Statement Explaining Why the Applicant (Lime Rock) Seeks a Variance

The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of 19.15.17.11.J:

> (4) The primary (upper) liner and secondary (lower) liner shall be geomembrane liners. The geomembrane liner shall consist of 30- mil flexible PVC or 60-mil HDPE liner, or an equivalent liner material that the division's district office approves. The geomembrane liner shall have a hydraulic conductivity no greater than 1 x 10-9 cm/sec. The geomembrane liner shall be composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. Liner compatibility shall comply with EPA SW- 846 Method 9090A or subsequent relevant publication.
>
> (5) The operator shall minimize liner seams ... The operator shall ensure field seams in geosynthetic material are thermally seamed (hot wedge) with a double track weld to create an air pocket for non-destructive air channel testing. The operator shall test a seam by establishing an air pressure between 33 and 37 psi in the pocket and monitoring that the pressure does not change by more than one percent during five minute after the pressure source is shut off from the pocket…

With respect to the material of the primary liner, Lime Rock proposes 45-mil LLDPE-R liner. The thermal fusion seams will be as directed by the manufacturer and QC tested as outlined in the attached Frobel Technical Memo.

The proposed materials for the primary liner are easier to install, will contain fewer field seams, and has several additional characteristics that are better than the prescribed 30-mil PVC. The applicant seeks a variance to provide a better product that will promote the use of these pits to conserve fresh water resources.

Demonstration That the Variance Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment

With respect to the evaluation of the proposed materials for the primary liner, we believe the following elements are critical. First, in discussing liner media for Multi-Well Fluid Management Pits, NMOCD Rules state [emphasis added]:

> (5) The appropriate division's district office may approve other liner media if the operator demonstrates to the satisfaction of the appropriate division's district office that the alternative liner protects fresh water, public health, and the environment as effectively as the specified media.
>
> And
>
> 19.15.17.15 EXCEPTIONS AND VARIANCES:
> A. Variances.
> (1) An operator shall demonstrate with a complete application to the appropriate division district office that the requested variance provides equal or better protection of fresh water, public health and the environment. The appropriate division district office shall approve or deny the variance within 60 days of receipt of the complete application.
> (2) If the appropriate division district office denies the variance….

(3) An application for a variance shall include:
(a) a statement in detail explaining why the applicant wants to vary from the requirement of 19.15.17 NMAC, and
(b) a detailed written demonstration that the variance will provide equal or better protection of fresh water, public health and the environment.

The Rule does not state that the alternative media must be equivalent to the specified material; it states that the liner media (as described in a variance or exception) must provide equal or better protection of fresh water, public health or the environment [as the specified liner media, for example]. Nevertheless, the attached letter from Mr. Ron Frobel compares and contrasts the characteristics of 30-mil PVC and 45-mil LLDPE-R as primary liner systems for MWFM Pits and other containment structures.

The most important element of this demonstration that the proposed variance provides better protection of fresh water, public health and the environment than the specified 30-mil PVC material and, for the limited lifetime of these impoundments, is an excellent material to use for the primary liner.

Information on the qualifications of Mr. Frobel are also included in this submission.

R.K. FROBEL & ASSOCIATES
Consulting Engineers

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August 20, 2014

RE: Technical Memorandum
LLDPE-R and PVC as Alternative Primary Liner Systems in Produced Water Pits
NMOCD Draft Recycling Rule Title 19, Chapter 15 Requirements
Multi-Well Fluid Management Pits

Dear Mr. Hicks:

At your request, I have reviewed the specification for the Geomembrane materials and in particular the suitability of application for both 30 mil PVC and 45 mil LLDPE-R reinforced geomembrane as alternative primary liners for Multi-Well Fluid Management (MWFM) Pits and other produced water storage pits with a lifetime of less than 10 years. In consideration of the primary lining system application, life expectancy of the pits, size of impoundments and depth, design details as well as the chemical analysis provided for the processed water, it is my professional opinion that the 45 mil LLDPE-R geomembrane will provide the requisite barrier against processed water loss and will function far better than 30 mil PVC as a primary liner system in short term (5 to 7 years) exposure. The following are discussion points that hopefully will exhibit the attributes of a 45 mil LLDPE-R primary lining system:

LLDPE-R Base Polymer. As discussed in previous technical memorandums, the LLDPE resin is similar to HDPE with the major difference noted that LLDPE exhibits lower density, lower crystallinity (more flexible and less chemical resistant) and better thermal fusion weld capability.. LLDPE resin will resist aging and degradation and remain intact for many years in exposed conditions. As referenced in my June technical memorandum, the Geosynthetic Research Institute (GRI) study on lifetime prediction (GRI Paper No. 6), shows that the half life of HDPE (GRI GM 13) exposed is > 36 years and the half-life of LLDPE (GRI GM 17) exposed is also approximately 36 years (the Yates and Lime Rock Multi-Well Fluid Management Pits life span is expected to be only 7 years maximum). It is understood that in order to ensure compliance of materials, the primary geomembrane to be used in the pits must meet or exceed GRI Specification Requirements and in this case should meet or exceed GRI GM 17 for non-reinforced LLDPE and/or GRI GM 25 for reinforced LLDPE-R. Adhering to the minimum requirements of the GRI Specifications, 45 mil LLDPE-R when used as an alternate primary liner will be far superior to an exposed 30 mil PVC. It should be noted that PVC geomembranes are not addressed in GRI specifications.

PVC Base Polymer. PVC base resin is formulated with a number of components including oils, plasticizers, fillers and carbon black. The polymer structure is relatively

amorphous and low in crystallinity and thus more permeable than the semi-crystalline LLDPE structure. PVC must include plasticizers to make the sheet flexible and the plasticizers tend to leach out of the PVC polymer over time making the sheet stiff and very difficult to repair. Plasticizer migration is accelerated in exposed conditions by heat and UV/ozone attack. Thus PVC geomembranes are always designed with soil cover to protect the polymer from premature degradation. PVC geomembranes have been observed to deteriorate in exposed conditions in less than 2 years.

Durability of Geomembranes is directily affected by exposure conditions. Buried or covered geomembranes are not affected by the same degradation mechanisms (UV, Ozone, Chemical, Stress, Temperature, etc) as are fully exposed geomembranes. In this regard, the PVC lining material is much less robust when fully exposed to the elements than LLDPE-R. PVC geomembranes are required to be covered by other geosynthetics or earth materials to prevent exposure to UV, heat and oxidation. In particular, PVC geomembrane materials will degrade due to the extraction of plasticizers which is accelerated due to UV and heat exposure. LLDPE-R geomembranes do not have extractable resin components that would degrade the base polymer when subjected to fully exposed conditions.

Thermal FusionSeaming Requirements. Thermal seaming and QC seam test requirements for geomembranes are product specific and usually prescribed by the sheet manufacturer. Both dual wedge and single wedge thermal fusion welding is commonly used on LLDPE-R and QC testing by air channel (ASTM D 5820) or High Pressure Air Lance (ASTM D 4437) is fully acceptable and recognized as industry standards. In this regard, there should be no exception or recommended practice for seaming and QC testing in the OCD rules. This would be fully covered in comprehensive specifications for both the Primary and Secondary geomembranes that would be reviewed by OCD.

Potential for Leakage through the Primary Liner. Leakage through geomembrane liners is directly a function of the height of liquid head above any hole or imperfection. The geonet drainage media provides immediate drainage to a low point or sump and thus no hydrostatic head or driving gradient is available to push leakage water through a hole in the secondary lining system. Leakage through the Primary geomembrane is driven by size of hole and depth and will be detected by the increase of waste water in the sumps and the volume being pumped. If required, location of holes in the Primary can be found by Electrical Leak Location Survey (ELLS) using a towed electrode (ASTM D 7007). Holes found can then be repaired and thus water seepage into the Secondary will be kept to a minimum. This is particularly important when considering impoundments that will be in operation for only 5 to 7 years. Dependent on New Mexico OCR requirements for Action Leakage Rate (ALR), the sump volumes may only be monitored. For example, a typical ALR is < 20 gpad whereas a rapid and large leak (RLL) may be > 100 gpad. Most states specify maximum ALR values for waste impoundments usually in the range of 100 to 500 gpad. However, New Mexico does not specify any ALR for waste water impoundments (GRI Paper No. 15). .

Chemical Attack. Chemical attack to polymeric geomembranes is directly a function of exposure time as well as crystallinity. For short term exposure of 5 to 7 years, the LLDPE-R when used as a primary liner will provide a chemically resistant liner that can be QC tested to reduce potential defects or holes. Due to extractable components of PVC and less chemically resistant nature of the polymer (more amorphous and low crystallinity), PVC will not provide the requisite chemical resistant barrier in exposed conditions.

Geomembrane Installation. In consideration of the MWFM Pits as well as other impoundments, the following installation attributes of LLDPE-R should be considered:

- The scrim reinforcement of LLDPE-R provides a very dimensionally stable sheet in temperature extremes which results in far less field wrinkles and waves during and after installation. Non reinforced PVC is not as dimensionally stable.

- The LLDPE-R geomembrane is easily repaired using the same thermal fusion bonding method without the need for special surface grinding/preparation for extrusion welding. PVC, when oxidized and exhibiting loss of plasticizer is very difficult to repair and repair is usually by chemical fusion methods that are not as reliable as thermal fusion methods.

- Due to the scrim reinforcement, the LLDPE-R geomembrane will provide superior installation and operation resistance to mechanical damage and is especially resistant to tear propagation, puncture and abrasion. 30 mil PVC does not exhibit the same strength requirements necessary for a primary geomembrane that will be exposed to the elements.

- LLDPE-R does not require a soil cover or other type of cover system to protect it from exposure to the elements over a 5 to 7 year period whereas PVC geomembranes should be protected from direct exposure to the elements.

In summary, it is my professional opinion that 45 mil LLDPE-R geomembrane will provide a short term (5 to 7 years) primary liner system that is superior to 30 mil PVC and will provide the requisite protection of fresh water, public health and the environment for many years and especially for the estimated 5 to 7 year life of the MWFM Pits.

If you have any questions on the above technical memorandum or require further information, give me a call at 303-679-0285 or email geosynthetics@msn.com

Sincerely Yours,

R K Frobel

Ronald K. Frobel, MSCE, PE

References:

C-1445 Supplemental Information
Round Tank # 1 and # 2 Permanent Pits
Mack Energy Corporation
Section 19 T15S R29E Chaves County
September 2013
Prepared by R. T. Hicks Consultants Ltd.

NMOCD Draft Recycling Rule, Title 19, Chapter 15 – Produced Water, Drilling Fluids and Liquid Waste 2014 – Section 19.15__.12 B (4, 5, 6, 7)

Geosynthetic Research Institute (GRI) Published Standards and Papers 2013

ASTM Standards 2013

Attachments:

R. K. Frobel C. V.