

Directive 055—Addendum 2011-10-11

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Interim Requirements for Aboveground Synthetically-Lined Wall Storage Systems, Updates to Liner Requirements, and Optional Diking Requirements for Single-Walled Aboveground Storage Tanks

The Energy Resources Conservation Board (ERCB/Board) approved this addendum to *Directive 055* on October 11, 2011.

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1 Introduction

ERCB *Directive 055: Storage Requirements for the Upstream Petroleum Industry* sets out the requirements for the storage of materials produced, generated (including wastes), and used in the upstream petroleum industry. The containment devices it addresses are aboveground and underground tanks, containers, lined earthen excavations, and bulk pads. It also addresses secondary containment, leak detection, spill prevention and loss control, and weather protection systems, as well as operating procedures, maintenance practices, and inspection programs for maintaining the containment systems.

Multi-stage hydraulic fracturing operations associated with the emerging development of unconventional oil and gas resources in Alberta may involve the use of large volumes of water (either fresh or saline) with the addition of proppants such as sand) and small volumes of fracturing additives and products. Operations may also need to handle large backflow

volumes of the injected materials (e.g., fracturing flowback fluids), which may have been altered by contact with subsurface rock. Companies producing unconventional oil and gas reserves in other jurisdictions have used aboveground, synthetically-lined wall storage systems (AWSSs) in place of numerous single-walled aboveground tanks. They describe the advantages as including a smaller lease footprint, less truck traffic, fewer spills and releases because there are fewer piping and manifold systems, and fewer freezing issues in winter.

This addendum to *Directive 055* describes the minimum requirements for use of AWSSs in the Alberta upstream petroleum industry, and it updates liner requirements and optional diking requirements for temporary single-walled aboveground storage tanks (ASTs). The requirements are designed to provide acceptable storage practices that do not compromise public safety or environmental protection.

2 Aboveground Synthetically-Lined Wall Storage Systems

The ERCB has determined that AWSSs are appropriate for the uses specified below provided the requirements are followed. AWSS capacities are limited and may be reviewed if design and construction specifications for AWSSs become available from recognized standards writing organizations. Upstream petroleum licensees or approval holders wanting to use AWSSs for other storage purposes must submit an application which details sufficient information to substantiate the applicability and appropriateness of the use with respect to integrity containment (i.e., engineering design and construction details related to the wall and liner system), environmental protection, and safety. AWSSs are not ASTs and are not considered appropriate for permanent storage.

2.1 Storage of Cement Returns

Small AWSSs are a practical storage option for cement returns from drilling and completion operations when the intent is to remove the cement after it has hardened and send it for disposal. The following requirements must be met when using AWSSs for storage of cement returns:

- 1) The capacity must not exceed 50 cubic metres (m³).
- 2) The synthetic liner must be at least 30 mil thick, have properties (i.e., density, tensile strength, elongation, tear resistance, and puncture resistance) suitable for the intended use, be chemically resistant to the compounds used to formulate the cement, and be rated for the temperatures encountered (i.e., the temperature of the cement returns and the ambient temperatures). The manufacturer's liner specifications must be documented.
- 3) The wall system must be engineered to withstand the hydraulic pressure of the stored contents at full capacity.
- 4) The liner must cover the ground floor of the wall system, extend up the wall, and be keyed onto the outside of the wall.
- 5) The system used to key the liner must secure the liner to the wall system but not damage the liner.
- 6) The maximum storage duration must not exceed one year (i.e., cement returns must be removed and sent to an approved landfill for disposal, and the AWSS must be dismantled within the one year timeframe). Licensees not wanting to landfill the cement returns must apply to the ERCB under *Directive 050: Drilling Waste Management* for approval to manage the returns in an alternative manner.

- 7) Liners must not be reused and must be managed as an oilfield waste in accordance with *Directive 058: Oilfield Waste Management Requirements for the Upstream Petroleum Industry*.

2.2 Storage of Fluids Associated with Hydraulic Fracturing Operations

There may be two or more larger AWSSs on a site to handle injection and flowback fluids and to treat fluids for reuse in other fracturing operations, which will reduce the need for additional fresh water.

Whereas the requirements below do not apply to freshwater storage, design and construction provisions and measures for protecting the physical integrity of the AWSS should be considered when storing large volumes of fresh water in an AWSS. Note that Section 3.4.1 of *Directive 055* states that aboveground and underground tanks do not have to meet secondary containment requirements if they are used to store water that meets the surface water discharge criteria described in Section 11 of *Directive 055*. The criteria in Section 11 are used to define fresh water in this document. Fresh water in an AWSS should be tested to ensure that it has not been contaminated by other sources.

An AWSS storing water that exceeds the criteria in Section 11 of *Directive 055* must meet the following requirements.

- 1) The AWSS can be used to store water-based fracturing fluids and fracturing flowback fluids, but it must not be used to store hydrocarbon-based fracturing fluids or fracturing flowback fluids.
- 2) The capacity of the AWSS must not exceed 3000 m³.
- 3) The wall system must be constructed of steel and be designed, fabricated, tested, and installed to applicable engineering, manufacturing, and regulatory standards. It must be engineered to withstand the hydraulic pressure of the stored contents at full capacity. The design and construction of the wall system must be certified by a professional engineer in good standing with the Association of Professional Engineers, Geologists, and Geophysicists of Alberta.
- 4) Because the synthetic liner is being used for primary containment, it must be at least 30 mil thick, have a hydraulic conductivity of 10⁻⁷ cm/s or less, have properties (i.e., density, tensile strength, elongation, tear resistance, and puncture resistance) suitable for the intended use, be chemically resistant to the hydraulic fracturing and flowback fluids, and be rated for the temperatures it encounters.
- 5) The synthetic liner must have a quality assurance/quality control (QA/QC) report from the manufacturer specifying the liner properties and its construction (e.g., guaranteed quality seams). The QA/QC report must be provided to the ERCB upon request.
- 6) The ground surface preparation and installation of any geotextile must be documented and signed off as acceptable by the liner installation contractor before the synthetic liner is installed. This documentation must be provided to the ERCB upon request, and it must reflect a consideration of site-specific conditions such as
 - substrate stability and bearing capacity,
 - slope and grade,
 - the adequacy of surface conditions, and
 - the need for an intervening geotextile cushion.

- 7) The liner must cover the ground floor of the wall system, extend up the wall, and be keyed onto the outside of the wall. The system used to key the liner must secure the liner to the wall while not damaging the liner.
- 8) The installation of the liner, including keying to the steel wall, must follow the manufacturer's specifications and be done by qualified personnel.
- 9) The AWSS must be tested for integrity before it is put into service.
- 10) The liner installation and the integrity verification of the AWSS must be documented (QA/QC data) and provided to the ERCB upon request.
- 11) The walls and liner of the AWSS must not be penetrated (i.e., fluid receipt and transfer lines must not go through the walls and liners).
- 12) Lines and hoses must be appropriately screened and located within the AWSS so as to prevent damage to the liner.
- 13) For protection of the AWSS, it must be located on the lease so as to isolate it as much as practicable from drilling and fracturing operations and from vehicle traffic. Barriers (e.g., earthen berms, blocks) may be used for added protection.
- 14) All ERCB equipment spacing and setback requirements must be followed.
- 15) Before directing flowback fluids into the AWSS, the fluids must first be directed to a tank, series of tanks, or other separation equipment to drop out solids, separate out any hydrocarbons that may have infiltrated from the reservoir, and reduce fluid temperature.
- 16) Where necessary, freeze protection must be sufficient to prevent stored contents from reaching the freezing point.
- 17) Measures must be implemented to prevent wildlife from entering or landing within the AWSS.
- 18) Where fugitive emissions or odours from the AWSS are concerns, mitigative measures must be implemented.
- 19) The AWSS must be visually inspected daily for leaks, and the results of the inspection must be documented and made available to the ERCB upon request.
- 20) Contingency plans must be in place to immediately remove and appropriately manage the contents of the AWSS in the event that containment of the AWSS fails.
- 21) A minimum freeboard of 1 m must be maintained within the AWSS at all times.
- 22) The normal storage duration must not exceed three months. Contents must be removed and the AWSS dismantled within the three-month timeframe.

 Note: should it be anticipated that the three-month storage duration will be exceeded, licensees must surround the AWSS with a dike meeting the requirements of Section 5.3.2.1(a) of *Directive 055*, or alternatively, licensees must surround the site with a 1 m berm. The AWSS must not be in use for more than a year (the one-year limit includes the three months that the AWSS can operate without a dike or perimeter berm). Contents must be removed and the AWSS must be dismantled within the one-year timeframe.

 AWSSs located closer than 100 m to a water body must be diked, or alternatively, the site must be bermed (refer to Section 8.060 of the *Oil and Gas Conservation Regulations*).
- 23) If the daily inspection identified any leaks or if the integrity of the AWSS was compromised or suspected of being compromised, the soil of the area on which the AWSS was located must be sampled and assessed for contaminants related to the storage.

Remedial measures must be implemented to reduce contamination to applicable Alberta Environment Tier 1 Soil Remediation Guideline values.

- 24) Liners must not be reused and must be managed as an oilfield waste in accordance with *Directive 058: Oilfield Waste Management Requirements for the Upstream Petroleum Industry*.
- 25) Licensees must notify the ERCB if they are planning to use an AWSS. The notification must be e-mailed to Directive055@ercb.ca with "Use of AWSS" in the Subject field. The notification must be submitted two weeks prior to use of the AWSS and include
 - licensee name and BA code,
 - well licences of the wells being fractured,
 - legal land location of the site on which the AWSS is situated,
 - the number of AWSSs on the site, and
 - the duration of use of the AWSSs (i.e., three months, or one year with a secondary containment dike or site perimeter berm).

3 Updates to Liner Requirements

Section 13 of *Directive 055* details liner requirements, but whereas the section identifies hydraulic conductivity ratings for primary and secondary compacted clay liners and natural liners, it does not specify such ratings for synthetic liners. Section 13 also specifies that synthetic liners used for secondary containment must be at least 30 mils thick, but it does not specify a minimum thickness for primary containment.

Section 9, Requirements for Bulk Pads, identifies that liners used for primary containment must have a hydraulic conductivity rating of 10^{-7} cm/s or less, but the same requirement is not identified in Section 8, Requirements for Lined Earthen Excavations.

This addendum to *Directive 055* updates Section 13, Liner Specifications, regarding hydraulic conductivity ratings for liners and the minimum thickness for synthetic liners used for primary containment as follows (all other requirements in Section 13 remain in effect).

- 1) Liners used for primary containment must have a hydraulic conductivity rating of 10^{-7} cm/s or less.

For compacted clay and natural liners, the 10^{-7} cm/s hydraulic conductivity is determined in situ. When determined in a laboratory from a representative disturbed sample, the material must have a hydraulic conductivity of 10^{-8} cm/s or less under full hydrostatic head.

- 2) Liners used for secondary containment must have a hydraulic conductivity rating of 10^{-6} cm/s or less.

For compacted clay and natural liners, the 10^{-6} cm/s hydraulic conductivity is determined in situ. When determined in a laboratory from a representative disturbed sample, the material must have a hydraulic conductivity of 10^{-7} cm/s or less under full hydrostatic head.

- 3) Synthetic liners used for primary containment must be at least 30 mil thick.

4 Optional Diking Requirements for Temporary Use of Single-Walled Aboveground Storage Tanks

Section 3.5 of *Directive 055*, Temporary Storage, identifies specific upstream petroleum industry operations involving temporary storage and states temporary storage should typically not exceed three months. It also identifies for the specified operations, situations in which diking can be optional for temporary use of single-walled ASTs. The large fluid capacities of some of the multi-stage hydraulic fracturing operations that accompany the emerging development of unconventional oil and gas resources in Alberta were not contemplated when the 2001 edition of *Directive 055* was being developed. It also appears that the typical three-month temporary storage duration is often disregarded when the operation is well drilling, completions, testing, or servicing.

The situations specified in Section 3.5 for which diking is optional for temporary use of single-walled ASTs remain. This addendum applies the following maximum capacity and storage duration to the requirements.

- 1) The total combined capacity of all temporary single-walled ASTs on a site must not exceed 3000 m³ (e.g., forty-seven 400-barrel tanks).
- 2) The normal storage duration must not exceed three months; the contents must be removed from the ASTs, and the ASTs must be removed from the site.

Note: should it be anticipated that either the maximum storage capacity or the three-month temporary storage duration will be exceeded, licensees must surround the ASTs with a dike meeting the requirements of Section 5.3.2.1(a) of *Directive 055* (an impervious liner is not required because the duration is less than one year) or alternatively, licensees must surround the site with a 1 m berm. The storage duration must not exceed one year. The one-year limit includes the three months that the ASTs can operate without a dike or perimeter berm. All ERCB equipment spacing requirements must be met.

With the above additions to Section 3.5 of *Directive 055*, the following statement from Section 3.5 is no longer in effect:

Approval holders or licensees exercising the option to not dike a tank for well drilling, completions, testing, or servicing operations must empty the tank or remove it from the site within 72 hours of completing the operation.

When opting to not dike ASTs, licensees are expected to use reasonable judgment to ensure that environmentally sensitive areas are protected. ASTs located closer than 100 m to a water body must be diked, or alternatively, the site must be bermed (refer to Section 8.060 of the *Oil and Gas Conservation Regulations*).