Saskatchewan Upstream Petroleum Industry Storage Standards

Directive S-01

June 2020

Revision 2.1

Governing Legislation:

Act:	*The Oil and Gas Conservation Act*
Regulation:	*The Oil and Gas Conservation Regulations, 2012*
Order:	97-20

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Record of Change

Revision	Date	Description
0.0	June 1, 2010	Original
1.0	June 1, 2011	Revision
2.0	November 2015	Update to facilitate implementation of IRIS in 2015.
2.1	June 2020	Update to facilitate implementation of IRIS in 2020.

Contents

1. General Discussions

1.1 General Discussions

This directive provides comprehensive storage standards for the Saskatchewan upstream petroleum industry. The purpose of the storage standard is to ensure that materials produced, generated and used by the upstream petroleum industry are stored in an environmentally responsible manner.

The Ministry of Energy and Resources (ER) recommends all operators employ the following environmental and safety measures:

- Select storage methods that minimize potential impacts to the environment;
- Implement operating procedures, maintenance practices, and inspection programs to prevent failures, spills and leaks from storage vessels and associated equipment;
- Store materials in such a manner that:
  - They do not generate extreme heat, pressure or cause fire or explosion;
  - They do not produce uncontrolled fumes/gases that pose a risk of fire or explosion;
  - They do not damage the structural integrity of a storage vessel;
  - Incompatible materials are segregated to prevent contact with other incompatible materials and from contaminating benign materials.

The design, construction and operation of storage tanks, containers and facilities shall meet applicable industry standards and comply with ER's legislation, regulations and any applicable requirements of other regulatory agencies. Compliance with this directive does not release the operator from its responsibilities to comply with all applicable municipal, provincial and/or federal requirements applicable to their storage facility or storage devices.

The use of flare pits as storage receptacles is strictly prohibited in Saskatchewan. The deadline for the decommissioning of flare pits was January 1, 2004, unless otherwise approved in writing by ER. Any remaining unremediated flare pits must be reported to ER immediately and a decommissioning plan submitted. Contaminated flare pits shall be excavated and remediated to ER's requirements as soon as possible. Failure to comply with this requirement may lead to the suspension of the license or other legislative actions.

Earthen pits may be used for oily and salt water storage in the case of emergency. Any earthen pit to be used as storage for oily and salt water waste must follow all requirements of *GL 97-01, Guidelines for Construction and Monitoring of Oily Byproduct Storage Structures in Saskatchewan* (GL 97-01).

1.2 Applicable Facilities

The standards specified in this directive apply to all upstream petroleum sites and facilities including, but not limited to, oil and gas production facilities (batteries, compressors, gas processing plants, oil and gas wells), fieldgates, custom treating facilities, transfer stations, metering stations, sand injection facilities, skimming operations, slop injection facilities, water injection facilities, EOR injection facilities and waste processing facilities.

The following facilities and activities are exempt from these storage standards:

- Oily byproduct storage structures (OBSST) and desand pits (must comply with the requirements of GL 97-01);
- Storage of drilling wastes (must comply with the requirements of Guideline GL 99-01: Saskatchewan Drilling Waste Management Guidelines);
- Storage of frac sand and fluids (must comply with the requirements of Guideline GL 2000-01: Saskatchewan Hydraulic Fracturing Fluids and Propping Agents Containment and Disposal Guidelines);
- Petrochemical Refineries (Ministry of Environment);
- Pipelines and Pipeline Facilities licensed under *The Pipelines Act, 1998*. Upon request by ER, the pipeline licensee shall provide document of proof;
- Pipeline Storage Facilities regulated by the Canada Energy Regulator (CER), unless otherwise specified in writing by the CER.

1.3 Applicable Materials

Any material(s) produced, generated or used by the upstream industry shall be stored in accordance with these standards. Applicable materials include, but are not limited to, the following:

- All upstream oil and gas products, byproducts or wastes generated during exploration, handling, processing, recovery, storage, testing, transferring, transporting and treating of primary petroleum resources, other than exempted as above;
- Any material contaminated with any of the above described materials;
- Refined chemicals and refined chemical wastes used directly or generated at upstream facilities and oil and gas sites.

1.4 Exempted Materials

The S-01 Storage Standards do not apply to the following:

- Natural gas liquids (C2 to C4, pressurized vessels);
- Storage of water that meets unrestricted discharge or irrigation discharge criteria as specified in Appendix 3: Surface Water Discharge Criteria;
- Products, byproducts or wastes associated with petrochemical refining processes;
- Sewage, scrap metal, garbage and construction materials;
- Pressurized vessels regulated under *The Boiler and Pressure Vessel Act*;
- Man-made radioisotopes regulated by The Canadian Nuclear Safety Commission.

Vapour tight tank packages, pressure vessels or other positive pressure systems used to store oil are considered a process vessel and not a conventional storage tank and therefore are not required to meet the secondary containment requirements listed in section 3.6.

However, pressurized vessels used to store natural gas liquids and vessels regulated under *The Boiler and Pressure Vessel Safety Act* shall be spaced in accordance with the equipment spacing requirements in Appendix 2.

1.5 Storage Duration

Refined chemical products stored at upstream sites shall be used or disposed of within two years. The storage duration for oilfield wastes, refined chemical wastes, spent filters and empty containers at an upstream site shall not exceed two years. The prescribed storage duration does not apply to production products. The operator shall be able to demonstrate that the product has not exceeded the prescribed storage duration.

1.6 Temporary Storage

The temporary storage of produced products, byproducts and wastes from upstream facilities and wells must not exceed one year unless written permission is obtained from the appropriate ER Field Office. Temporary storage includes plant turnarounds, construction operations, containment and clean-up of spills, site remediation, emergency pop tanks, testing and servicing operations. At the end of the temporary storage operation, materials must be treated and processed or properly disposed of.

The temporary storage area shall be designed to contain and minimize the discharge of contaminants into the environment. The containment features may include tanks, impervious liners, dikes and/or other measures. The operator should employ an appropriate level of protection and containment based on site specific conditions, duration of storage and risk posed to the environment by the material stored. The temporary storage structure shall be decommissioned immediately after its use. The area impacted shall be assessed and remediated in accordance with ER's requirements.

1.7 Alternative Storage Systems

Alternative storage systems are permitted if it can be shown that the materials, systems, equipment, procedures, or new technologies can meet the objectives and intent of the requirements of this directive. Licensees wishing to implement storage systems alternative to the requirements of this directive must include the design details in the application for a facility licence. The application must contain sufficient information to substantiate that an equivalent level of environmental protection and safety will be achieved by the proposed storage system.

2. Environmental Protection Measures

2.1 Facility Siting and Setbacks

Facility related equipment includes:

- Oil storage tanks;

- Salt water storage tanks;
- Process equipment;
- Flame type equipment;
- Combustion systems (flares, incinerators & combustors); and
- Compressors.

Facility related equipment must be located at least:

- 75 metres (m) from any right of way of any surface improvement, occupied dwelling, permanent farm building, public facility or urban centre; and
- the outer perimeter of the berm shall be at least 100 m away from any water body, including a major water body, minor water body and a private water body.

Licensee power lines, surveyed access roads, and flowline(s) are exempt from the setback requirements listed.

All facilities shall have at the entrance to the facility a sign indicating the operator (owner's) name, emergency phone number, warning symbols and the legal land description. The legal requirements for signage are listed in section 19 of *The Oil and Gas Conservation Regulations.*

Unless otherwise directed by ER, all facilities and well sites shall be fenced if it is reasonable to expect that they will come in contact with livestock, children and/or the public. If livestock are to be moved in to a new area, a fence shall be constructed at the landowner's request. In order to receive ER's waiver for fencing requirements, the licensee must provide land owner's consent or provide application to the appropriate ER Field Office as to why a fence should not be constructed.

A visual interpretation of facility setbacks is displayed in Appendix 1.

2.1.1 Licenced Facilities

If the facility has a total daily fluid design throughput less than 350 cubic metres (m^3), it must not be constructed within 100 m of an occupied dwelling, public facility or urban centre. If the facility has a total daily fluid design throughput volume equal to or greater than 350 m^3 but less than 500 m^3 per day, it must not be constructed within 300 m of an occupied dwelling, public facility or urban centre.

The following facilities must not be constructed within 500 m of an occupied dwelling:

- An upstream facility with a total daily fluid design throughput volume greater than 500 m^3 per day;
- A compressor station with a combined power rating of the compressor(s) greater than 186.5 kw (250 hp);
- A gas processing plant;
- A waste processing facility;
- Any facility, excluding a satellite, where H_2S concentration of inlet gas/fluid is equal to or greater than 10 mol/kilomol as measured at the source of emission or 0.01 mol/kilomol as measured at the edge of the lease; or
- A facility venting and/or flaring greater than 900 m^3 of gas per day.

Licensed facilities shall be located to meet the following criteria:

- At least 200 m from a private or community well;
- Are not located in a flood plain of 1:100 years; and
- Glycol dehydrators should be sited and/or benzene emissions reduced to comply with *Guideline S-18: Reduce Benzene Emissions from Glycol Dehydrators*.

These standards apply unless a shorter distance is justified by an exemption request on the facility licence application.

A visual interpretation of facility setbacks is displayed in Appendix 1.

2.2 Equipment Spacing

All equipment at a facility or site shall be spaced in accordance with the equipment spacing requirement in Appendix 2.

2.3 Local Spill Response Units

It is a condition of both the well and facility licence that all licensees be a member in good standing of an Area Spill Response Unit. Licenses failing to uphold membership can have their licence suspended. Operators who are members in good standing of an Area Spill Response Unit or Western Canada Spill Services are only required to provide the name(s) and phone number(s) of their emergency contact personnel. The operators must maintain their membership with the Area Spill Response Unit and participate in the annual spill training exercise(s).

2.4 Lease Berm and Production Flow Control System Requirements

In addition to a dike around the tank or battery of tanks, all wells or facilities may require a lease berm and/or contoured lease. The purpose of a lease berm is to contain significant releases from the well head, pumping devices, associated piping and equipment on the lease. A lease berm or a contoured lease is required:

- when it is specified in the well or facility license;
- when ordered verbally or in writing by ER;
- where the ground elevation of the well center is 1.5 m or higher than the edge of the lease; or
- where it is reasonable to believe that a domestic water supply, dugout, surface water body or other sensitive features will be impacted by produced fluid released from a well before an operator can intervene.

An appropriately designed and maintained stuffing box system that prevents leakage or secondary containment immediately surrounding the stuffing box to contain release of well-bore fluids is required for all oil wells. In addition, the entire production flow control system consisting of wellhead, stuffing box, flow line, storage tanks and transfer points must be maintained to prevent or minimize environmental impact for all wells. Failure to comply with these requirements can result in shutting-in of the well.

3. Aboveground Storage Tanks

The use of single or double-walled tanks is up to the designer of the system. For storage tanks with a capacity below 1 m^3 (1,000 litres), please see section 5, Storage Containers.

3.1 Aboveground Storage Tank Classification

Aboveground Storage Tanks (AST) are defined as having an internal volume greater than 1 m^3 (1,000 litres) and more than 90% of its capacity is above surface grade. An acceptable aboveground storage tank system includes:

1. New welded steel tanks manufactured to American Petroleum Institute (API) 12D, 12F, 620 and 650 standards.
2. Reconditioned and used welded steel tanks that meet the following standards:
   - inspected by an individual with appropriate qualifications and training;
   - inspected as per applicable API standards; and
   - repaired, altered or reconstructed as per applicable API standards.
3. Fiberglass reinforced plastic tanks manufactured to API 12P may be used at all facilities.
4. Riveted tanks may be used for temporary storage of fluids caused by emergencies or upset conditions from normal operations (i.e. pop-tanks). All fluids shall be removed from the tank as soon as reasonably possible. Maximum storage duration shall not exceed 90 days.
5. Other tanks such as skid mounted tanks, bolted tanks, portable tanks, plastic tanks, totes, slips, chemical and bulk type may be used at any upstream facility if they are installed and used in accordance with the manufacturer's instructions or recommendations.

Aboveground storage tanks refer to tanks used primarily for the storage of fluids. Aboveground tanks shall be used only for those applications specified in their respective standards. The operator shall not use the tank for any purpose contrary to manufacturer's instructions, recommendation or any applicable industry standards.

3.2 Single Walled Tank with Internal Volume Equal To or Greater Than 5 m^3

General construction criteria for new aboveground storage tanks with an internal volume equal to or greater than 5 m^3 are as follows:

- Steel tanks should be externally coated or have cathodic protection if they are exposed to a corrosive environment.
- Steel tanks shall be internally coated where the tank is used to store corrosive (corrosive liquids have a pH less than 5 or greater than 10).
- Steel tanks used for storage of salt water shall be internally coated, cathodically protected or otherwise protected against corrosion by means acceptable to ER.
- All tanks shall be equipped with secondary containment system and leak detection as specified in section 3.6.
- All tanks shall be equipped with transfer spill preventers.
- All tanks shall be equipped with one or more of the following overfill protection systems: automatic shut-off devices on pumps, high level alarms, two-stage alarms, visual indicators or any appropriate device that will prevent overfilling. If an automatic shut off device is not employed appropriate operating practices must be in place to prevent the overfilling of tanks.

3.3 Double-Walled Tank Requirements

Double-walled tanks shall have the following features:

- A functional leak detection system in the interstitial space between the two walls;
- An overfill protection system and corrosion protection system (where required);
- All tanks shall be equipped with transfer spill preventers;
- Tank secondary containment is not required.

3.4 Single Walled Tanks with Internal Volume Less Than 5 m^3

Aboveground storage tanks with a total internal volume greater than 1 m^3 but less than 5 m^3 and all pop tanks, dog dishes and emergency storage devices shall comply with the following requirements:

- A monthly visual inspection of the storage devices and storage area;
- Any abnormal circumstances shall be documented;
- Description of the circumstance (when, what, where, why);
- Action taken to correct the problem;
- Must be grounded to eliminate any static electricity and a proper deflection plate shall be installed to prevent splashing;
- A mechanical integrity test is not required;
- Secondary containment is not necessary, however, the operator must implement a physical barrier or operational procedure to mitigate impact to the environment if an accidental release occurs. When the aggregate storage capacity of these tanks exceeds 15 m^3 on a lease, secondary containment is required;
- A dog dish open top tank that is used only to store blow down water (produced water and formation mud) from a shallow gas well can include plastic tubs, fiberglass reinforced plastic tanks or steel tanks. Corrugated steel piping or rings lined with synthetic liners, evaporation ponds, concrete or earthen pits (lined or unlined) are not an acceptable dog dish, and any new installation of such devices is prohibited.

3.5 New and Existing Storage Tank Inspection Requirements

3.5.1 New Storage Tanks

Aboveground storage tanks installed after April 1, 2002 shall be installed in accordance with the standards specified in this directive. Beginning April 1, 2012, any tank that is ten years old or greater will not be considered a new storage tank.

3.5.2 Existing Storage Tanks

All aboveground storage tanks installed before April 1, 2002 that do not meet the requirements of the applicable standards specified in this directive shall be inspected every five years to verify mechanical integrity. Beginning April 1, 2012, any tank that is ten years old or greater will be considered an “Existing Storage Tank” and must be inspected every five years.

Specifically, at least 20% of the total tank population shall be inspected annually, until 100% of the existing tanks are inspected over a five-year period. Upon request, ER may allow the operator to perform inspections on any percentage of the total tank population in any one year. Thereafter, an ongoing testing/inspection program shall be conducted.

The operator may conduct inspections in accordance with applicable API standards or design their own mechanical integrity testing program. The inspection should be completed by a properly certified tank inspector. A report verifying the mechanical integrity of the tank must be kept on record for the life of the tank. The operator shall notify ER of any alternate mechanical integrity test(s) or inspection schedule(s) in writing. The operator must wait to receive written permission from ER prior to proceeding.

The operator may use an existing tank(s) until the tank fails (a spill occurs due to failure) or fails the mechanical integrity test or as otherwise ordered by ER. If any of these events occur, the operator shall initiate corrective actions. These actions must be documented and may include:

- repairing and re-testing the tank, and then install the tank as per the standards specified in this directive.
- replacing the tank and installing it as per the new standards.
- assessing the area surrounding the tank for contamination and conducting clean-up activities as required.
- notifying ER as required in *Directive PNG014: Incident Reporting Requirements* if the failure of the storage device results in a spill of reportable quantity.
- conducting any corrective actions ordered by ER.

3.5.3 Scheduled Tank Inspection Program

New Tanks:

- Monthly visual inspection of the secondary containment and leak detection system.
- Any abnormal circumstances shall be documented on the inspection sheet.
- Description of the circumstance (when, what, where, why).
- Action taken to correct the problem.

Existing Tanks:

- Monthly visual inspection of the tank, storage area for leaks or spills.
- Any abnormal circumstances shall be documented on the inspection sheet.
- Description of the circumstance (when, what, where, why).
- Action taken to correct the problem.
- Mechanical integrity tests as described in section 3.5.2.

3.6 Secondary Containment

Operators shall provide an appropriate secondary containment system for aboveground storage tanks with an internal volume equal to or greater than 5 m^3 for any of the following products:

- Refined Product: refined chemical product such as acids, amine, base, diesel, gasoline, glycol, methanol and solvents.
- Produced Products: upstream oil and gas products (unrefined), byproducts, wastes and materials contaminated with produced products. These include, but are not limited to crude oil, condensate, drilling fluids, drilling waste, frac fluids, frac sands, liquid petroleum gas, oily byproduct, produced water, produced sand and any other material contaminated with produced products.

Acceptable secondary containment systems for this purpose are double-walled tanks, synthetic liner and clay liner systems with an impermeable dike.

3.6.1 Synthetic Liner System Specifications

SL-1: Single Synthetic Liner System:

- Primary liner to consist of synthetic liner directly over a minimum of 300 millimetres (mm) thick clay subsoil.
- Geomembrane that is impervious to, resistant to, inert to or compatible with the material it is intended to contain.
- Provides a hydraulic conductivity less than $1.0X10^{-10}$ centimeters (cm)/s, or equivalent performance and durability.
- Layer of protective covering for the primary liner, as required.
- An impermeable dike (liner must be anchored to the dike).
- Leak detection by incorporation of porous material, such as sand or gravel, over the liner and underneath the tanks in conjunction with a sloped/graded system to allow any leakage to move preferentially through the porous material to a visually marked leak detection/collection area or sump within the diked area.
- Depending on the site specific situation ER may require additional leak detection provision that may include subliner leakage detection devices (see figure 1), rubber coaster system or raised tanks.
- Monthly visual inspections of tanks and the surface of the diked area for evidence of problems, damage or leakage.

3.6.2 Clay Liner System Specification

Clay Prepared Liner with Impermeable Dike:

- Clay liner to consist of 500 mm of clay that is scarified then mechanically compacted to Standard Proctor Density equal to or greater than 95% (at optimum moisture level) and installed in lifts of 100 mm or less. Minimum hydraulic conductivity must be less than or equal to $1.0x10^{-6}$ cm/second ($1.0x10^{-8}$ m/second).
- The bottom of the pit must be separated from the groundwater table (as measured at the time of installation) by at least 500 mm of continuous impermeable subsoil and 500 mm of prepared clay as mentioned above.
- Acceptable soil hydraulic conductivity testing methods include:
  - Laboratory Evaluation of Candidate Liners for Secondary Containment of Petroleum Products API Publication Number 328, 1995;
  - Overview of Soil Permeability Test Methods, API Publication Number 351, April 1999;
  - Any method developed and directly implemented by or implemented under supervision of an APEGS registered Professional Engineer with appropriate experience and knowledge in testing hydraulic conductivity.
- The specification of the clayey material used for the liner and the details of the liner construction (quality assurance/quality control [QA/QC] data) must be documented and made available to ER staff upon request.
- Leak detection by subliner leakage detection device (see figure 1), rubber coaster system or raised tanks.
- Monthly visual inspections of tanks and the surface of the diked area for evidence of problems, damage or leakage.

3.6.3 Impermeable Dikes and Berms

An impermeable dike is a dike completely surrounding a storage device(s) that is constructed of clay, concrete, steel and/or a synthetic material that will not deteriorate or develop leaks during the projected life of the structure. It must withstand the hydrostatic head associated with it being full of liquid and sized at least 110% of the capacity of the tank when the diked area contains one tank, or when the diked area contains more than one tank, 100% of the volume of the largest tank plus 10% of the aggregate capacity of all other tanks. There shall be no opening in the dike (e.g. dike drains). Clay dikes must comply with all of the same requirements of a clay liner and must be maintained in good condition all of the time. The area encompassed by the dike shall be kept free from extraneous combustible material.

A lease berm (includes contoured leases) is a dike surrounding the whole or part of an oil and gas lease that is capable of containing produced fluid released from any operation on the lease and prevent large amounts of surface water from entering and flooding the lease.

Figure 1. Aboveground Storage Tank Clay Liner Leak Detection System

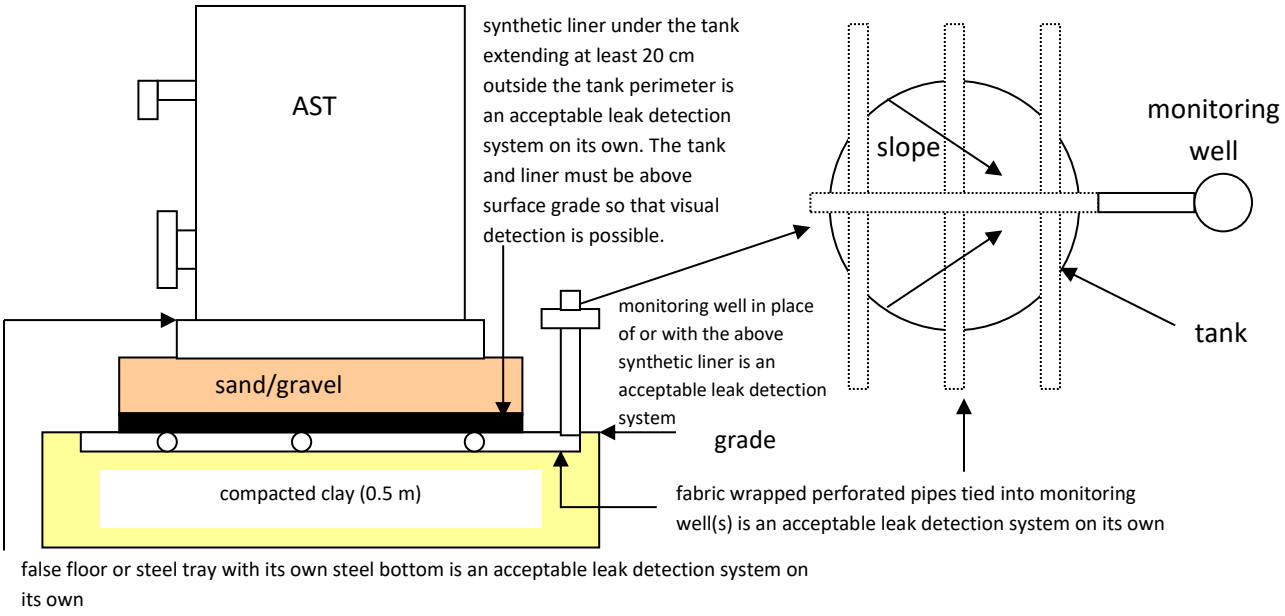
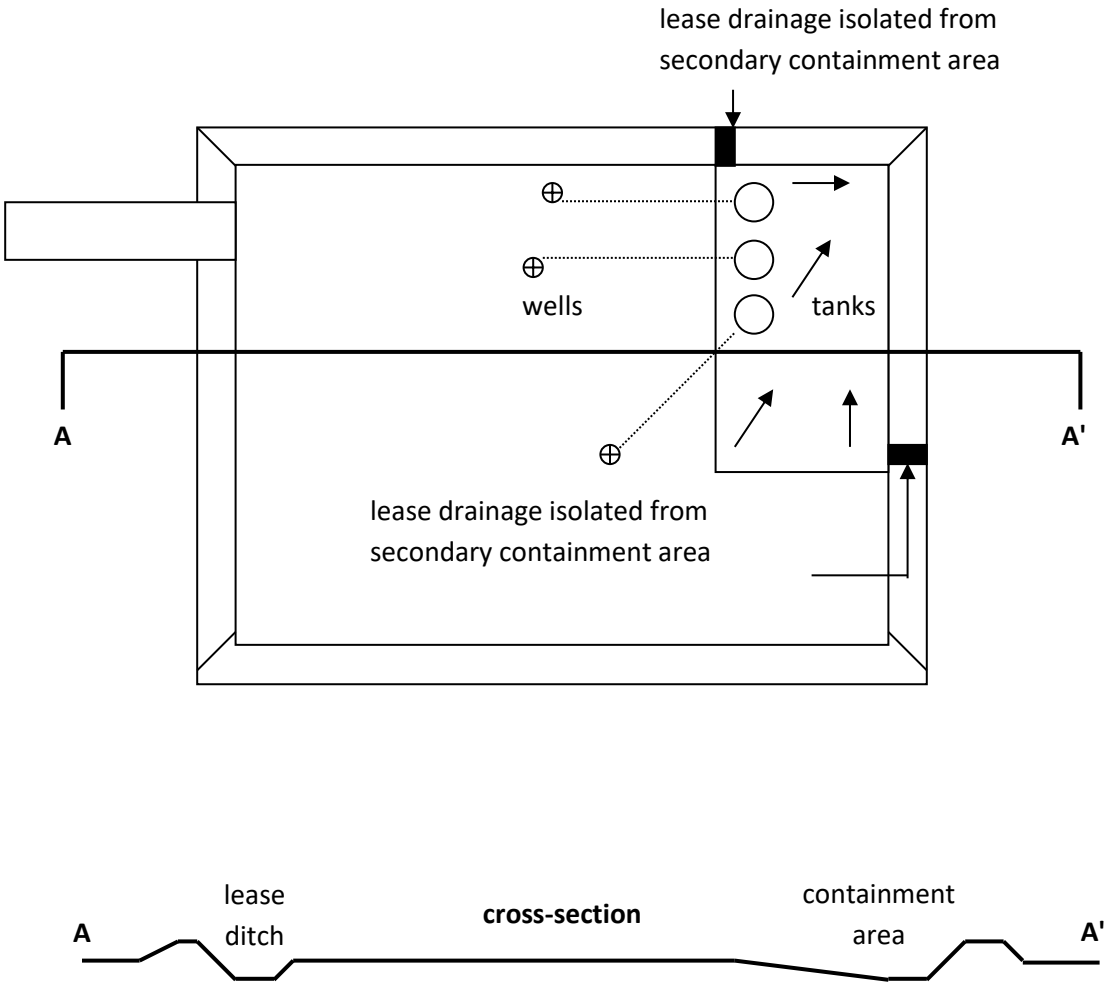


Figure 2. Example Sketch of a Contoured Lease



Please note this sketch is only provided as an example, the operator should develop their own design based on site-specific conditions.

4. Underground Storage Tanks

Installation of new underground storage tanks is prohibited except by special application as outlined in Appendix 4. ER recognizes that in some rare circumstances operators have no alternative other than to install an underground storage tank. Where the operator can demonstrate (in writing) that no alternative exists, ER may provide permission to install underground storage tank(s); the permission may be site-, pool- or area-specific. In all circumstances, new underground storage tanks shall be installed in accordance with requirements specified in Appendix 4.

All existing underground storage tanks (including dual-walled underground storage tanks) and piping shall be precision tested/inspected once every three years to verify the mechanical integrity of the existing storage device. In the event the existing underground storage tank(s) leaks or fails the above-required test(s), the operator shall notify the appropriate ER Field Office and initiate corrective actions. The actions must be documented. Those actions may include

- replacing the tank with an aboveground storage tank.
- assessing the area surrounding the tank for contamination, conducting clean-up activities as required and conducting any further corrective actions ordered by ER.

Shallow gas operations (Saskatchewan Area Three, producing natural gas from above the top of the Fish Scales formation) are permitted to install underground storage tanks without applying for permission provided they abide by all provisions in this section and the requirements specified in Appendix 4.

5. Storage Container(s) Requirements

5.1 Container Definitions and General Requirements

All hazardous materials or produced byproducts and waste containers shall be contained to prevent release into the environment, and stored to provide minimum exposure to the elements.

A container or a collection of containers with an aggregate volume less than 1 m^3 (1,000 litres) at one site does not require secondary containment or weather protection. Containers must be stored in such a manner so that a visual leak detection of the bottom of the container surface can be conducted. Secondary containment is required where a release cannot be contained on-site and there is a reasonable expectation that a release will impact a stream, water body and groundwater.

A collection of containers with an aggregate volume greater than 1 m^3 (e.g. approximately five 45-gallon drums) at one site requires secondary containment and weather protection.

All containers must be stored and handled in a manner to maintain the integrity of the containers and to protect against spills. For example, extra caution must be exercised when handling and storing bottles and bags of chemicals.

5.2 Container Secondary Containment System

Secondary containment systems for containers (e.g. dikes, curbs, collection trays) must be constructed of materials that are impervious to the materials being stored and shall be:

- constructed of material that will not react with any material being stored and which has no openings that may provide direct connection to the ground underneath the container;
- a minimum height of 15 cm, or have a net capacity greater than that of the largest container within the storage area, or 15% of the total volume of all containers in the storage area, whichever is greater. Containment may be achieved via the proper use of at least one of the following devices:
  - Storage compounds which meet the secondary containment criteria for Aboveground storage tanks;
  - Metal, plastic bins or overpacks;
  - Drip trays or spill pallets; or
  - Any other devices deemed to be acceptable by ER.

5.3 Container Weather Protection

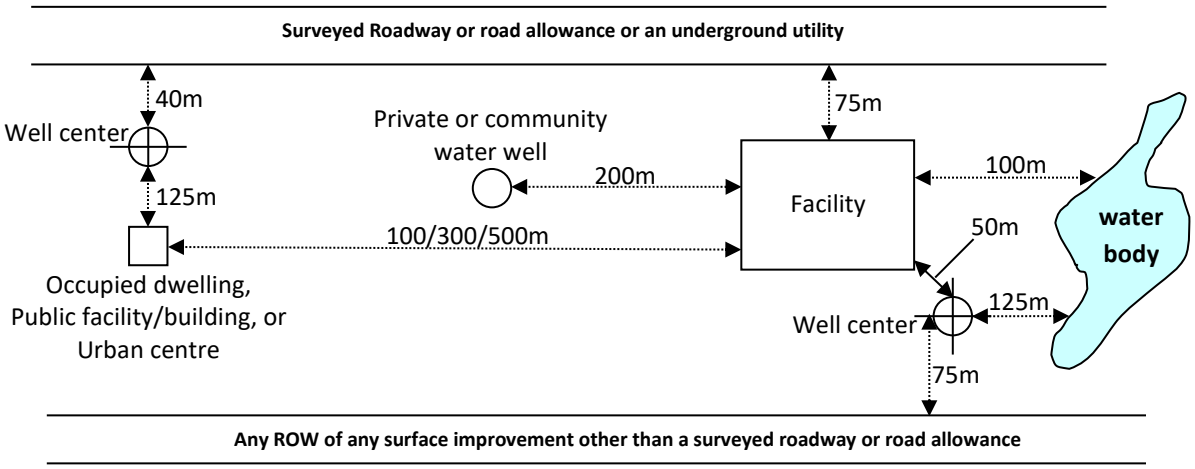
Weather protection is intended to preserve the condition of the primary container and hence the usefulness of the material contained therein. Weather protection is considered to be a physical cover/coating made of weather resistant materials (i.e., plastic) over the containers. Acceptable weather protection devices include:

- Covered metal or plastic bins;
- Overpacks;
- Storage docks possessing a roof and walls on three sides;
- Secured canvas, plastic tarpaulins or weather resistant plastic covers;
- Protective coatings and corrosion resistant paints;
- Storage trailers and buildings.

All containers must be visually inspected for surface damage and leaks on a daily basis at a manned facility or on each site visit at an unmanned site. Any abnormal circumstances must be documented.

Appendix 1 – Isolation Distance For Facilities and Wells

Facility setbacks are specified in section 2. They are calculated based on the type of the facility, the H_2S concentration, the flare volume and the total daily liquid throughput of the facility. The minimum setbacks of the facility ranges between 75 m and 500 m.



Legend:
well: oil, gas, injection well and single well battery
facility: EOR, multi well oil battery, large and permanent gas compressor station, gas processing plant, satellites, water injection facility and waste processing plant
water body: measured from the shoreline
right of way (ROW): measured from the edge of the right of ways

Appendix 2 – Equipment Spacing Requirements

Equipment Spacing Distances (m)	Oil or Gas well	Water supply, water injection or water disposal well	Flare/Incinerator	Oil Storage tanks	Salt water storage tanks	[1]Portable water tanks	[2]Process Equipment	[3]Flame type equipment with flame arrester	[3]Flame type equipment without flame arrester	[4]Compressor	Internal combustion engine exhaust
Oil or gas well		na	50	50	50	25	25	25	25	50	6
Water supply, water injection or water disposal well	na		25	50	na	na	na	na	na	25	Na
Flare/Incinerator	50	25		50	50	50	25	25	25	25	na
Oil storage tanks	50	50	50		na	na	na	25	25	25	na
Salt water storage tanks	50	na	50	na		na	na	25	25	25	na
[1]Portable water tanks	25	na	50	na	na		na	25	25	25	na
[2]Process Equipment	25	na	25	na	na	na		na	25	na	na
[3]Flame type equipment with flame arrester	25	na	25	25	25	25	na		25	na	na
[3]Flame type equipment without flame arrester	25	na	25	25	25	25	25	25		25	na
[4]Compressors	50	25	25	25	25	25	na	na	25		na
Internal combustion engine exhaust	6	na	na	na	na	na	na	na	na	na	

[1]**Portable Water tanks** are skid mounted, less than 65 m^3 and are not heated.

[2]**Process equipment** consists of any non-flame type equipment used in the upstream petroleum recovery or treatment process including (but is not limited to) amine tanks, pop tanks, flare knockout drums (N/A with appropriate overfill protection and flame arrestor), scrubbers, sweetener and separators. Process equipment generally does not have a permanent footing.

[3]**Flame type equipment** includes any open flame equipment, other heating device or electrical device that has open ignition and/or could potentially cause a fire or explosion. For the purpose of equipment spacing, flame type equipment includes, but is not limited to, steam boilers, free water knock-outs, dehydrators, generators, heaters, treaters, diesel engines without automatic air shut offs and heated water tanks on a skid.

[4]**Compressors** that are used exclusively for casing gas or used in association with a gas wellhead for on lease fuel are exempt from the spacing requirements. If the compressor is under 250 HP

and on non-permanent concrete footings, it can be considered a booster compressor and spaced 25 m from a wellhead.

Equipment Spacing Details:
Equipment spacing measurement points:

- Where a dike is present, the measurement shall be from the outer perimeter of the dike of the object to the nearest outer perimeter of the dike of the target object (if dike is present) or to the nearest outer wall of the target object (if dike is not present);
- Where dike is not present, the outer wall of the target object to the nearest outer wall of the target object; and
- For wells, the measurement shall be from the well centre to the target object's outer wall or outer perimeter of the dike facing the well.

"na" means equipment spacing requirements do not apply however must comply with National Fire Code, Local Fire Regulations, Canadian Electrical Code, Local Bylaws and/or other applicable requirements.

Flame Type Equipment:

- Flame-type equipment where air intake of the burner is fitted with an adequate flame arrester may be placed closer than 25 m from process equipment, compressor or other flame type equipment fitted with flame arrester.
- Where flame-type equipment is located in the same building with another flame-type equipment, separator or dehydrator, the flues from the burner(s), vent relief valve(s), safety head(s) and other source(s) of ignitable vapour(s) shall be vented outside the building and above the peak height roof level. Also, the inside of the building shall be adequately cross-ventilated.
- An exhaust pipe from an internal combustion engine located within 25 m of any oil or gas well, separator, oil storage tank or other unprotected source of ignitable vapour is to be constructed so that any emergence of flame along its length or at its end is prevented; and the end is not closer than 6 m to the vertical centre line of the well and is directed away from the well.
- All vessels and equipment from which ignitable vapours may issue are to be safely vented to the atmosphere, and all vent lines from oil storage tanks that are vented to flare system are to be provided with flame arresters or other equivalent safety devices.
- Vapour Recovery Units are exempt from the equipment spacing provided that they are located at a safe distance to prevent fire and explosions.
- A genset that is compliant with *CSA 149.3, Code for the field approval of fuel-related components on appliances and equipment* may be installed at a distance specified in the applicable electrical code.
- Installation of flame type equipment must comply with National Fire Code, Local Fire Regulations or Bylaws and other applicable requirements.

Incinerators for destruction of trace vent gasses, such as those emitted from a gas dehydrator, are exempt from the spacing regulations provided they are designed to prevent ignition of gas that may leak from surrounding equipment (i.e. devices must be equipped with flame arrestors).

In the heavy oil area, the spacing measurement point is from the tank wall, not from the edge of the dike. Operators may obtain company wide equipment spacing exemptions (from 50 m to 25

m) for storage of crude oil and salt water in relation to a heavy oil well (this exemption is not available to batteries, facilities or other upstream facilities). Requests must be made in writing and signed by a company executive (i.e. vice president).

Equipment located at existing facilities that were in compliance with the regulations prior to implementation of the new spacing requirements that came into effect January 1st, 2008 are exempt from the new spacing requirements.

Abandoned Wells:
Wells that have received abandoned status do not have to meet the spacing requirements listed above. The operator is required to leave enough space around the abandoned well center to ensure it can be properly serviced, if further remedial work is required.

Appendix 3 – Surface Water Discharge Criteria

Unrestricted Discharge: Applies to surface water collected at upstream oil and gas facilities which meets the criteria listed in the unrestricted column in Table 1. Landowner consent is required if the water is disposed of on either privately- or crown-owned land. Operators must comply with other relevant regulatory agencies' requirements.

Irrigation Discharge: Applies to surface water collected at upstream oil and gas facilities which meets all of the criteria listed in the irrigation column in Table 1. If the water is to be used off-lease, written landowner consent is required. Operators must comply with other relevant regulatory agencies' requirements.

Controlled Discharge: Applies to surface water collected at upstream oil and gas facilities which meets the criteria listed in the controlled column in Table 1. The operator shall dispose of the water at an approved waste processing facility or disposal well. Operators must comply with other relevant regulatory agencies' requirements.

Table 1. Surface Water Discharge Criteria for Upstream Oil and Gas Facilities

Surface water discharge criteria				
Parameters		**Unrestricted**	**Irrigation**	**Controlled**
Routine Tests all surface water must be tested for these parameters and meet the criteria prior to discharge	pH	**6 to 8**	**6 to 8**	**<6 or >8**
	chloride (total)	**≤500 mg/L**	**≤1000 mg/L**	**> 1000 mg/L**
	visible hydrocarbon	**no visible sheen**	**no visible sheen**	**visible sheen**
Special Tests these additional tests are required if the surface water has or is suspected of having contacted spill or contaminated materials	oil and grease: hexane extraction (silica gel) gravimetric EPA 1664	**non detect (<10 mg/L)**	**non detect (<10 mg/L)**	**>10 mg/L**
	conductance	**≤1 dS/m**	**≤2 dS/m**	**>2 dS/m**
	TDS	**≤700 mg/L**	**≤1400 mg/L**	**> 1400 mg/L**
	Microtox® EC50(15)	**≥75%**	**≥75%**	**not required**

Appendix 4 – Underground Storage Tank (UST) Requirements

Produced water, crude oil, condensate and volatile organic hydrocarbons (VOC with a flashpoint less than 32°C) must be stored in aboveground tanks, unless otherwise approved in writing by ER. The operator will be required to submit a written application justifying any request for below ground installations. USTs can have a maximum volume of 5,000 litres and may be constructed using steel, fiberglass reinforced plastic or other appropriate materials.

Siting Requirements

USTs shall be installed with the following hydrogeological conditions:

- Bottom of the UST shall be at least 1.5 m above the seasonally high ground water table;
- All fluids in the underground storage tank shall be removed as soon as practical, not exceeding 180 days, unless otherwise approved by ER.

General Construction Requirements

General construction criteria for underground storage tank facilities are as follows:

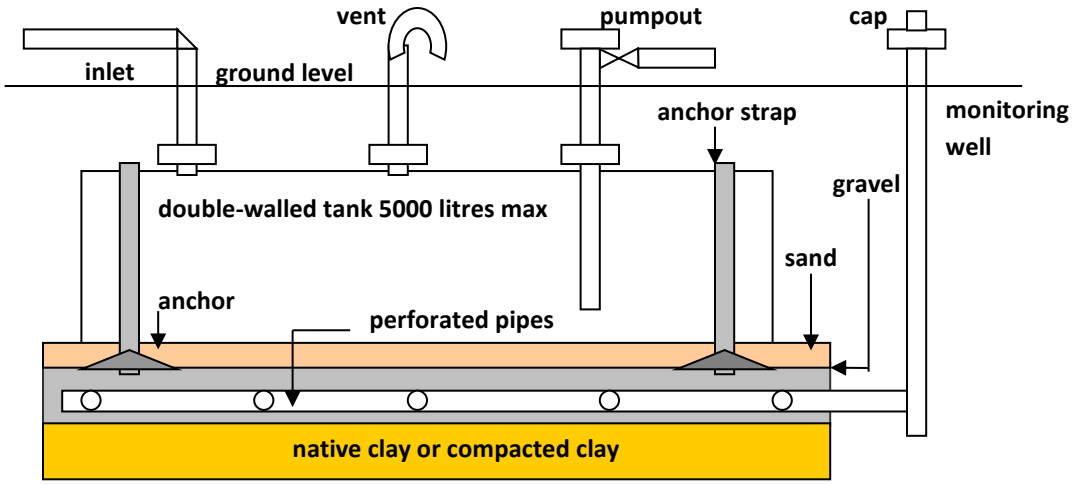
- USTs shall be designed, fabricated, tested and installed to the manufacturer's requirements and to appropriate engineering/construction standards;
- Newly installed underground storage tanks and associated piping shall be integrity tested as a complete system prior to being put into service;
- Steel tanks shall have internal and external corrosion protection;
- Incorporate measures to prevent overfilling and breathing vents shall be designed to prevent plugging-off.

Secondary Containment Requirements and Leak Detection System

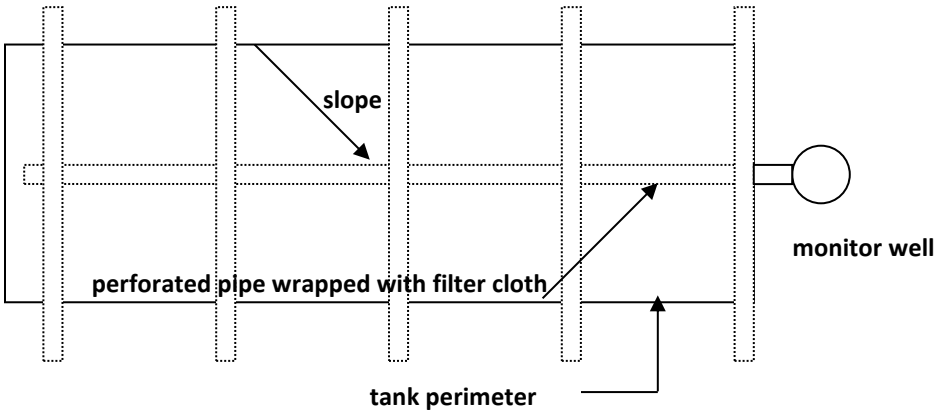
All USTs containing fluids that do not meet the unconditional or irrigation surface water discharge criteria shall be double-walled and installed with a leak detection system. Vaulted tanks are exempted from this requirement; however, they must meet the aboveground storage tank requirements.

An acceptable leak detection system for underground storage tanks includes a weeping tile system installed underneath the tank. The weeping tiles shall be sloped to encourage the collection of fluids. At least one monitoring well shall be completed at the lowest collection point.

Underground Storage Tank Leak Detection System Profile View



Underground Storage Tank System Leak Detection System Top View



Scheduled Inspection Program

The interstitial space and monitoring well tied into the weeping tile shall be inspected at least once a month. Any abnormal circumstances shall be documented on the inspection sheet including description of the problem and the action taken to correct the problem.

In the event the underground storage tank(s) fails, the operator shall notify the appropriate ER Field Office and immediately initiate corrective actions. The actions must be documented and may include:

- repairing the tank and testing as per a new installation;
- replacing the tank and testing as per a new installation;
- assessing the area surrounding the tank for contamination and conducting clean-up activities as required;
- conducting any corrective actions ordered by ER.

Appendix 5 – Pressure Safety Valve and Pop Tank Requirements

The pressure safety valve or relief device from a pressure vessel at an oil or gas facility should be connected to a pop tank or flare system. The relief system must be designed such that when the pressure-relief device activates, the relief system can safely manage the pressure and flow and withstand the increase in pressure without being damaged.

If the licensee does not utilize a pop tank or flare system in association with the relief device, the system must be engineered to ensure that in an overpressure scenario, product of any kind from an oil or gas well or facility shall not be allowed to freely flow to the surrounding land.

An engineered system includes the following:

- The pressure setting of the relief devices will not exceed the rated maximum operating pressure of the vessels.
- Each pressure vessel will be equipped with its own high-pressure and high-level sensors and controls.
- Sensors and controls will be connected to a valve installed on the inlet of the vessel that will shut off the flow of fluids into the vessel in the event of a high-pressure or high-level occurrence.
- The pressure setting of the high-pressure sensors and controls will not exceed 90% of the relief device's pressure setting.
- One or more isolation valves will be installed between the high-pressure sensor and the pressure vessel to facilitate testing of the sensor.
- High-pressure and high-level sensors and controls will be function tested annually ensure that they are working correctly. A tag must be placed on the controls indicating the last test date.
- Sensors and controls will be replaced or repaired immediately if they are defective or non-functional.
- High-pressure and high-level sensors and controls will be calibrated annually. A tag must be placed on the controls indicating the last calibration date.
- If the pressure-relieving device is directed to the atmosphere, *Directive PNG036: Venting and Flaring Requirements* must be met.

A pop tank is by definition open to atmosphere; therefore, if an operator directs a pressure relief device at an oil facility where the H_2S content is greater than 10 mol/kmol to a pop tank, there must be redundant (i.e. two sets of) sensors and controls for both high-pressure and high-level installed on the pressure vessels.

Glossary

"aboveground storage tank" (AST) means a storage tank of which more than 90% of its capacity is above surface grade.

"clay" (clay subsoil) means fine-grained soil with 50% plastic fines passing the No. 200 sieve (0.074 mm).

"compacted clay" means 500 mm of clay (pre-existing or imported) that is scarified then mechanically compacted to Standard Proctor Density equal to or greater than 95% (at optimum moisture level) and provides a minimum hydraulic conductivity less than or equal to 1.0x10-8 m/second.

"containers" mean any portable aboveground containment device (e.g. drums, pails, bags, boxes, totes) with a capacity not exceeding 1 m^3.

"dehydrator" means an apparatus designed and used to remove water from gas.

"diesel engine" means an internal combustion engine in which the heat produced by the compression of the air in the cylinder ignites the fuel.

"dog dish" means (usually an open top) tank that is used only to store blow down water (produced water and formation mud) from a shallow gas well and it can include plastic tubs, fiberglass reinforced plastic tanks or steel tanks.

"environment" means all components of the earth including air, land and water; all layers of the atmosphere, all organic and inorganic matter and living organisms; and interacting natural systems.

"existing" (existing tank, flare) means storage devices that were installed prior to the release of this directive and do not meet the requirements specified in this directive.

"facility" means any building, structure, installation, equipment, or appurtenance that is connected to or associated with the recovery, development, production, handling, processing, treatment, or disposal of hydrocarbon based resources or any associated substances or wastes.

"flame type equipment" means open flame equipment, other heating device or electrical device that has open ignition and/or it could potentially cause a fire or explosion. For the purpose of equipment spacing, flame type equipment includes, but is not limited to, steam boilers, free water knock-outs, dehydrators, generators, heaters, treaters, diesel engines without automatic air shut offs and heated water tanks on a skid.

"geomembrane" means a polymeric sheet material that is impervious to liquid - when it maintains its integrity.

"geosynthetic clay liners" (GCL) mean a layer of processed clay (typically bentonite) either bonded to a geomembrane or fixed between two sheets of geotextile.

"geotextile" (geofabric) means a woven or nonwoven sheet material less impervious to liquid than a geomembrane, but more resistant to penetration damage.

"heavy crude oil" (heavy oil) means crude oil with density equal to or greater than 920 kg/m^3. This definition only applies in the context of this directive. It does not apply to any other legislation, regulations, policies, standards or guidelines.

"high water mark" is the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams) this refers to the "active channel/bank-full level" which is often the 1:2 year flood flow return level. In inland lakes or wetlands it refers to those parts of the water body bed and banks that are frequently flooded by water so as to leave a mark on the land and where the natural vegetation changes from predominately aquatic vegetation to terrestrial vegetation (excepting water tolerant species). For reservoirs this refers to normal high operating levels (Full Supply Level).

"hydraulic conductivity" is a measure of the ability of a material to transmit fluid, but is dependent on the type of fluid passing through the material.

"impermeable dike" means a dike completely surrounding a storage device(s) which is constructed of clay, concrete, steel and/or a synthetic material that will not deteriorate or develop leaks during the projected life of the structure. It must withstand the hydrostatic head associated with it, being full of liquid and sized at least 110% of the capacity of the tank when the diked area contains one tank, or when the diked area contains more than one tank, 100% of the volume of the largest tank plus 10% of the aggregate capacity of all other tanks. There shall be no opening in the dike (e.g. dike drains). It must be maintained in good condition all of the time. The area encompassed by the dike shall be kept free from extraneous combustible material.

"internal combustion engine exhaust" means exhaust from gasoline engines, diesel engines with air shut-offs, natural gas engines, propane engines and their respective exhaust gases and free liquids. It does not include diesel engines with no air shut-offs. There are no spacing requirements applicable to internal combustion engines. The exhausts from these engines must be placed away from an oil and gas wellhead, a minimum distance of 6 m. The exhausts from these engines must be pointed away from the wellhead, either by orientating the exhaust vertically up or pointing it in the opposite direction from the wellhead. Connecting engine exhaust to a wellhead is strictly prohibited.

"leak detection system" means a system or method that is capable of detecting a leak from the primary containment device.

"lease berm" (includes contoured leases) means a dike surrounding the whole or part of an oil and gas lease that is capable of containing produced fluid released from any operation on the lease and prevent large amounts of surface water from entering and flooding the lease.

"major water body" means a water body that includes, but is not limited to, a lake, river, creek, stream, or other body of water that is fish bearing.

"minor water body" means a water body that includes, but is not limited to, field/seasonal drainage, a water run, an irrigation ditch, a slough, a wet low areas, or an area that may potentially flood (e.g., dry sloughs, low areas, etc.).

"monitoring well" means a well placed into a specific subsurface zone to enable the sampling of groundwater and to detect the presence of any leachate in the groundwater aquifer or the unsaturated zone.

"native clayey subsoil" means 1.5 m of continuous clay layer that is pre-existing at the site and it is usually not mechanically compacted. It must provide a minimum hydraulic conductivity less than or equal to 1.0x10-6 m/second.

"natural gas booster compressors" mean a compressor that is portable with trailer or skid mounts and does not have a permanent concrete footing and does not exceed 250 horsepower. The natural gas booster compressors must be installed a minimum of 25 m from a wellhead.

"new" (new tanks) means storage devices installed after the effective date specified in this directive.

"occupied dwelling" means a building occupied by a person on a temporary or permanent basis.

"oil and gas site" means any sites or facilities associated with oil and gas exploration, recovery, production, processing, transmission, transportation, treatment and/or disposal. It includes waste processing facilities but it does not include refineries or upgraders.

"operator" means licensee of the facility. Where license does not exist, the operator is the company(s) or person(s) who owns the facility or has control on the selection and design of the storage devices installed at the facility.

"overfill protection system" means a mechanical or electrical device that is installed in or on a storage tank to prevent the storage tank from being overfilled. Excess capacity within the storage system is considered to be an acceptable overfill protection system. Specifically, it means a system that is operated in a fashion such that the remaining storage capacity exceeds the amount of fluids that would be added to the system before the next operator visit by a factor of two.

"permanent storage" refers to the storage of materials produced, generated, and used by the upstream petroleum industry in a device that is a permanent fixed part of an operating facility. Permanent storage devices may include aboveground storage tanks, containers and bulk pads.

"permeability" (hydraulic conductivity) means the rate of discharge of water under laminar flow conditions through a unit cross-sectional area of a porous medium under a unit hydraulic gradient and standard temperature conditions (20ºC). Acceptable permeability tests are described in API Publication 351, Overview of Soil Permeability Test Methods.

"primary containment device" (storage device) means a device used to physically contain the materials. They include, but are not limited to, tanks and containers.

"primary production facility" means all upstream facilities and any other oil and gas sites, including but not limited to gas wells, oil wells, water source wells, disposal wells, Enhanced Oil Recovery projects (steam, water, fire, CO2, solvent floods) and waste processing facilities.

"primary liner" means the upper most liner that covers all of the area within the dike and it is keyed into the dike walls or incorporated into the dike wall.

"private water body" means a water body that belongs to an individual or group (e.g., a dugout).

"produced products" mean upstream oil and gas products (unrefined), byproducts, wastes and materials contaminated with produced products. They include, but are not limited to, crude oil, condensate, drilling fluids, drilling waste, frac fluids, frac sands, liquid petroleum gas, oily byproduct, produced water, produced sand and any other material contaminated with produced products.

"process equipment" means any non-flame type equipment used in the upstream petroleum recovery or treatment process such as amine tank, pop tank, scrubber, sweetener and separator. Process equipment generally does not have a permanent footing.

"private water body" means a water body that belongs to an individual or group (e.g., a dugout).

"public facility" means a public building or location where the presence of the public can be anticipated, including a hospital, place of business, campground, school or recreational facility or other building or location created for the use of the public.

"refined product" means refined chemical product such as acids, amine, base, diesel, gasoline, glycol, methanol, lube oil and solvents.

"salt water" (for the purpose of salt water storage in a steel tanks means) is water with a total dissolved solid concentration that is equal to or greater than 4000 mg/L (0.3%).

"secondary containment" means an impervious barrier placed between the primary containment device and the ground beneath and surrounding it for the purpose of containing and preventing any leakage from the primary containment device from impacting the environment.

"secondary containment for indoor aboveground storage tanks" means building containing storage tanks, pressure piping and compressors must have impermeable floors and be designed to prevent escapes of leaks. Additional provisions of the Saskatchewan Fire Code may apply.

"secondary liner" means a liner beneath the primary liner, sometimes separated by a leak detection system that covers all of the area within the dike.

"separator" means an apparatus for separating liquid and gas at the surface as they are produced from a well.

"set-back or set-back distance" means the distance by which a well or facility must be separated from a specific entity such as a body of water, a residence, a public building, or a surface improvement.

"sour gas" means natural gas containing hydrogen Sulphide (H_2S) concentrations equal to or greater than 0.01 moles per kilomole (10 PPM, 0.001%).

"storage" means holding of material produced, generated and used by the upstream petroleum industry for a period of time until the products, byproducts or wastes are transported, treated or disposed.

"storage area" means a segregated area of an operating facility that is used to store materials produced, generated and used by the upstream petroleum industry in containers and/or tanks and includes all land and associated structures.

"storage facility" means a facility dedicated to the storage of materials produced, generated and used by the upstream petroleum industry in containers and/or tanks and includes all land and associated structures.

"surface improvement" includes, but is not limited to, railways, canals, dugouts, water wells, above-ground pipelines, power/telephone or other utility lines, road allowances, surveyed roadways, aircraft runways or taxiways.

"shallow gas operation" means any operation in Saskatchewan Area Three conducted specifically for the production of natural gas and producing from no lower than the Medicine Hat formation.

"synthetic liner" means geomembrane that is impervious to, resistant to, inert to or compatible with the material intended to contain. They include, but not limited to, GCL, polyethylene, polyvinyl chloride, polypropylene, steel, spray-on polymer and/or other synthetic polymers. The liner must be a minimum thickness of 30 mil and provide a hydraulic conductivity less than 1.0X10-10 cm/second, or equivalent performance and durability.

"tank" means a device designed to contain materials produced, generated and used by the upstream petroleum industry which is constructed of impervious materials that provides structural support.

"transfer spill preventer" means a collection device located on the fill pipe or other filling device of a storage tank that is designed to collect any over-delivery during the delivery of the product(s). The operator may choose to implement Best Management Practices (BMP) in place of transfer spill preventer. The BMP should include proper trucker loading procedures, spill prevention procedures such as the plugging of loadlines when not in use and repairing leaking valves. Where the operator BMP is proven inadequate (by a site inspection), ER may require the operator to replace the BMP with transfer spill preventers. The upgrade order may range from a site specific action all the way up to a company wide upgrade.

"treater" means an apparatus for separating oil, gas and water at the surface as they are produced from a well.

"underground storage tanks" mean a storage tank that has at least 10% of its volume below the surface of the ground and includes pipes below the surface of the ground that are connected to a storage tank that is not below the surface of the ground.

"upstream facility" means all wells and facilities including oil and gas production sites, pipelines, flowlines and associated equipment, satellites, batteries, metering stations, compressor stations, pump stations, truck unloading stations, and gas plants.

"vaulted tank" means a tank that is contained in a concrete or other type of man-made solid walled space (e.g. vault) either below or aboveground level. The vault can be accessed through a man-way or a top that is opened to atmosphere. It may or may not be possible to visually inspect the tank on all sides; however, it must be possible to visually detect any leaks from the tank. Vaulted tanks are considered to be aboveground storage tanks and the vault is classified as the secondary containment.

"underground utility" includes, but is not limited to, pipelines, Saskatchewan water lines, power cables, etc.

"waste processing facility" means a system or arrangement of tanks, treaters or other surface equipment that is intended to receive waste material from any oil or gas field operation for processing or disposition.

"water body" means a body of water or an area where water flows, or is present, whether the flow or presence of water is continuous, seasonal or intermittent, or occurs only during a flood. There are three main categories of water bodies: major, minor and private water bodies.

"water table" is the upper surface of the zone of permanent saturation. Its level migrates from season to season. Operators may determine the water table by excavating a pilot hole or installing groundwater monitoring wells. They may also consult with hydrogeologists, local water well users or check well records.

"venting" means the intentional controlled release of un-combusted gas.