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Liners Provide Secondary Containment

By Beth Powell

TYRONE, PA.–While the debate rages about the risk of groundwater contamination posed by hydraulic fracturing, surface spills are one area where industry, regulators and environmentalists tend to agree on the risk. Sources of oil, fracturing fluid and flow-back spills at the pad include the drilling rig, mud tanks, diesel tanks, frac tanks, sand kings, generator sets, light stands, contractor vehicles, and blowouts at the wellhead.

The American Petroleum Institute has written a recommended practice (51R) and a guidance document (HF3) regarding environmental protection and mitigating surface impacts. The secretary of the Energy Advisory Board states, "Incidents causing problems have been unrelated to fracturing itself, but have arisen from surface spills, poor cementing jobs in wellbores, and other operational failures."

The Pennsylvania governor's Marcellus Shale Advisory Commission notes, "The primary concerns regarding hydraulic fracturing relate to surface spills of fluids, well control, and lost containment of production and flow-back water on the surface."

The risk of surface spills can be mitigated by secondary containment, which is a method of safeguarding added to the primary containment system (storage tanks, pipes, drums, blowout preventers). Depending on the liquid, secondary containment may be required by federal and state regulations.

Common secondary containment options include dikes, berms or retaining walls sufficiently impervious to contain oil; curbing; culverts, gutters or other drainage systems; weirs; booms; barriers; spill diversion and retention ponds; sorbent materials; drip pans; and sumps and collection systems (40 CFR 112.7).

Types Of Secondary Containment

There are two types of secondary containment, according to the federal definition: specific and general. Specific secondary containment requirements are intended to address a major container failure (the entire contents) associated with a bulk storage container, single compartment of a tank car or tank truck, mobile/portable containers, and production tank batteries. Provisions provide explicit requirements for sizing, design, and freeboard (rainfall accumulation).

General secondary containment requirements are intended to address the most likely discharge (typical failure mode and the most likely quantity) from bulk storage containers, mobile/portable containers, production tank batteries, and oil-filled operational equipment. According to 40 CFR 112.10, onshore drilling sites are required only to have general secondary containment, which can be passive (does not require human intervention to function) or active (does require human intervention).

Because of the large volumes in the diesel and frac tanks involved in drilling and completions, secondary containment tends to be passive, such as liners and/or berm systems. Active measures such as vacuum trucks, spill trailers and absorbents are unlikely to be deployed in time to prevent a large spill from leaving the pad.

Federal SPCC Regulation

The major federal regulation regarding oil storage at well sites is the Spill Pre-

Drilling pad containment typically consists of some local containment deployed around specific contaminant sources such as reservoir, fuel or chemical tanks, along with complete containment deployed over the entire pad. In either case, liners should be durable, impervious, and chemically compatible with the liquid.

If the top layer of containment sub-base is too hard, protruding debris and stones cannot be pushed down and may result in punctures. If the sub-base is too soft, ruts may cause traffic to bounce and embed equipment forks into the liner.

vention, Control and Countermeasure (SPCC) rule. This rule is part of the Clean Water Act's oil pollution prevention regulations (40 CFR 112). The purpose of SPCC is to develop plans designed to prevent oil discharges from reaching navigable waters.

These plans should include:

- Containment and procedures to prevent oil discharges;
- Proactive control measures to keep an oil discharge from entering navigable waters; and
- Effective countermeasures to contain, clean up, and mitigate any oil discharge that affects navigable waters.

SPCC only regulates oil, but it is oil of any kind or in any form, including petroleum oils, greases, fuel oil, sludge synthetic oils, mineral oils, oil refuse, oil mixed with waste, natural gas drip or condensate, and synthetic, hydraulic, lubricating and mineral oils. A good rule of thumb is if a substance coats or floats, it probably is an oil.

Not included in the SPCC definition of oil is natural gas and highly volatile liquids that volatize on contact with air or water (liquid natural gas and liquefied petroleum gas).

Two criteria have to be met for the SPCC rule to apply to operations. First, the on-site oil storage capacity must be greater than 1,320 gallons from containers of 55 gallons or more. The diesel tanks on the drilling rig and the generator sets during fracturing typically meet the above-ground threshold.

Second, an oil discharge could "reasonably be expected to discharge oil into navigable waters of the United States or adjoining shorelines." Navigable waters include surface waterways such as streams, creeks, rivers and lakes; wetlands adjacent to a navigable waterway; and intermittent streams.

Pennsylvania Act 13 Of 2012

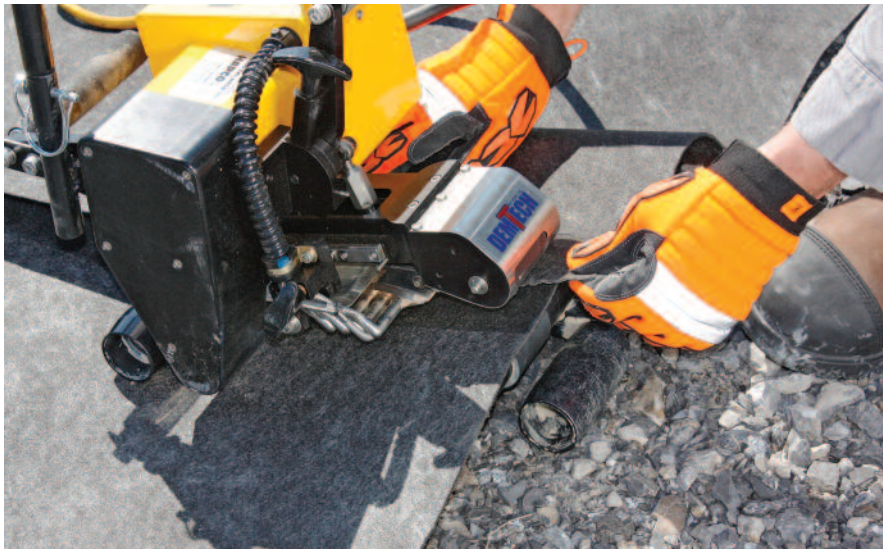
Because of SPCC and the API recommendations, secondary containment for drilling mud, diesel tanks and fracturing additives is common practice in most oil and gas plays, unless they are in an arid location that is unlikely to discharge to navigable waters. The use of liners under the drilling and completion operations, however, started as industry's response to limit state violations for surface spills.

It is important to point out that federal regulations trigger a violation when navigable waters are impacted (surface sheen), but Pennsylvania's trigger is a spill to ground, not to water. The reportable quantity is five gallons outside of secondary containment. Notification is requested for spills of more than 42 gallons inside secondary containment.

Pennsylvania's Act 13 not only encompasses the oils used on site, it brings flow-back water under secondary containment regulation. As such, Pennsylvania has the strictest secondary containment regulations for the Marcellus and Utica plays.

The containment plans required by Act 13 are called master containment plans (MCPs). These detailed plans should include the installation, utilization, integration and maintenance plans for all containment systems that may be used, as well as the manufacturer's specifications for materials used, installation directions, maintenance requirements, chemical compatibility, warranted uses, and reuse/disposal considerations. The MCP should state how the secondary containment system will be used in practice, either as local containment or as complete containment.

Local containment is deployed only at the site of the reservoir (tanks), such as diesel fuel tanks, chemical tanks, roll-offs, drilling rigs, and trucking transfer stations. Complete containment is deployed for the entire well pad.



Large liner panels should be seamed together with a wedge welder, rather than a hot air gun or extrusion welder, to ensure good seam contact over long lengths. The welder should be set to the correct temperature and speed, depending on liner and site conditions.

Typically, a hybrid approach is used with some local containment and some large-area containment. In either case, the liner should be durable, impervious, and chemically compatible with the liquid.

Durability is needed to support the weight and traffic of heavy equipment, such as drilling rigs, frac tanks and trucks, without punctures and tears. Impervious means the system does not leak and is able to hold the liquid until cleanup can occur. To be chemically compatible, the liner's physical and chemical characteristics must not be adversely affected by the waste.

Liner Containment Systems

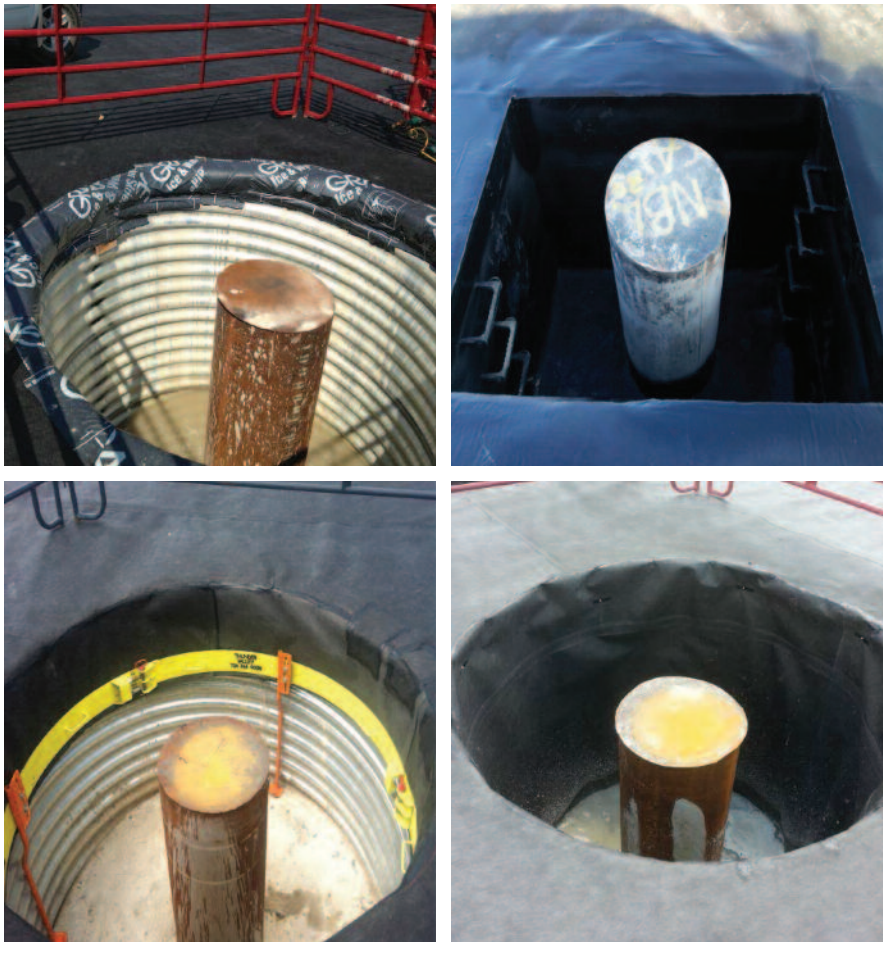
Four types of containment typically are found on Appalachian well pads: pad, tank, equipment and chemical storage.

Pad containment is the main liner that is placed over a large area. Typically, it is centered off the wellheads, on which multiple operations take place. The liner is installed before rigging up and before a completion move. The liner may be attached directly to the cellar walls, either mechanically or with a coating, to prevent any backup at the wellhead from pushing under the liner.

Tank containment is the containment under the diesel tank or a battery of frac tanks, and may or may not be on top of pad containment. Plastic, metal or concrete barricades are used to provide high walls to meet 110 percent containment of the largest tank.

Equipment containment is placed directly under equipment that is leak prone. It may be on the pad containment to limit spread (mud tanks, pump house) or it could be under a generator, light post, sewer treater, etc., that is off the pad containment.

Chemical storage containment is placed under liquid and dry chemical storage to prevent mixing or dust blowing. It may be on the pad containment or a separate containment. If on the main pad, the driveways should be protected with plastic mats because of the high number of loads moved.



The liner should be attached to the cellar walls, either mechanically or with a coating, to prevent any backup at the wellhead from pushing under the liner. Cellar attachment options pictured here are, clockwise from top left, an ice guard, spray urea, cementing the liner column, and metal ring.

Recommended Practices

There are a number of lessons that can be learned from the experience and field testing performed by Appalachian Basin operators.

The sub-base for containment needs to provide a flat, firm foundation. If the top layer of the sub-base is too hard, such as soil cement, protruding debris and stones cannot be pushed down by traffic and can result in punctures. Cement soil should be capped by one-two inches of gravel.

If the top layer of the sub-base is too soft, such as mud or high-clay content soil, developing ruts will cause traffic to bounce and embed equipment forks into the liner. The rutted areas do not support the liner, which can result in tears.

The gravel base needs some ability to shift to disperse load. We recommend 0.75-inch to fine limestone (2A-modified, crusher run, 57 pounds).

All pads should be rolled before the liner is installed.

Large liner panels should be seamed together with a wedge welder, not a hot air gun or extrusion welder, to ensure good seam contact over long lengths. The hot air gun and extrusion welder should be used only for spot repairs or detail work around obstacles. The welder should be set to the correct temperature and speed, depending on liner and site conditions.

Suspect field seams should be tested for water tightness. The air lance test and the vacuum plate test are nondestructive.

When installing berms:

- Place plastic barricades around the perimeter to maintain designated entrance areas.
- Do not use metal L-brackets to build spot containment. They are an impalement hazard.
- If corrugated pipe is used to make the berm, the sections that meet to establish a corner should either be strapped together or banded to 90-degree elbows to prevent kick-out.

Maintenance And Safety

Containment should be inspected fre-

quently for holes and berm issues. These should be patched according to manufacturer's instructions. Mud and water must be removed before applying the patch.

Vacuum off standing water before it freezes. If there is more than an inch, it takes a long time to melt off. Use a dark-colored liner in the winter. The sunlight in the morning will melt ice quickly and evaporate water.

A rotatory nylon brush is highly effective at removing construction dirt, sand and snow from the surface of the liner. A contained brush–typically used to clean roadsides–also picks up water and mud, and is more effective at removing trace amounts of dirt and sand.

Do not place pipe racks directly on the containment liner. Use rig mats/ground stabilization mats, or keep the liner tight to the catwalk. For closed-loop systems, use rig mats in the backyard for the drill cutting bins and track hoe path.

If the liner installation will be used for both drilling and completions, tack drop cloths around the wellheads. When drilling is complete, these areas typically are contaminated and can be removed easily before the completion operations begin.

Safety considerations include using liners with high coefficients of friction (COF) to limit slips and falls. Avoid liners with smooth surfaces. Also avoid textured liners with smooth seams, since there is a large change in the COF between the two areas. A consistent, high COF is critical when snow, ice and drilling mud are on the surface.

Active snow removal greatly reduces ice buildup.

Limit loose layers and wrinkles in the containment liner. Wrinkles should be pulled out during installation and after equipment is placed. The edges should be weighted until berming is complete.

Do not place grounding rods in high traffic areas. They are an impalement hazard. Cover exposed rod ends with buckets, tennis balls or other protective cushioning.

Spill Prevention

Liners should be designed for the application. Liners exposed to vehicles and equipment should be highly resistant to tears and punctures.

If grounding rods are placed through the liner, boots and standing pipe must be used to maintain sump capacity. The height must be at least as tall as the berm.

To avoid spills backing up under the liner, place a liner sleeve into the cellar and bond the liner edges to it to conform to the opening.

Clean up hydrocarbon spills such as drilling mud and pipe dope as quickly as possible. Place catch basins at transfer locations (valves).

The liner should terminate at or beyond the top of the berm. The lowest point of the liner determines the entire containment's sump capacity.

Avoid parking on the berm because this lowers the overall sump capacity.

Secondary containment on drilling and completion sites requires planning and inspection to ensure compliance with federal and state regulations. The subbase, inherent liner durability, and seaming method have a direct impact on the long-term functionality of the containment system.

Maintenance programs should address inspection frequency, correct patching methods, and berm repair. Controlling traffic and on-site contractor training will greatly reduce maintenance costs.

When choosing the liner or other barrier, be aware of safety concerns. In cold and wet climates, a surface with a high coefficient of friction can reduce slips and falls significantly. Limiting wrinkles, removing spills, and repairing tears also have a direct impact on safety. ❐

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Beth Powell is vice president and general manager at New Pig Energy, a subsidiary of Tyrone, Pa.-based New Pig Corporation, which supplies environmental, health and safety products to more than 200,000 sites in more than 70 countries. New Pig Energy supplies advanced secondary containment liner systems to operators in the Marcellus, Utica and Niobrara plays. With 19 years of experience in chemicals and plastics manufacturing, Powell has invented absorbents, hazardous material packaging, leak protection products, and secondary containment systems. She has been granted four U.S. patents, along with their international issuances. She is a director-at-large for the Pennsylvania STEPS (Service, Transmission, Exploration and Production Safety) Network. Powell holds a B.S. in chemical engineering and an M.B.A. from Pennsylvania State University.