

Overfill Prevention for Storage Tanks in Petroleum Facilities

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Overfill Prevention for Atmospheric Storage Tanks in Petroleum Facilities

1 Scope

1.1 Scope

This document applies to atmospheric storage tanks associated with refining, marketing, pipeline, and terminals that contain NFPA Class I or Class II liquids. This standard does not apply to:

- tanks of 1320 US gallons (5000 liters) or less, unless connected to a transporter or marine delivery system;
- tanks that are covered by PEI RP 600;
- tanks filled exclusively from wheeled vehicles (i.e. tank trucks or railroad tank cars), where the fill rate is less than 630 bbl/hr (440 gpm) (100m³/hour);
- dedicated pipeline relief tanks; and
- tanks storing LPG and LNG.

The purpose of this standard is to assist owner/operators and operating personnel in the prevention of tank overfilling by implementation of a comprehensive overfill prevention system (OPS). The goal is to receive product into the intended storage tank without overfilling or mechanical damage.

1.2 Minimum Requirements

This standard is one of minimum requirements. Alternate approaches or variations on the principles of this standard that provide equivalent or more robust overfill prevention are acceptable. Alternate approaches may be needed when the tank system varies from the typical configurations described in this standard. The rationale for the implementation of each overfill prevention process (OPP) should be documented and retained by the owner/operator. This standard is not intended to prevent the use of systems, methods, or devices of equivalent or superior quality, effectiveness, durability, and safety over those provided in this standard. Where the rules in API 2350 conflict with local, state, or federal regulations, the regulations shall take precedence over API 2350. In the event that there are conflicts, the more stringent of API 2350 or the regulations shall be applied.

2 Normative References

The following referenced documents are necessary for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61511¹, *Functional Safety – Safety instrumented systems for the process industry sector – Part 1: Framework definitions, system, hardware, and software requirements* (This document is only classified as normative when chosen as an option by the owner/operator.)

API MPMS Chapter 3.1A, *Standard Practice for the Manual Gauging of Petroleum and Petroleum Products*

API MPMS Chapter 3.1B, *Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging*

Other references in the document, including those in the Bibliography, are provided for information only and are not normative to this standard.

¹ International Electrotechnical Commission, 3 rue de Varembe, PO Box 131, CH-1211 Geneva 20 Switzerland, www.iec.ch.

3 Terms, Definitions, and Acronyms

3.1 Terms and Definitions

For the purposes of this document, the following terms and definitions apply:

3.1.1

abnormal operation

Any operation that is not based on procedures developed for normal operating conditions, including but not limited to operating without normal utility power, operating without the LAH or LAHH alarms as applicable, operating while there are temporary arrangements for the piping, tank, or its instrumentation that are in effect, etc.

3.1.2

alarm

Audible and visual means of indicating an abnormal condition or potential emergency that requires a specific response or action by operating personnel.

3.1.3

alert

Audible or visual notifications indicating an equipment or process condition that requires awareness. Alerts may not require specific action. Alerts may indicate need for investigation or owner/operator-defined action.

3.1.4

atmospheric tank

A storage tank with internal design pressures not more than 17.2 kPa (2½ psig).

3.1.5

attendance

The term describing when personnel are physically on site at the facility where the tanks are located during receiving operations. Personnel on site have the ability to monitor the tank level and either have the ability to terminate the receipt or are in real-time contact with people who have the ability to terminate the receipt.

3.1.5.1

fully-attended facility

A competent person is on site continuously during the entire receipt or transfer of products.

3.1.5.2

semi-attended facility

At a minimum, a competent person is on site during the first and last 30 minutes of the receipt of products or transfer operations (first denoted by the flow of product, last denoted by the termination of flow).

3.1.5.3

unattended facility

A competent person is not required to be on site during any part of a receipt or transfer of products.

3.1.6

authority having jurisdiction (AHJ)

An organization, office, or individuals responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, or procedures.

3.1.7

automated overfill prevention system (AOPS)

An overfill prevention system not requiring operating personnel action in order to function. This system is intended to reduce the potential risk of a manual overfill prevention system failing to prevent overfilling.

3.1.8

automatic tank gauge (ATG)

A mechanical or electronic device designed to continuously measure the liquid level in a storage tank without manual action.

3.1.9**capacity**

The volume (amount) of product contained in a tank at designated levels [i.e. the levels of concern (LOCs)].

3.1.10**Class I liquid**

As defined in NFPA 30, i.e. a liquid that has a flash point below 100 °F (37.8 °C).

3.1.11**Class II liquid**

As defined in NFPA 30, i.e. any liquid that has a flash point at or above 100 °F (37.8 °C) and below 140 °F (60 °C).

3.1.12**competent person**

An individual who is trained, capable, and able to perform the assigned duties as determined by the owner/operator.

3.1.13**continuous level sensor**

A mechanical or electronic level sensor designed to measure the liquid level in a storage tank without personnel action.

3.1.14**control center**

Locally or remotely manned operating center that can monitor, control, and terminate operations at the subject facility.

3.1.15**Critical High (CH) level**

The highest level in the tank that product can reach without detrimental impacts (i.e. product overflow or tank damage).

3.1.16**dedicated relief tank**

A tank that does not store product on a normal basis, but is used to hold product during pipeline pressure relief events.

3.1.17**diagnostic alarm**

Indication that there has been a malfunction of equipment. It applies to any condition affecting the proper operation of instrumentation, control, or alarm systems (including power outages) that requires operating personnel response.

3.1.18**electrically supervised**

OPS instrumentation that is electronically self-checking to indicate when communication between the sensor, logic solver, or final element has failed and can generate a diagnostic alarm.

3.1.19**facility**

A location with tanks within the scope of this standard.

3.1.20**final element**

Block valves, diversion valves, pumps, or other equipment that terminates flow to prevent tank overfilling.

3.1.21**High-High tank level alarm (LAHH)**

An alarm generated when the product level reaches the High-High (HH) tank level.

3.1.22**High-High (HH) tank level**

A level sufficiently below the Critical High (CH) level to enable termination of a receipt or transfer before the Critical High (CH) level is reached.

3.1.23**incident**

An event with undesirable consequences affecting safety, health, the environment, or financial impact to the facility.

3.1.24**independent alarm**

An alarm function separate from the device or system used for routine operational tank level measurement.

3.1.25**level of concern (LOC)**

Calculated product level in a tank that allows the owner/operator to determine appropriate levels to set alerts, alarms, or AOPS functions.

3.1.26**local**

Located or operated on-site at a facility.

3.1.27**manual overfill prevention system (MOPS)**

An overfill prevention system requiring operating personnel to terminate receipt.

3.1.28**marine vessel**

A barge or tanker ship that can deliver product directly into petroleum facility tanks (usually through temporary connections to facility pipelines).

3.1.29**maximum fill rate (in./hr)**

The rate of liquid level rise in the tank at the maximum flow rate, excluding outflow from the tank.

3.1.30**maximum flow rate (bbl/hr)**

The highest volumetric rate at which product can enter a tank at the same time from various sources.

3.1.31**maximum working level**

An operational level that is the highest product level to which the tank is routinely filled during normal operations.

3.1.32**monitored**

The observation of tank levels, alarms, flow rates, etc. during a receipt or transfer activity. The term describing the type of tank gauging and degree of observation of tank operations. The activity of monitoring can be local or remote.

3.1.32.1**continuously monitored**

A tank fitted with an automatic tank gauging system with real-time transmission of operational information and/or alarms to a control center that is manned 24 hours per day, 7 days per week.

3.1.32.2**fully monitored**

A tank fitted with an automatic tank gauging system with real-time transmission of operational information and/or alarms to a control center that is manned during the entire receipt period.

3.1.32.3**semi-monitored**

A tank fitted with an automatic tank gauging system with real-time transmission of operational information and/or alarms to a control center where tank alarms are monitored during the first and last 30 minutes of the receipt.

3.1.32.4**locally monitored**

A tank without signal transmission to a control center.

3.1.33**operating personnel**

The person who manages tank receipt or dispatch operations; whether located at a facility, local or remote control center, operating personnel are available, have access to equipment and controls, and are competent to respond to notifications, alerts, alarms, and abnormal conditions pertaining to receipt operations at a facility.

3.1.34**overfill**

Any product level that exceeds the critical high (CH) level.

3.1.35**overfill prevention system (OPS)**

An engineered system consisting of the physical equipment and procedures to ensure that safeguards directed at effectively receiving products and minimizing the potential for tank overfills are incorporated.

3.1.36**owner/operator**

The company that owns and/or operates the facility.

3.1.37**parallel tanks**

Two or more tanks at the same facility that can be filled simultaneously and effectively operated as one tank.

3.1.38**person in charge (PIC)**

A U.S. Coast Guard regulatory term from 33 *CFR* 154.700 for a trained and experienced individual designated as a "person in charge" of transfer operations at marine terminals.

3.1.39**product**

Class I or Class II liquids as defined by NFPA 30.

3.1.40**proof testing**

A partial or complete overfill prevention system instrumentation loop test through the primary sensing element verifying appropriate response from sensors to the final control element, including alarms to the extent possible.

3.1.41**receipt**

A delivery or transfer of product into a tank.

3.1.42**response time**

The time required to complete a set of actions to terminate a receipt.

3.1.43**risk analysis**

An estimate of likelihood and consequences in order to assess the degree of risk.

3.1.44**risk assessment**

Overall process of risk analysis and risk evaluation.

3.1.45**risk screening**

Often, a first step in the risk analysis process. An activity used to prioritize risk assessment activities typically by assigning weighting factors to provide a relative risk ranking.

3.1.46**supervisory control and data acquisition system (SCADA)**

A computer-based system or systems used by a controller in a control room that collects and displays information about a facility and could have the ability to send commands back to a remote facility.

3.1.47**sensors**

Continuous or point type product level sensing elements that detect and measure physical properties of the media in which it is installed to trigger alarms, alerts, and shutdown and diversion actions.

3.1.48**terminal**

An owner/operator or third-party facility with tanks that receive, ship, dispense, or transfer product.

3.1.49**terminate**

Stopping or redirecting receipt flow to prevent flow of excess product into a tank. Examples include:

- a) eliminating the source of pressure, e.g. shutting down a pump;
- b) diverting the incoming flow;
- c) shutting down the flow (closing a receipt valve); or
- d) using an alternative method for bringing the receipt process to a safe state without overfilling the tank.

3.1.50**transporter**

The person(s)/organization responsible for delivering the product to/from either a refinery, marine, terminal, or pipeline organization.

3.1.51**valve lineup**

The practice of opening or closing valves in the system to ensure that product is directed to the intended tank(s) and not diverted to incorrect tank(s).

3.1.52**watchdog timer (WDT)**

An external or internal diagnostic device that monitors the health of an electronic system and performs a specific operation after a certain period of time if something goes wrong with an electronic system and the system does not recover on its own.

3.1.53**wet probe test**

Sensor test by simulation of overfill by exposure of a sensor to a liquid (water or hydrocarbon) to verify alarm and/or control system functionality.

3.2 Acronyms

AHJ	authority having jurisdiction
AOPS	automated overfill prevention system

ATG	automatic tank gauge
CH	Critical High
HH	High-High tank level
LAHH	High-High tank level alarm
LNG	liquified natural gas
LOC	level of concern
LOPA	layer of protection analysis
LPG	liquified petroleum gas
MOC	management of change
MOPS	manual overfill prevention system
MW	maximum working level
OPS	overfill prevention system
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIC	person in charge
PLC	programmable logic controller
SCADA	supervisory control and data acquisition system
SIS	safety instrumented system
WDT	watchdog timer

4 Overfill Prevention System (OPS)

4.1 Overview

The likelihood and the associated consequences of overfilling a tank vary from one facility to another and even between tanks within a facility. Prevention of tank overfills requires taking into account the following factors:

- awareness and calculation of available tank capacity and inventory;
- careful monitoring and control of product movement and tank level during filling;
- use of reliable instrumentation, sensors, and systems;
- use of human response to manually initiate the termination of flow (MOPS);
- use of automatic tank gauging systems, independent high-level alarms, etc. to address the gaps arising from a risk assessment and risk analysis; and
- use of automated response systems to automatically terminate the flow (AOPS), where appropriate.

Consequently, a comprehensive and flexible approach to overfill prevention is provided in this document. Careful consideration was given to the benefits provided by overfill prevention for tanks in petroleum facilities relative to:

- safety and environmental protection;
- optimization of the workplace and operating practices;
- inspection, testing, and maintenance;
- equipment and system selection and installation;
- safe work practices, emergency procedures, and training;
- management of change programs relative to tank overfill prevention;
- inclusion of current technology and practices related to process control and automated safety instrumented systems.

This allows the owner/operator of each facility to assess the risks and implement appropriate facility-specific or tank-specific practices to prevent tank overfills.

The OPS consists of several fundamental components:

- a) management system;
- b) risk assessment process;
- c) operational parameters;
- d) procedures (including those for receipt termination) and training; and
- e) equipment supporting OPS and its inspection, testing, and maintenance.

4.2 Requirements for the Management System

A management system is the framework of administrative processes and procedures used to enable the owner/operator to fulfill the tasks required to prevent an overfill. A management system is required and shall be documented for conformance with API 2350, but this standard does not specify how to implement nor document such a system. This management system may be integrated with existing safety or environmental procedures or be developed as a stand-alone system. This task is the responsibility of the owner/operator. A properly structured management system provides all the practices and components required for a good OPS and is managed and periodically assessed and updated to keep practices current as people and equipment change. API RP 1173, *Pipeline Safety Management Systems*, provides some guidance on management systems.

At a minimum, the management system shall address:

- a) formal documented operating procedures and practices, including safety and emergency response procedures;
- b) competency of operating and maintenance personnel;
- c) functional equipment systems, tested and maintained by competent personnel;
- d) scheduled inspection and maintenance programs for overfill instrumentation and equipment;
- e) systems and procedures to address both normal and abnormal operating conditions;
- f) management of change (MOC) process that includes personnel and equipment changes;
- g) system to identify, investigate, and communicate overfill near-misses and incidents;
- h) system to share lessons learned;
- i) follow-up system to address any needed mitigation of circumstances leading to near-misses or incidents;

- j) communication systems protocols within the owner/operator organization and between the transporter and the owner/operator that are designed to function under abnormal as well as normal conditions; and
- k) periodic review and updating of management system for continuous improvement.

4.3 Requirements for Risk Assessment

Risk assessment for each tank subject to overfill shall be performed by the owner/operator. Risk assessment methods and procedures may conform to the owner/operator's procedures. This standard does not specify how risk assessments should be conducted (e.g. qualitative or semi-quantitative, including LOPA), because tank operations, associated risks, corporate risk assessment knowledge, and methods vary widely, and risk tolerance is site- and owner/operator-specific.

The owner/operator shall utilize the requirements in 5.2 where the categories (found in Annex G) are used with the associated response times found in 4.4.23 until a risk assessment is undertaken. For a tank that does not fit into a category, the owner/operator shall default to the next more conservative applicable category.

Personnel who are familiar with the site-specific tank facilities and operations, personnel familiar with the risk assessment methodology, and personnel who are familiar with impacts to and from the transporter should participate in these analyses.

Procedures for performing risk assessments on tank systems subject to overfills should be developed and implemented for use in OPS. These may be either qualitative or quantitative. Annex E provides a conceptual overview for a risk assessment program.

To assess the risk of overfill, the operating procedures and associated instrumentation described in this document and their effectiveness should be evaluated, including:

- a) consequences of overfill;
- b) operation conditions (max flow rates, number of receipt lines operating at one time to fill tanks);
- c) procedures for pre-receipt activities;
- d) procedures for activities during receipt;
- e) procedures for emergencies, i.e. alarm response;
- f) design, testing, operation, and maintenance of instrumentation systems;
- g) design and maintenance of OPS.

When a risk assessment shows the acceptance criteria are not satisfied, further risk reduction through additional safeguards including layers of protection (e.g. additional level instruments and procedures) and changes in operations and procedures shall be provided to meet the acceptance criteria. AOPS may provide additional risk reduction; however, it is important to consider the potential for hydraulic surge.

Documentation of risk assessment(s) should include a description of the methods and procedures used to perform the assessment, including:

- risk assessment methodology;
- determination of risk, risk mitigation, and risk acceptability;
- team members and their expertise;
- probability and consequence factors and their evaluation, including calculations, to determine risk;
- basis for the assessment, including assumptions, data sources, and data analysis;

- owner/operator risk criteria.

Risk assessments should be reviewed when changes occur to a tank, facility, or surrounding areas that affect the overfill risk. Risk assessment results shall be reviewed and updated at least every 10 years.

4.4 Defining Operating Parameters

Operational parameters govern the establishment and setting of LOCs in addition to the determination of appropriate response times for operations. The following procedures may be used to establish operational parameters:

4.4.1 Establish Levels of Concern (LOCs)

The owner/operator shall establish and document the following levels of concern (LOCs) (see Figure 1) that are applicable for tanks covered by this standard:

- critical high (CH) level;
- AOPS activation level (if equipped with an AOPS);
- high-high (HH) level;
- high (H) level (optional); and
- maximum working (MW) level.

Establishing LOCs should take into account the equipment and ability to respond to alerts and alarms. In addition, the tank strapping table (whether hard copy or electronic) shall be accurate and current when calculating the response time. When determining a response time, the response time calculation shall include the factors discussed in 4.4.2. Once this response time-volume (response time – maximum flow rate) is calculated, a tank calibration table or equivalent calculation method shall be used to determine the vertical distance in the tank corresponding to that time-volume.

Special cases exist, such as:

- tanks used for pipeline relief (relief tanks) in addition to their normal product use. Non-dedicated relief tanks shall maintain the proper amount of free volume in the tank based on the anticipated relief event and associated capacity. When determining LOCs, the required relief volume should be taken into account between maximum working level and high-high (HH) level, or in some other way as defined by the owner/operator;
- tanks being operated in parallel or at different heights or elevations. One tank may be “full” (reached its overfill level) before the other(s);
- tanks may not fill at the same rate, e.g. if you are relying on a gauge from one tank to cover multiple tanks.

Operating personnel shall be notified of these LOCs through an operating practice developed by the owner/operator. The LOCs shall be available and displayed so that they are visible to the personnel responsible for filling the tank, i.e. near the manual gauge hatch, tank gauging equipment, at the bottom of the tank, and be available at the control center.

Tanks that have had major repairs or have had significant settlement since the last calibration shall be recalibrated.

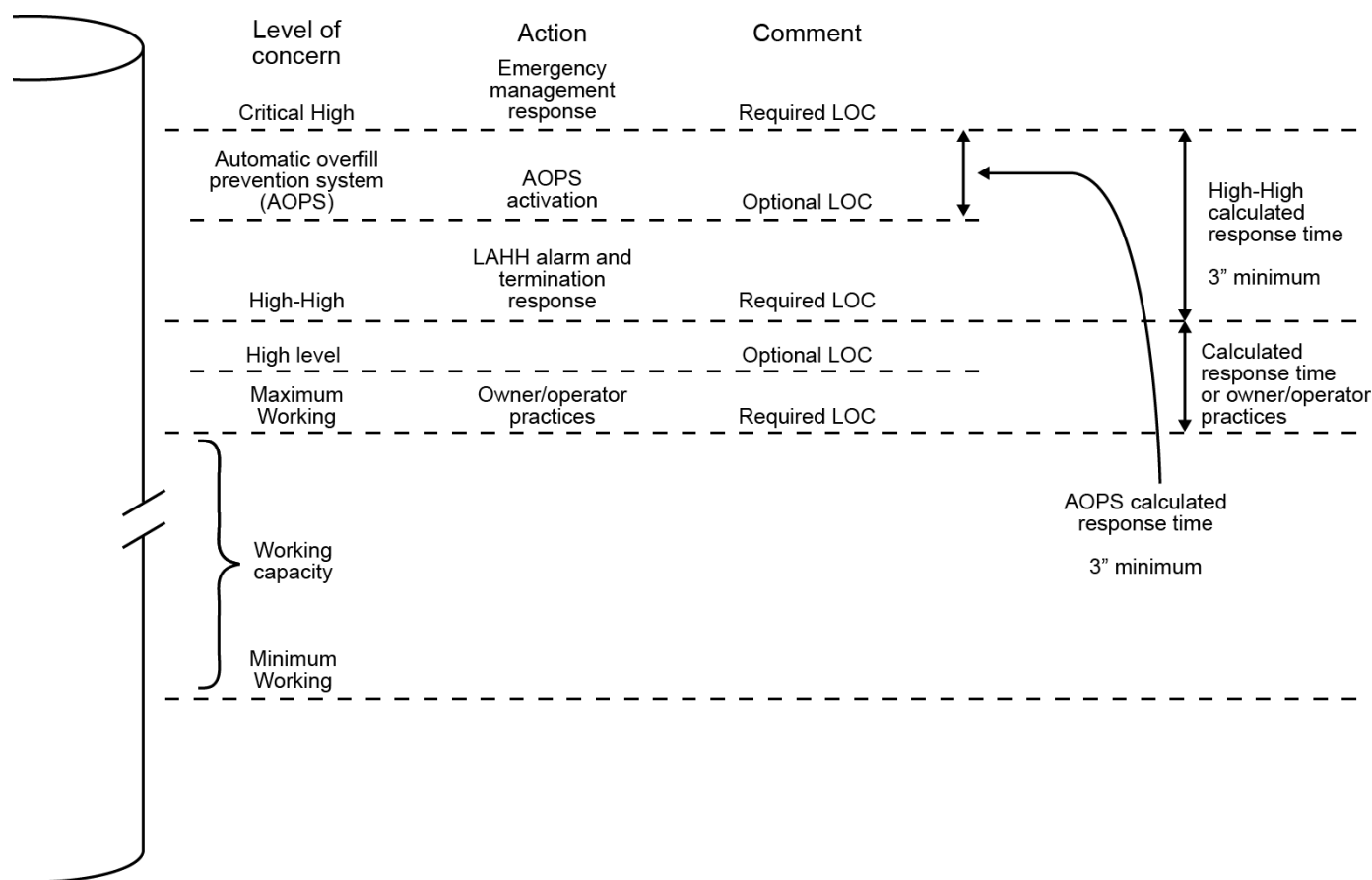


Figure 1—Tank Levels of Concern (LOCs)

NOTE In previous editions of this standard, a high-level alarm was utilized as a required LOC. Starting with the 4th edition, a LAH is not required. If used, an LAH may be applied as an alert or alarm. When used as an alert, no requirements of this standard apply. When used as an alarm, all appropriate requirements of this standard apply. The term "high-high (HH) level" is still used as the priority LOC where an alarm should be established to initiate immediate shutdown of filling operations (which reflects industry practice).

4.4.1.1 Critical High (CH) Level

The critical high (CH) level is the highest level in the tank without detrimental impacts, such as:

- overflow of product;
- exceedance of the allowable tank shell design stresses;
- leakage from a corroded area or temporary repair; or
- level designated by the owner/operator, considering:
 - mechanical contact of the floating roof, floating roof seals, floating roof legs, foam chamber deflectors or foam dams, or other appurtenances with the tank roof or platform/ladder structure;
 - seals rise to a level where they are in contact with vents or top of the tank shell.

NOTE Potential detrimental impacts are variable and resulting levels are determined by owner/operator evaluation. Depending on the structural design and geometry of floating and fixed roofs, experience shows some configurations may allow an overfill with minimization of structural damage to the fixed roof or loss of the internal floating roof; whereas, location of certain obstructions have caused damage to the fixed roof and/or caused the internal floating roof to sink without resulting in an overfill. Loss of the floating roof is a critical fire safety situation. Likewise, shell integrity may need to be evaluated by an engineer experienced with storage tank design.

4.4.1.2 AOPS Activation Level

The AOPS activation level is the level at which an automated system, if applicable, terminates the flow into a tank or changes the system state to a safe condition before the Critical High (CH) level is reached.

- The level shall be set sufficiently below the Critical High (CH) level to account for the response time of the AOPS system to activate and terminate flow. The difference between the CH and AOPS activation levels shall not be less than 3 inches.
- The AOPS activation level shall be set at or above the High-High (HH) tank level. However, it may be preferable to have the AOPS set above the High-High (HH) tank level in order to provide additional overfill prevention through a manual overfill prevention system (MOPS) where operating personnel can terminate the receipt prior to the AOPS activation.

4.4.1.3 High-High (HH) Tank Level

The High-High (HH) tank level is the last opportunity for the operator to terminate the flow to prevent an overfill or damage to the tank.

- The HH tank level shall be set sufficiently below the CH level to enable operator action to terminate product receipt before the CH level is reached.
- The vertical distance in the tank between the Critical High (CH) level and the High-High (HH) level shall be calculated based on the response times required to terminate a receipt at the maximum fill rate, but shall not be less than 3 inches.
- The response time used in these calculations should include the factors discussed in 4.4.2. Once this response time-volume (response time $\times$ maximum flow rate) is calculated, a tank calibration table or equivalent calculation method shall be used to determine the vertical distance in the tank corresponding to that time-volume.
- In addition to the response time, the owner/operator shall include adequate space to accommodate:
 - relief volume that may occur, where applicable;
 - drain-back volume to the tank due to line elevation, in the case of communication failure or valve malfunction;
 - excess volume of the taller of two parallel tanks; and
 - safety factor(s), if applicable.

Filling past the Maximum Working (MW) level is only allowed with written authorization on a case-by-case basis. Product levels reaching the High-High (HH) tank level should be lowered as soon as practical to the Maximum Working (MW) level.

Policies and procedures shall prohibit the use of High-High tank level alarms and AOPS for routine operation or control of tank-filling operations.

4.4.1.4 High (H) Level (optional)

The High (H) level may be used as a LOC alert at a point lower than the actual High-High alarm or AOPS.

4.4.1.5 Maximum Working (MW) Level

No alarm is required at the Maximum Working (MW) level, but alerts may be established by the owner/operator to aid operations.

The MW level is set at a distance below the High-High (HH) level alarm or the High (H) level alarm (if used) on the tank based either on response time or owner/operator practices.

The MW level should be 3 inches (76 mm) below the High-High (HH) level alarm or a larger calculated level that accounts for thermal expansion or other conditions that can inadvertently activate the High-High (HH) level alarm.

4.4.2 Response Time (RT)

Response times shall be calculated and evaluated when determining the levels described above.

Factors that shall be evaluated when establishing the response time include:

- a) time required to initiate the alarm (electronically or by manual observation of tank gauge);
- b) time to validate alarm (avoid inappropriate response to false alarms);
- c) time required to complete predefined response actions and terminate flow;
- d) time required to verify that system elements are responding appropriately and take appropriate action if the system is not responding properly; and
- e) owner/operator-defined safety factor;
- f) other factors to consider, including:
 - time for communications;
 - travel requirements;
 - equipment action;
 - staffing variations;
 - seasonal weather conditions.

4.4.2.1 Response times between Maximum Working (MW) and High-High (HH) may be different than the response time between High-High and Critical High depending on the different actions required between the levels.

4.4.2.2 Response times less than 10 minutes between the High-High (HH) and Critical High (CH) levels of concern shall be validated by a physical walk-through of the factors outlined in 4.4.2 that is timed and documented. Actual validated response times can be shorter than those given in 4.4.2.3.

4.4.2.3 Until response times are validated by the owner/operator, the minimum response times between Maximum Working/High-High levels and High-High/Critical High levels shall be, as shown in Table 1:

Tank Category	Minimum Response Time
0	60 minutes
1	45 minutes
2	30 minutes
3	15 minutes

Table 1—Minimum High-High (HH) Response Time

4.4.3 Level of Concern (LOC) Changes and Periodic Reviews

4.4.3.1 General

LOCs shall be reviewed at an interval determined by the owner/operator. Any revised LOCs shall be documented, communicated to all affected personnel, and implemented.

4.4.3.2 Physical Conditions or Changes Warranting Level-of-concern Review

A LOC review shall be conducted and documented for a new tank or when there are any physical changes to a tank, such as:

- changes to floating roof leg heights;

- change in floating roof seal dimensions;
- change in shell height (shell reduction or extensions);
- installation of geodesic domes or other fixed roofs (e.g. when external floating roof tanks receive retrofit covers);
- new internal or external floating roofs;
- side vent changes;
- new tank bottom or datum plate;
- addition of ancillary equipment (i.e. foam chambers);
- change in datum, strike plate, or gauge reference point, e.g. addition of gauge tube with datum; and
- modifications to the tank-strapping charts/gauge tables, such as new overflow height, floating roof critical zones.

4.4.3.3 Operational Changes Warranting Level-of-Concern Review

A LOC review and documentation shall be required whenever any of the following changes occur:

- change in incoming or outgoing piping;
- change in product to one with different density or viscosity;
- change in maximum flow rates;
- adjustments to LOCs due to tank inspection findings (corrosion, temporary repairs);
- change in operations (e.g. parallel tank, floating or high suction, continuous mixer operation);
- any other changes, such as settlement, repairs such as a double bottom, or other changes that affect the LOCs;
- change in ownership/operating control (e.g. acquisition); and
- change in response time resulting from adjustments in available personnel, accessibility, operation, or equipment changes.

4.5 Requirements for Overfill Prevention System (OPS) Procedures

4.5.1 Procedures for Operations

Documented operating procedures shall be established by the owner/operator and (where appropriate) coordinated with and agreed to by the transporter (refer to Annex F on transporter/owner/operator interface). The documented operating procedures shall be reviewed on the owner/operator's requirements and revised or amended as the facility equipment, procedures, process, or personnel change.

Because the flow rate, equipment, instrumentation, tank configuration, and type of transporter can differ at a facility for each receipt, one set of general operating procedures typically cannot be used for all receipts. Therefore, owner/operators shall prepare documented operating procedures for each type of receipt. This standard does not preclude the use of common procedures for receipts or transfers where the factors are common.

Procedures require planning that determines:

- a) the quantity of product to be received;
- b) single or multiple receiving tanks;
- c) maximum pressure allowed for the piping or equipment at the receiving facility;

- d) receipt starting level, flow rate (including any expected variations), and receipt end time;
- e) the amount of volume or space available in each tank, and any expected volume expansion, e.g. product temperature rise in the tank(s), or other receipts or activities;
- f) valve lineup;
- g) other simultaneous tank activities at the facility;
- h) whether (and when) a switch in receiving tanks is needed;
- i) who is responsible for monitoring and/or attending the receipt;
- j) who is responsible for terminating the receipt.

Specific procedures vary depending upon:

- a) transfer quantity, e.g. single truck unloading vs. transfers from a significantly larger tank;
- b) flow rates into and out of the tank;
- c) mode of transfer, e.g. pipeline, rail, marine, or truck;
- d) tank gauging and instrumentation equipment; and
- e) interaction with the transporter.

The requirements in the following sections shall be included in the pertinent, normal tank receipt and transfer procedures for all tanks.

4.5.1.1 Procedures for Planning the Receipt

4.5.1.1.1 Specific documented instructions for the receipt shall be prepared and reviewed (as appropriate) with personnel from the transporter and owner/operators. These instructions shall list specific procedures and any special controls needed to carry out the receipts.

More complicated operations requiring extra attention when creating procedures include:

- a) switching receiving tanks during the same receipt;
- b) multiple tanks being filled simultaneously;
- c) a tank receiving product from multiple sources; or
- d) abnormal operations.

4.5.1.1.2 Prior to receipt, product quantities to be received shall have been determined and compared to receiving tank available capacity to ensure that sufficient tank capacity is available. Planning shall be conducted sufficiently ahead of receipt to minimize the need for last-minute product transfers or withdrawals from a designated receiving tank prior to receipt.

4.5.1.1.3 The planned final product level in each tank shall be determined prior to each scheduled receipt and shall not exceed the Maximum Working level without written authorization. In no case shall receipt procedures be planned to reach the High-High (HH) level alarm or AOPS.

4.5.1.1.4 The owner/operator shall assign required duties to competent personnel before the start of the receipt (or duties may be documented as normal duties of a particular designated job).

4.5.1.2 Procedures for Pre-Receipt Activities

4.5.1.2.1 Prior to product receipt or transfer, the available volume in the receiving tank(s) shall be verified and compared to the planned receipt volume and deliveries out of the tank, i.e. truck loading operations. If the planned receipt volume exceeds the available receipt volume, the transporter shall be contacted and plans adjusted.

4.5.1.2.2 The pre-receipt information that is recorded for the tank shall be available to the transporter. The minimum information shared between the transporter and the tank owner/operator includes:

- a) planned receipt volume;
- b) planned receipt start time and expected receipt end time; and
- c) expected flow rate, including any variations.

4.5.1.2.3 Before the product is transferred or received, the valve lineup shall be verified to confirm the product is delivered into the designated tank(s) and that only the intended valves are open and the valves for other tanks are closed.

4.5.1.2.4 Prior to starting product transfer to fully- or semi-attended facilities, communications between the transporter and the facility owner/operator shall be tested. Based on staffing and instrumentation, communication frequency between the facility owner/operator and the transporter shall be agreed upon and maintained throughout the transfer. See Table G.1 in Annex G for an example of attendance and communication.

4.5.1.2.5 Prior to starting product transfer to unattended facilities, the owner/operator shall ensure that electronic supervision is not indicating a diagnostic alarm.

4.5.1.3 Procedures for Activities During Receipt

4.5.1.3.1 Regularly scheduled monitoring of product levels during receipts shall be required and documented.

4.5.1.3.2 Regularly scheduled comparisons (planned vs. actual) and recording of the following information shall be made during the receipt:

- a) tank(s) involved in the receipt or transfer;
- b) receipt or transfer fill rate;
- c) remaining receipt or transfer volume(s);
- d) remaining tank volume(s); and
- e) estimated time of receipt or transfer completion.

4.5.1.3.3 Tanks that are connected to the same product manifold, but that are not scheduled to receive product, shall be monitored to ensure that there is no unintended flow.

4.5.1.3.4 Immediately after the start of product receipt, a competent person or automatic system shall verify that product is only flowing into the correct tank(s) and that the gauging equipment is operative.

4.5.1.3.5 Procedures shall be established that ensure continuity of communications and control between operations personnel for shift changes while receipts are in progress.

4.5.1.4 Procedures for Post-receipt Activities

At the conclusion of the receipt, the valve lineup shall be secured. This may include closing tank, manifold, pipeline, or marine valves and other safeguards appropriate for the facility.

4.5.1.4.1 Documentation for Product Receipt

At the conclusion of the receipt, the following (along with the time and date) shall be documented: