from an ATG system could either trigger an alarm directly, or be wired to a PLC or control-room system that in turn activates alarms or alerts. In the case of category 3 tanks, communications to a PLC (or DCS) system would be most likely. The PLC system could then activate the alarm or Automatic Overfill Prevention System (AOPS) and share data from the instrument to the inventory control system or the transporter while still maintaining independence.

Tank gauging and alarm systems are utilized at the discretion of the facility owner and operator when tanks are fully attended during receipt.

Categorizing Tanks

The revised API standard provides guidance on how to categorize a petroleum tank based on the location of facility personnel and their ability to oversee receipt operations. This guidance helps to identify the levels within a tank that would be of concern during filling operations and the required response times needed to terminate the receipt.

Within this context, API Standard 2350 recommends that the on-tank measurement systems provide a minimum level of protection.

Levels of Concern (LOC)

At a minimum, three LOC are established (CH, HH, MW) to drive alarms and alerts. Two additional levels are deemed optional depending on the tank category. Each LOC is established by understanding the response time that is appropriate for the rate of volume change in the tank and the reaction time needed by personnel or a system to shut down the receipt. Depending on the tank category, API recommends specific actions be undertaken, and alarms, alerts, or notifications be triggered when an LOC is reached.

* Please refer to the published API Standard 2350 for specific attendance recommendations

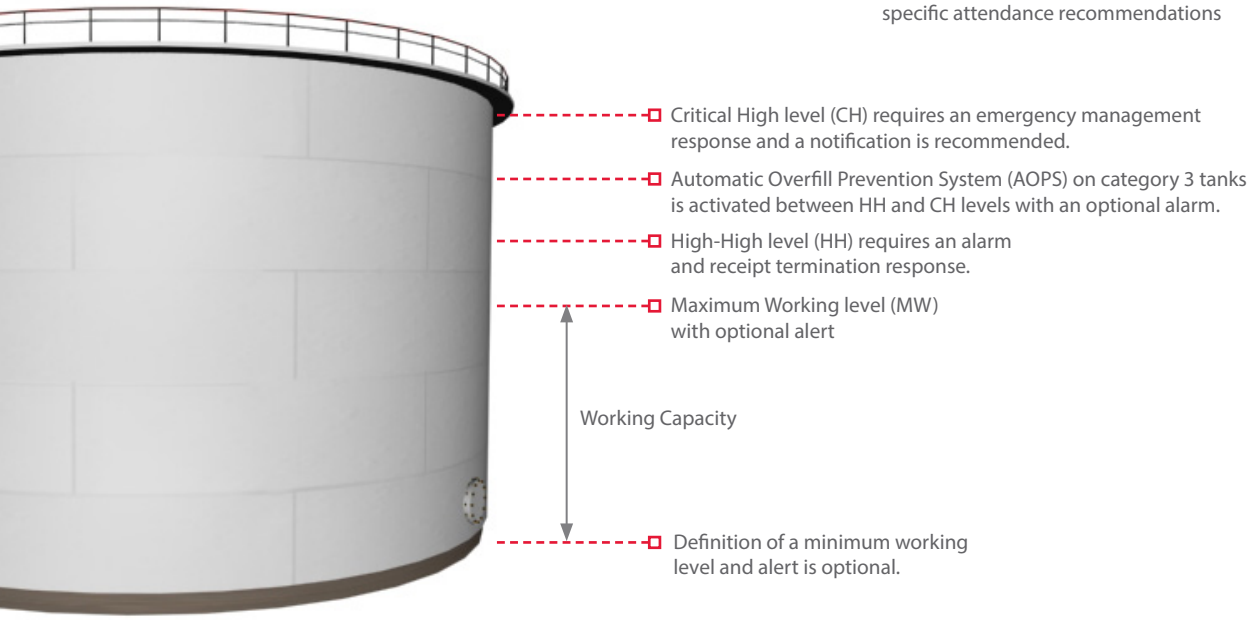


Fig. 1 - Levels of Concern per API Standard 2350

Unattended tanks should be monitored remotely to ensure product level is maintained within normal operating conditions

Tank Category

Category 1: Fully Attended Tanks (Diagrams 1 & 2) – Local operations personnel must monitor levels before and during the receipt and they must be able to manually shut down receipt and fill operations to the tank. The facility personnel must be in communication with the transporter, who is also able to terminate receipt.

Although the standard does not require instrumentation or alarms, Varec recommends a local tank gauge that provides a tank-side display and can also trigger a high-high alarm, such as a beacon and siren at the tank side. Alternatively, an independent alarm switch could be used to monitor the high-high level.

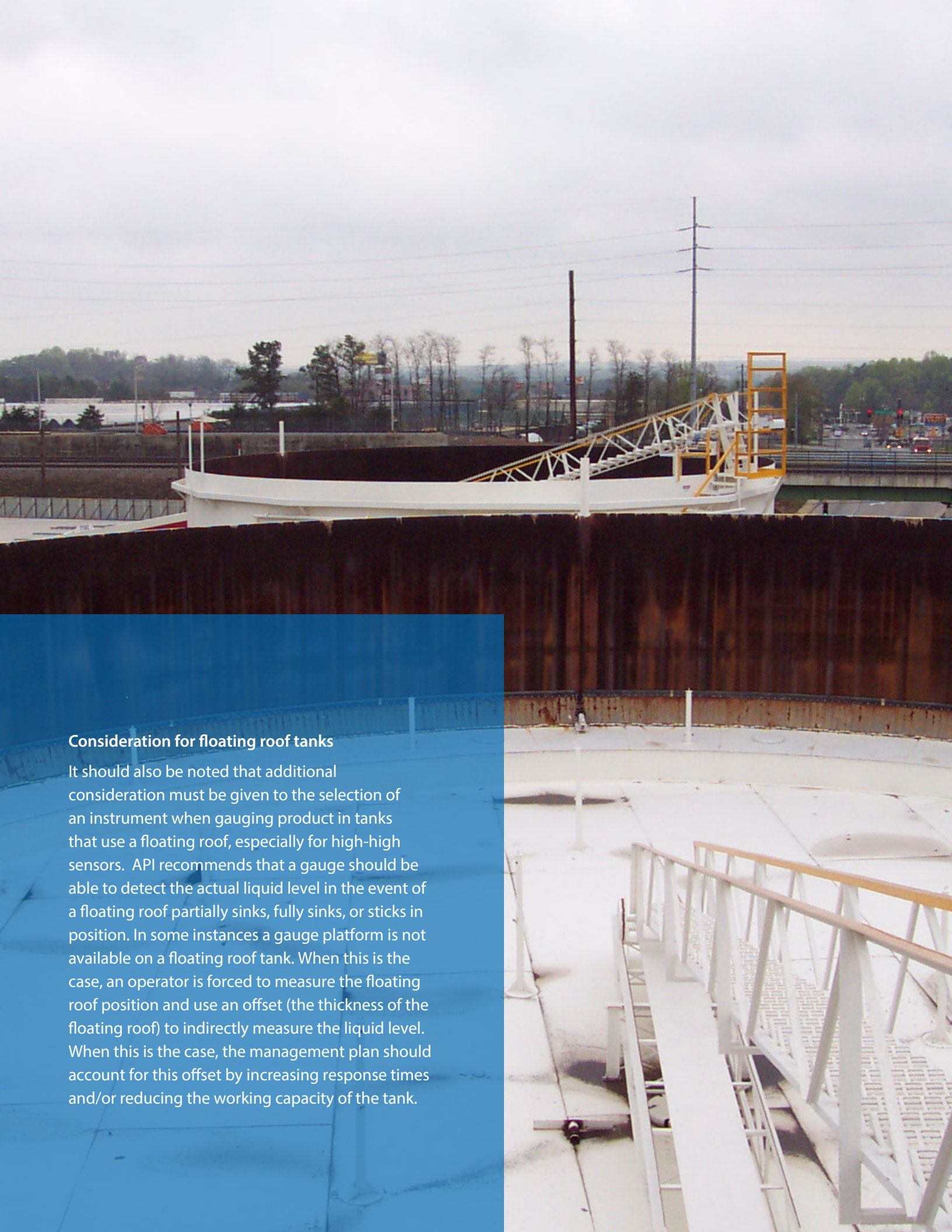
Category 2: Semi-Attended Tanks (Diagrams 3 to 8)– An automatic tank gauging system (ATGS) must be used that transmits level and high-high alarm information to a control room. The control room personnel must be capable of shutting down receipt and fill operations remotely. In addition, the facility personnel must communicate with the transporter, who must also monitor the high-high alarm and be capable of terminating receipt remotely.

Most ATGSs provide alarm outputs via built-in software, mechanical limit switches or electronic relays. These can be used to trigger alarms at the tank side, in the control room, or at the transporter's control room.

Category 3: Unattended Tanks (Diagrams 9, 10, & 11) – A primary ATGS must be used that transmits level (inventory) information to a control room system. An independent ATG monitors the product level for a high-high condition and triggers an alarm, also in the control room. The primary inventory measurement device and the measurement device that triggers high-high level alarms are recommended to operate in real-time and to use a different continuous measurement principle.

An automatic overfill prevention system (AOPS) shall be employed that is triggered by either a high-high condition or failure of the primary ATGS.

The transporter must also the monitor level and the high-high alarm, and must be capable of remotely terminating receipt.



Consideration for floating roof tanks

It should also be noted that additional consideration must be given to the selection of an instrument when gauging product in tanks that use a floating roof, especially for high-high sensors. API recommends that a gauge should be able to detect the actual liquid level in the event of a floating roof partially sinks, fully sinks, or sticks in position. In some instances a gauge platform is not available on a floating roof tank. When this is the case, an operator is forced to measure the floating roof position and use an offset (the thickness of the floating roof) to indirectly measure the liquid level. When this is the case, the management plan should account for this offset by increasing response times and/or reducing the working capacity of the tank.

Historic data from a control room system, such as FuelsManager® can assist in the definition of tank categories, assess response times and estimate risk.

Control Room Systems

The API Standard overlooks the benefits an inventory management system, such as Varec's FuelsManager software, can provide a facility operator. Such a system can provide valuable data for the risk assessment and fulfill direct requirements for the API-recommended management system. For example, historic data can be analyzed and used to define levels of concern (LOCs), assess alarm response times, and assist in process improvement.

When Planning for Receipt

Inventory reports and estimating features (such as FuelsManager's Tank Calculator) can function as planning tools to ensure adequate safety margins and tank space (ullage) before, during, and after receipt, and to estimating fill times. Standard Microsoft role-based security can assist in the definition of duties, chain of command responses, and the assignment of control activities to designated personnel. If a system is also capable of combining custom graphics with outputs from field devices, specific displays could assist an operator in validating the correct valve lineup to ensure product is delivered to the correct tank.

During Receipt

A suitable inventory management system should provide real-time monitoring and alert operators to abnormal conditions, such as deviations between expected product levels and those recorded by the ATGS. A movement-tracking system should be able to track, quantify, and document product transfers, also in real-time. It should do this for all tanks, not just those scheduled to receive product.

After Receipt

Of course, the system should provide detailed reports that help record and report inventories, track movements, and identify discrepancies.

Varec, Inc. Control Room Systems

Example Solutions

There are many ways for the different tank gauging technologies to be applied to this standard and to the individual applications of a particular operator. The following are examples that can be used as reference solutions.

Diagram 1

Float and Tape Tank Gauge Technology

- 6700 Liquid Level Indicator (LLI) measures product level
- 2557 Alarm Limit Switch (ALS) with two (four optional) normally closed switch outputs monitors levels of concern and provides local High-High alarm and alerts (audible and visible)

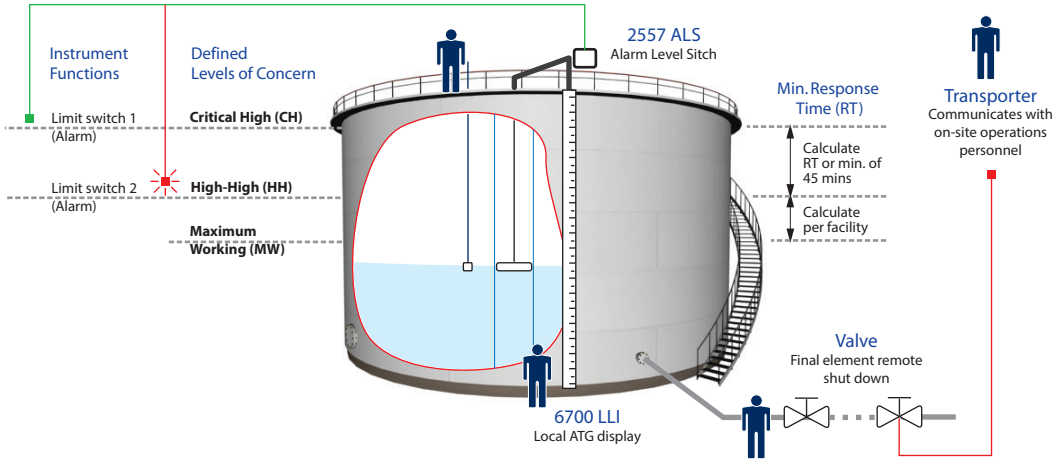
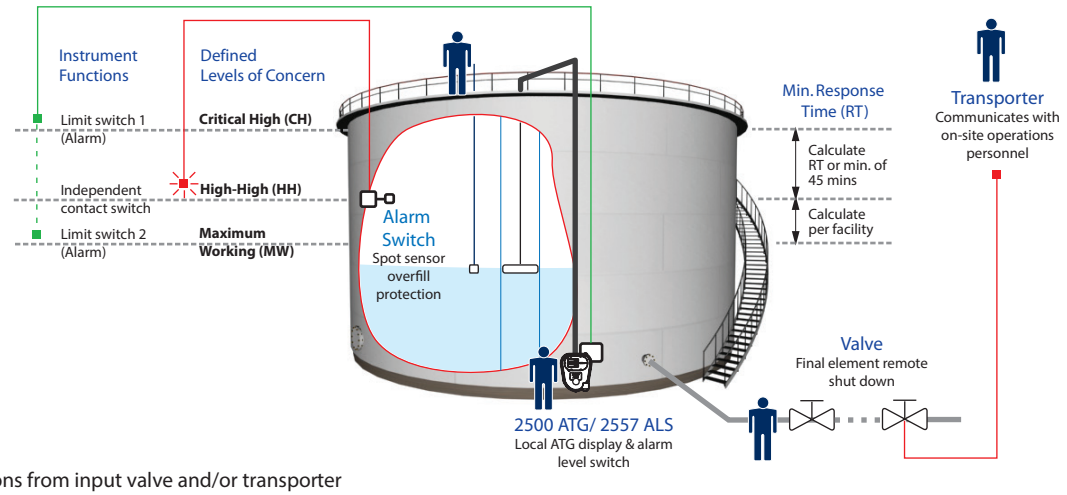


Diagram 2

Float and Tape Tank Gauge Technology

- 2500 Automatic Tank Gauge (ATG) measures product level
- 2557 Alarm Limit Switch (ALS) with two (four optional) normally closed switch outputs monitors levels of concern and provides local alerts (audible and visible)
- Independent Alarm Switch provides High-High alarm overfill protection



General Notes for Category 1 Tanks

- Facility is fully attended
- Able to manually shut down fill operations from input valve and/or transporter
- Manually hand gauge tank 30+ minutes after receipt
- All alarms, alerts and notifications are optional
- Diagrams for illustration purposes only; they do not include ATG system elements, such as on tank temperature and pressure sensors or logic solver systems, such as PLCs.

Diagram 3

Float & Tape Tank Gauge Technology

- 2500 Automatic Tank Gauge (ATG) measures product level
- 8200 Current Output Transmitter (COT) provides up to 4 limit switches for local output of High-High alarm and other levels of concern
- FuelsManager monitors continuous level via transmitter's 4-20 mA output

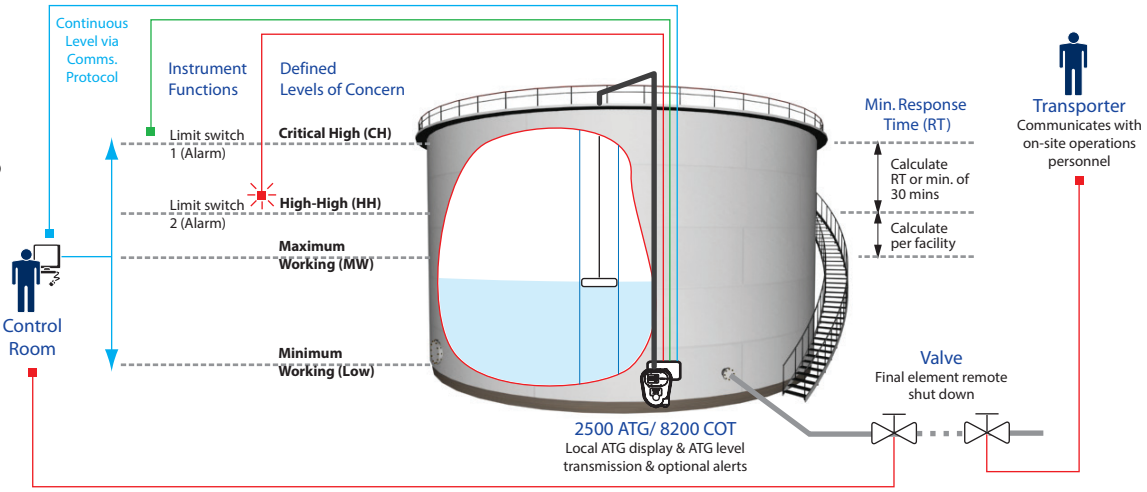


Diagram 4

Servo Tank Gauge Technology

- 6005 Servo Tank Gauge (STG) measures product level and provides dual overfill protection relays for local output of High-High alarm and other levels of concern
- FuelsManager monitors continuous level via STG field communications output (Modbus, Mark/Space, etc.)

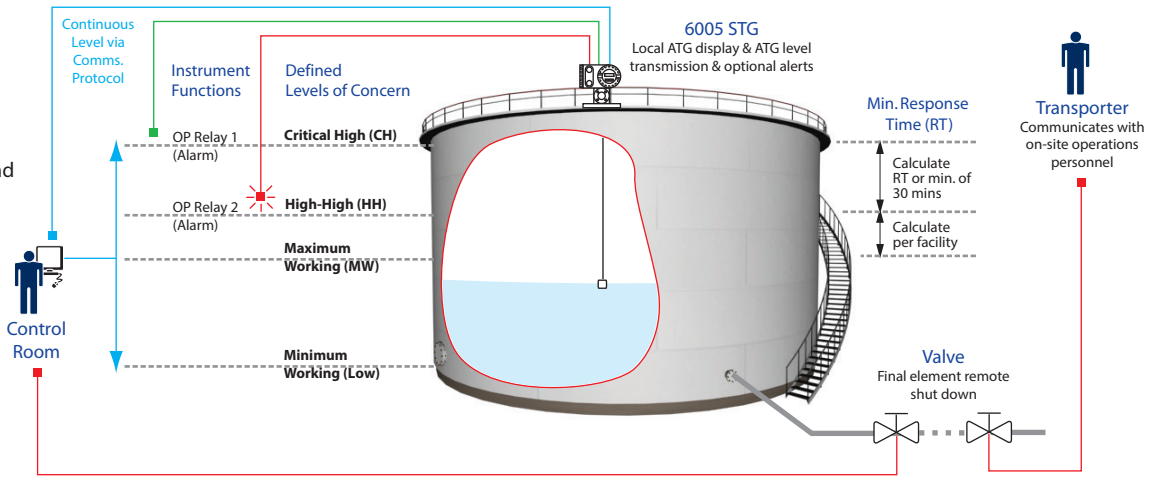
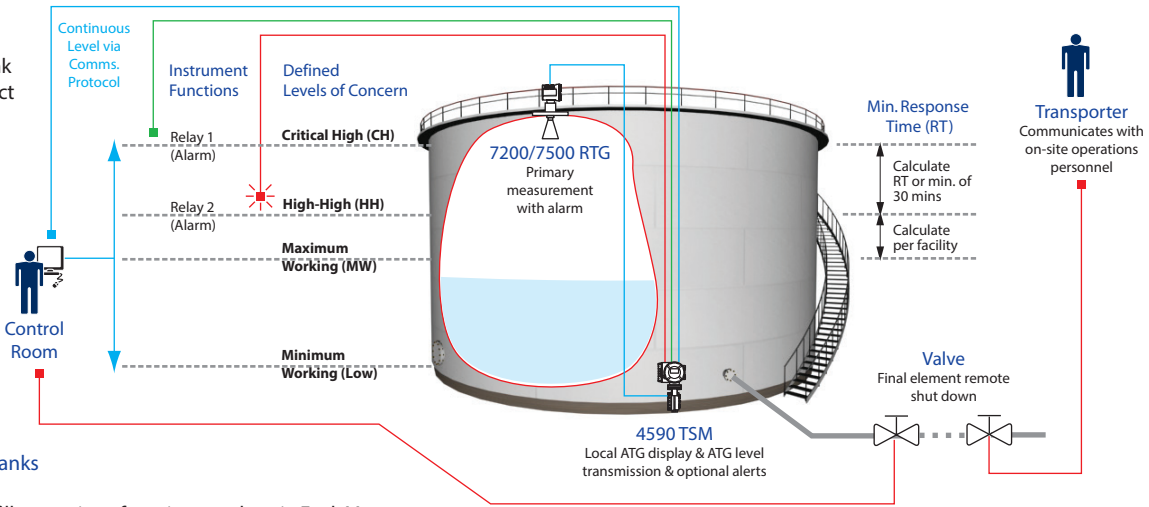


Diagram 5

Radar Tank Gauge Technology

- 7200 or 7500 series Radar Tank Gauge (RTG) measures product level
- Dual relays in the 4590 Tank Side Monitor (TSM) provide local High-High alarm and Critical High notifications
- FuelsManager monitors continuous level via TSM field communications output (Modbus, Mark/Space, etc.)



General Notes for Catagory 2 Tanks

- Facility is fully attended
- Able to remotely shut down fill operations from input valve via FuelsManager system
- Control room and transporter maintain frequent communications
- Diagrams for illustration purposes only; they do not include ATG system elements, such as on tank temperature and pressure sensors or logic solver systems, such as PLCs.

Diagram 6

Float and Tape Tank Gauge Technology

- 2500 Automatic Tank Gauge (ATG) measures product level
- 2920 Float & Tape Transmitter (FTT) transmits level via field comms. protocol (Modbus, Mark/Space, etc.). The AC version provides four software outputs while the AC or DC version provides up to an additional 4 limit switches
- FuelsManager monitors continuous level via FTT field communications output (Modbus, Mark/Space, etc.)
- Transporter monitors limit switch output direct from tank gauge for High-High alarm condition

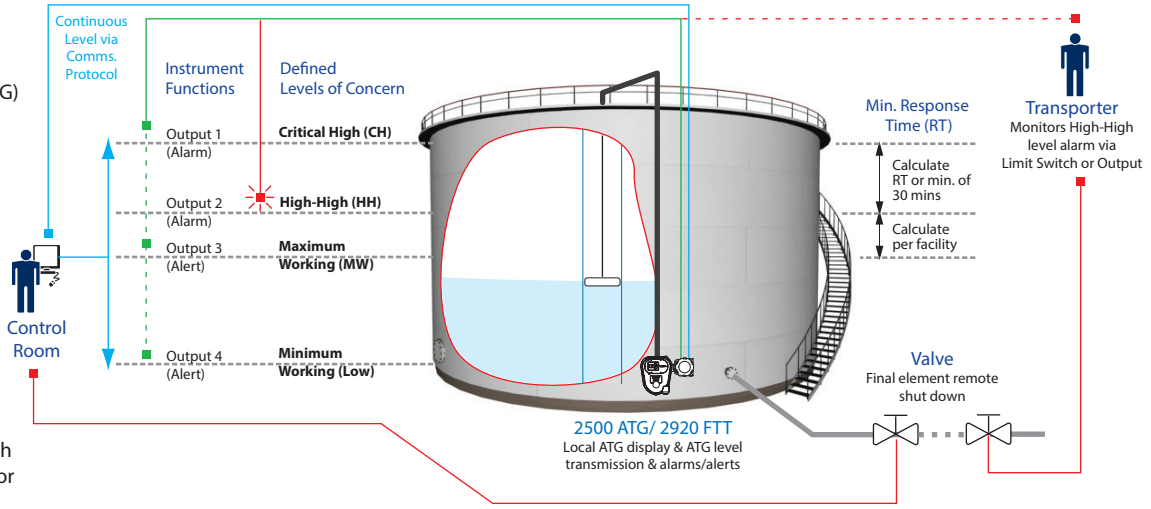


Diagram 7

Servo Tank Gauge Technology

- 6005 Servo Tank Gauge (STG) measures product level and provides four relays for local output of High-High alarm and other levels of concern
- FuelsManager monitors continuous level via STG field communications output (Modbus, Mark/Space, etc.)
- Transporter monitors a separate 4-20 mA output direct from the servo tank gauge for High-High alarm condition

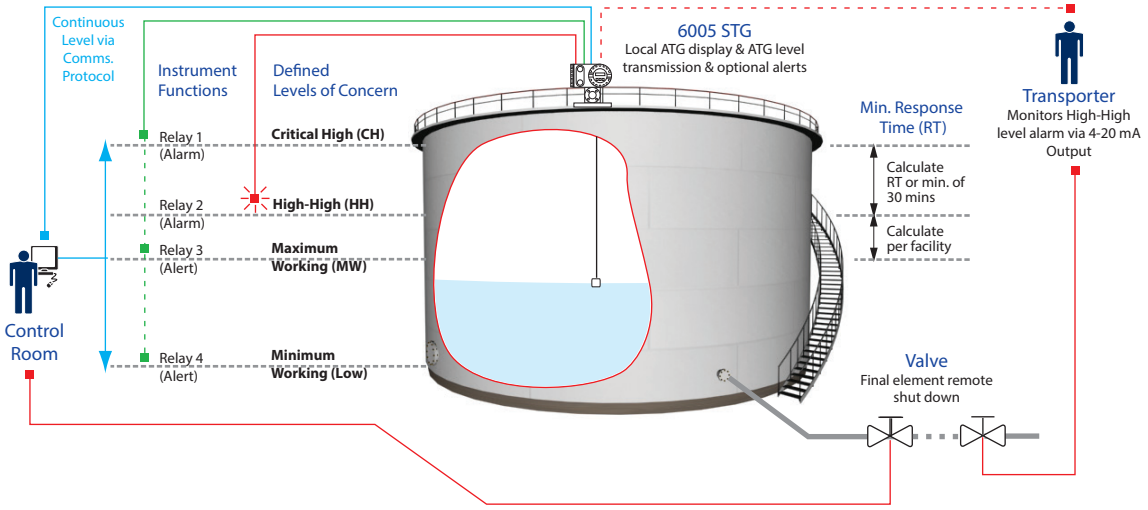
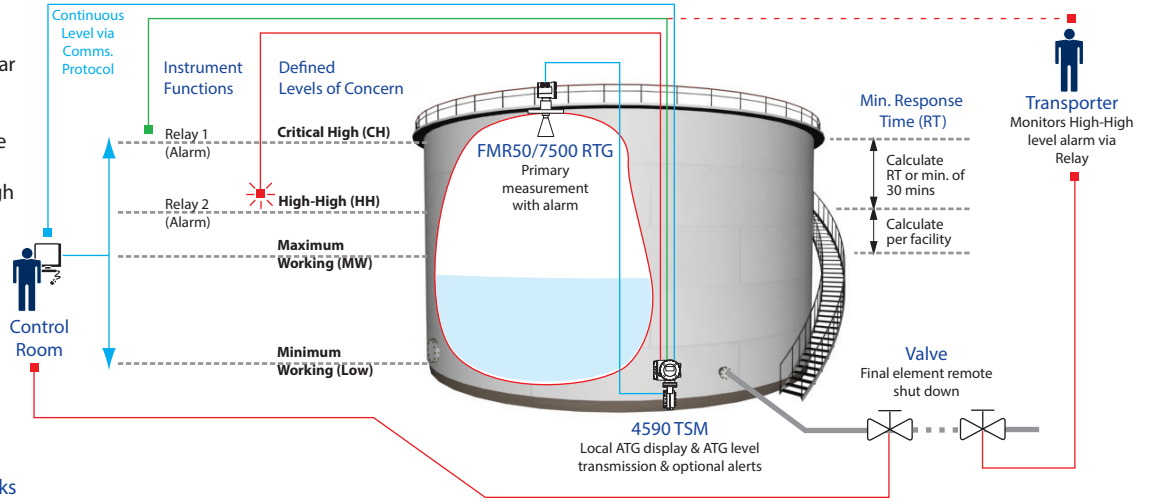


Diagram 8

Radar Tank Gauge Technology

- FMR50 series or 7500 series Radar Tank Gauge (RTG) measures product level
- Dual relays in the 4590 Tank Side Monitor (TSM) provide local High-High alarm and Critical High notifications
- FuelsManager monitors continuous level via TSM field communications output (Modbus, Mark/Space, etc.)
- Transporter monitors Relay output direct from the TSM for High-High alarm condition



General Notes for Category 2 Tanks

- Facility is semi-attended
- Able to remotely shut down fill operations from input valve via FuelsManager system
- Control room and transporter maintain communications as agreed
- Diagrams for illustration purposes only; they do not include ATG system elements, such as on tank temperature and pressure sensors or logic solver systems, such as PLCs.

Diagram 9

Radar/Servo Tank Gauge Technology

- FMR50 series or 7500 series Radar Tank Gauge (RTG) measures product level
- 6005 Servo Tank Gauge (STG) measures product level for overfill, provides a 4-20 mA output for AOPS activation and up to 4 relays for local output of High-High alarm and other levels of concern
- FuelsManager monitors continuous level via TSM field communications output (Modbus, Mark/Space, etc.) and redundant level via STG's 2nd 4-20 mA output and provides system alarm at deviation

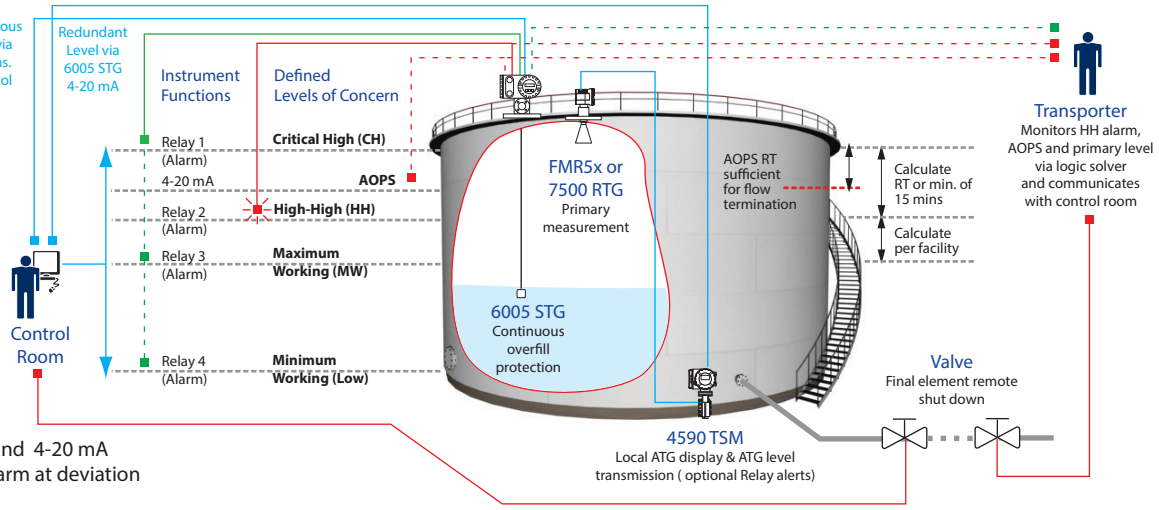


Diagram 10

Float & Tape/Radar Tank Gauge Technology

- 2500 Automatic Tank Gauge (ATG) measures product level
- 2920 Float & Tape Transmitter (FTT) transmits level via field comms. protocol (Modbus, Mark/Space, etc.) The AC version provides four software outputs while the AC or DC version provides up to an additional 4 limit switches
- FMR50 series Radar Tank Gauge (RTG) measures for overfill (AOPS & High-High levels)
- FuelsManager monitors continuous level via FTT, redundant level via logic solver (RTG) and provides system alarm at deviation

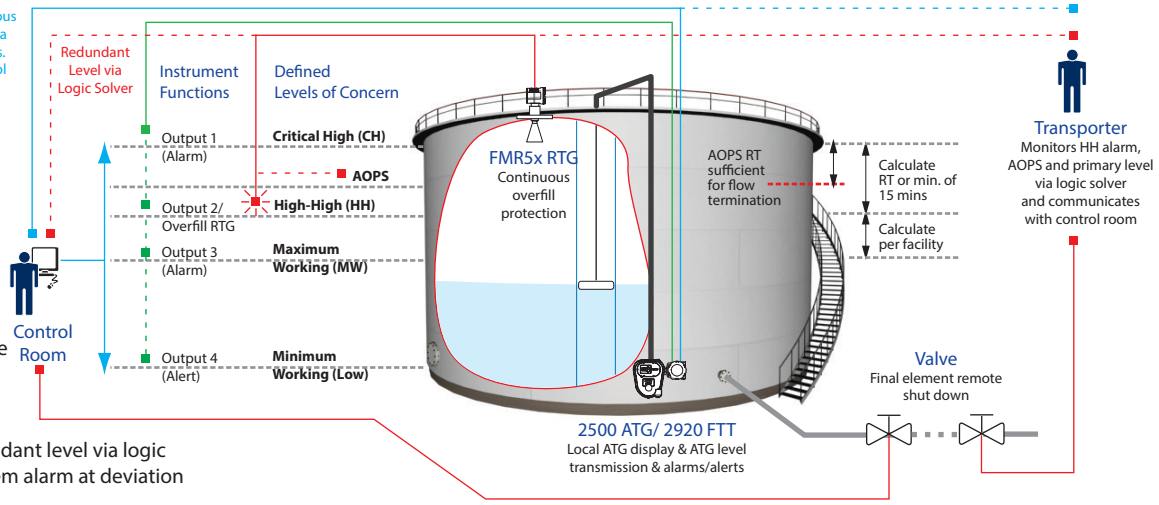
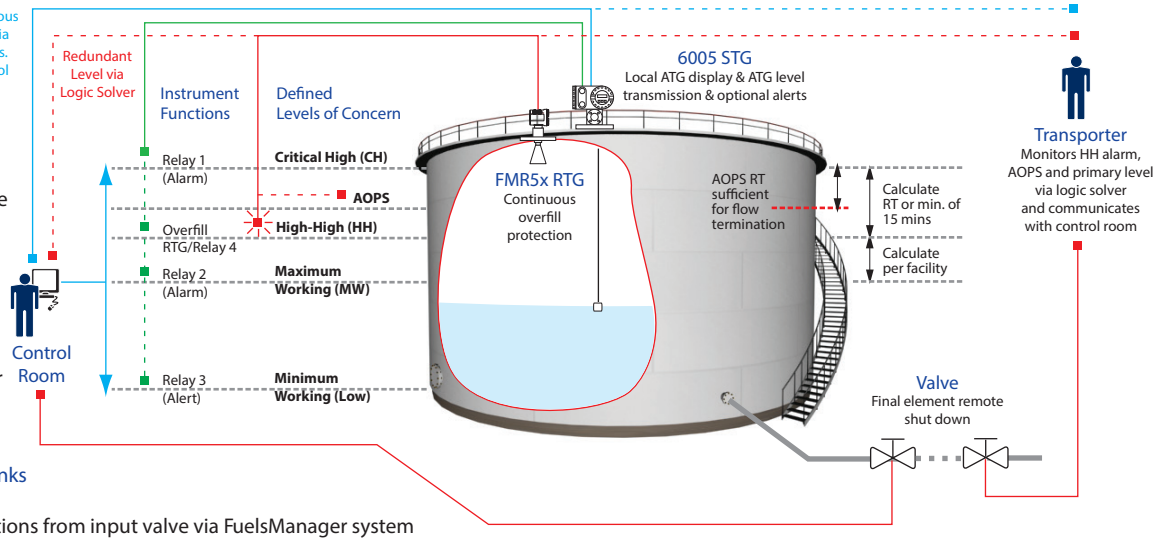


Diagram 11

Servo/Radar Tank Gauge Technology

- 6005 Servo Tank Gauge (STG) measures product level for and provides up to 4 relays for monitoring levels of concern
- FMR50 series Radar Tank Gauge (RTG) measures for overfill (AOPS & High-High levels)
- FuelsManager monitors continuous level via STG field communications output (Modbus, Mark/Space, etc.), redundant level via logic solver (RTG) and provides system alarm at deviation



General Notes for Category 3 Tanks

- Facility is unattended
- Remotely shut down fill operations from input valve via FuelsManager system
- Logic solver relays all High-High, AOPS, and primary level states to transporter
- Control room and transporter maintain communications as agreed
- Diagrams for illustration purposes only, they do not include ATG system elements, such as on tank temperature and pressure sensors or logic solver systems, such as PLCs.

The decision an operator has before them when addressing API Standard 2350 is how to meet the measurement, alarm, redundancy and fail safe requirements through device I/O, systems capabilities and communications.

Summary

API Standard 2350 does not force an owner or operator to re-invest capital in expensive instrumentation and systems. To address the needs of inventory measurement and overfill protection with tank gauging systems (as defined by API Standard 2350), operators must clarify their operational and overfill response procedures for their facility and agree to these with their transporter. They must also identify the tank category based on their unique operations—which LOCs demand automation for alarms and, if required, how they will meet the measurement, alarm, redundancy, and fail safe requirements through existing measurement technologies, device I/O, systems software, and logic solver capabilities.

API Standard 2350 Worksheet

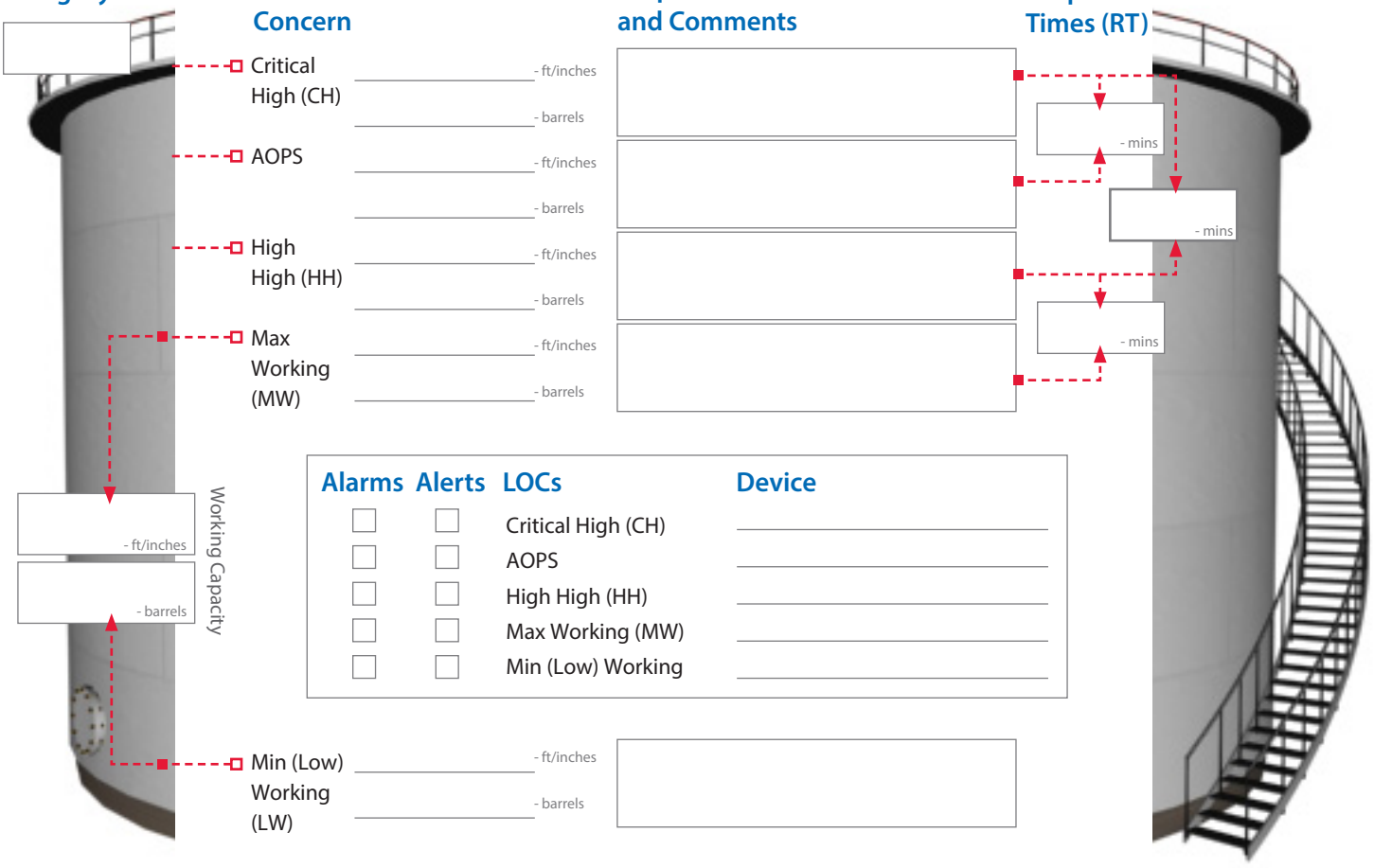
As noted by API, the capacity of a tank depends on the tank type, size, configuration, construction and operational parameters. The following worksheets can be used as a guide to help establish various tank parameters, such as levels of concern, response times and instrument functionality. They are not intended to replace authorized safety documents contained in an OPP or response management plan.

Tank Information

Facility _____ Contact _____

Tank Number _____ Prepared by _____

Location _____ Date _____



Category	Levels of Concern		Require Actions and Comments	Response Times (RT)
	Critical High (CH)	- ft/inches - barrels		- mins
	AOPS	- ft/inches - barrels		- mins
	High High (HH)	- ft/inches - barrels		- mins
	Max Working (MW)	- ft/inches - barrels		
- ft/inches - barrels (Working Capacity)	Min (Low) Working (LW)	- ft/inches - barrels		

Alarms	Alerts	LOCs	Device
☐	☐	Critical High (CH)	
☐	☐	AOPS	
☐	☐	High High (HH)	
☐	☐	Max Working (MW)	
☐	☐	Min (Low) Working	

Receipt Information (HH to CH)

A.	Maximum Fill Rate	- barrels/min	E.	Volume Received (During RT Period)	- barrels
B.	Maximum Response Time	- mins		Safety Factor Determined by facility operator	
C.	Maximum Time to Achieve Total Shutdown	- mins			
D.	Response Time	- mins	F.	Volume (E) Adjusted by Safety Factor	- barrels

Notes

- B = for facility operator or transporter to begin to start shutdown or diversion
- C diversion after facility operator or transporter begins response
- D = B + C
- E = A x D for each simultaneous line flowing to tank
- F = E x SF
- Safety Factor includes maximum measurement error to be determined by facility operator
- Items A-D shall be calculated for all simultaneous incoming sources.
- B and C may be different durations in response to maximum working as compared to High-High.

About Varec

Since its founding in 1928, Varec has been a leading innovator in the petroleum and chemical sectors, delivering automated systems and professional services for tank farm, terminal and refinery operators and owners worldwide. Today, Varec provides completely integrated measurement, control and automation solutions that are specifically designed to ensure safe storage and distribution, track product visibility and provide accurate accounting for the local facility operator to the corporate enterprise. This includes functionality for overfill prevention, facility monitoring and release detection.

About API Standard 2350

To obtain a copy of API Standard 2350 please visit:

http://www.publications.api.org

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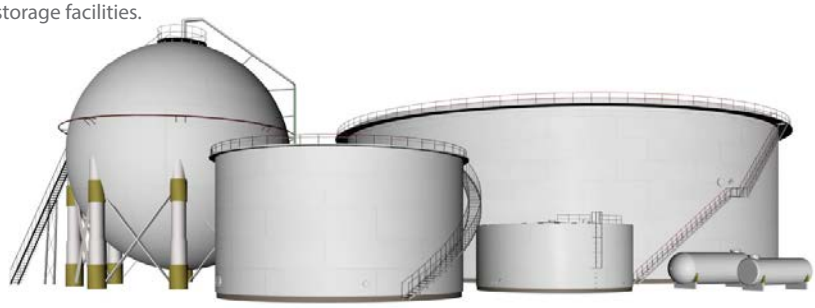

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