

## **Volume 2**

# **C-147 Registration Package for Buffalo 12 Containment & Recycling Facility Section 30, T26-S, R32-E, Lea County**

**Engineering Drawings and Liner Specifications  
Design/Construction Plan  
Select Energy Services Manual  
Variances for AST Storage Containments  
Applicability of Engineering Variances to Variety of  
Site Conditions in Permian Basin**



*Aerial view showing in-ground containments designed by Magrym Consulting and permitted by Hicks Consultants. Also shown are two 60,000 bbl above-ground storage tank containments permitted by Hicks Consultants. Photograph by permission from Magrym Consulting.*

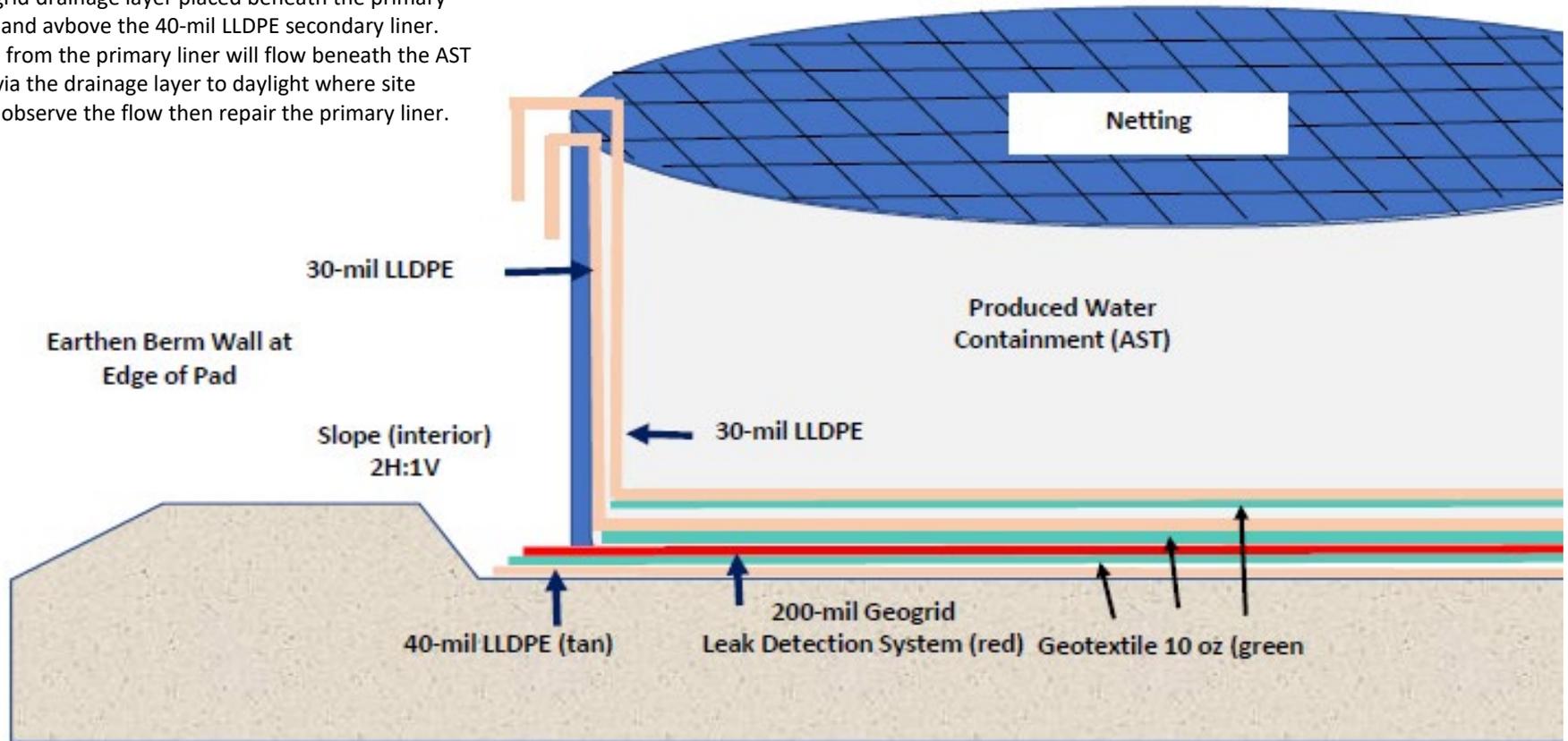
**Prepared for:**  
**Chisholm Energy Operating, LLC**  
**Ft. Worth, Texas**

**Prepared by:**  
**R.T. Hicks Consultants, Ltd.**  
**901 Rio Grande NW, Ste F-142**  
**Albuquerque, New Mexico 87104**

**Leak Detection Systems**

Select Energy employs a proprietary leak detection system between the two 30-mil LLDPE that comprise the primary liner. This system monitors seepage from the uppermost 30-mil LLDPE liner.

The leak detection system that complies with Rule 34 is the 200-mil geogrid drainage layer placed beneath the primary liner system and above the 40-mil LLDPE secondary liner. Any seepage from the primary liner will flow beneath the AST steel frame via the drainage layer to daylight where site workers can observe the flow then repair the primary liner.



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 505-266-5004	Select AST Schematic	Plate 1
	Chisholm Energy Operating - Buffalo 12	Mar-21









RTHC Note:  
 LLDPE spec is for Solmax LLDPE 30 mil see also  
<https://www.solmax.com/uploads/pdfs/c872c09979bde15306f50919d96f815a.pdf>

TECHNICAL DATA SHEET  
 Solmax 30mil LLDPE

Property	Test Method	Frequency (A)	Unit Metric	Solmax 130-2000
Thickness (min. avg.)	ASTM D 5199	Every roll	mm	0.75
Thickness (min.)	ASTM D 5199	Every roll	mm	0.68
Resin Density	ASTM D 1505	1/Batch	g/cc	<0.926
Melt Index-190/2.16(max)	ASTM D1238	1/Batch	g/10min	1.0
Sheet Density (C)	ASTM D1505	Every 2 rolls	g/cc	<0.939
Carbon Black Content (D)	ASTM D 4218	Every 2 rolls	%	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	Every 6 rolls	Category	Cat. 1 / Cat. 2
Oxidative Induction Time (min. avg)	ASTM D3895	1/Batch	min	100
Tensile Properties (min. avg)(B)	ASTM D 6693	Every 2 rolls		
Strength as Break			kN/m	20
Elongation at Break			%	750
2% Modulus (max.)	ASTM D 5323	PerFormulation	kN/m	315
Tear Resistance (min. avg.)	ASTM D 1004	Every 6 rolls	N	70
Puncture Resistance (min. avg.)	ASTM D 4833	Every 6 rolls	N	200
Dimensional Stability	ASTM D 1204	Every 6 rolls	%	+/- 2
Multi-Axial Tensile (min.)	ASTM D 5617	PerFormulation	%	90
Oven Aging-% retained after 90 days	ASTM D 5721	PerFormulation		
STD OIT (min. avg.)	ASTM D 3895		%	35
HP OIT (min. avg.)	ASTM D 5885		%	60
UV Resistance-% retained after 1600 hr	GRI-GM-11	PerFormulation		
HP-OIT (min. avg.)	ASTM D 5885		%	35

Note:

- (A) Testing frequency based on standard roll dimensions and one batch is approximately 180,000 lbs (or one railcar)
- (B) Machine Direction (MD) and Cross Machine Direction (XMD or TD) average values should be on the basis of 5 specimens each direction
- (C) Correlation table is available for ASTM D792 vs. ASTM D1505 Both methods give the same results.
- (D) Correlation table is available for ASTM D1603 vs. ASTM D4218 Both methods give the same results.

\*All values are nominal test results, except when specified as minimum of maximum  
 \* The information contained herein is provided for reference purposes only and is not intended as warranty of guarantee. Final determination of suitability for use contemplated is the sole responsibility of the user. Solmax along with Inland Tarp & Liner assumes no liability in connection with the use of this information.



SKAPS Industries  
 571 Industrial Parkway  
 Commerce, GA 30529 (U.S.A.)  
 Phone (706) 336-7000 Fax (706) 336-7007  
 e-mail: [info@skaps.com](mailto:info@skaps.com)

**SKAPS TRANSNET™ (TN)  
 HDPE GEOCOMPOSITE 220**

**SKAPS TRANSNET™ geocomposite consists of SKAPS GeoNet made from HDPE resin with non-woven polypropylene geotextile fabric heat bonded on both sides of the the geonet.**

Property	Test Method	Unit	Required Value			Qualifier
			With 6 oz.	With 8 oz.	With 10 oz.	
<b>Geonet</b>						
Thickness	ASTM D 5199	mil.	220±20	220±20	220±20	Range
Carbon Black	ASTM D 4218	%	2 to 3	2 to 3	2 to 3	Range
Tensile Strength	ASTM D 5035	lb/in	45	45	45	Minimum
Melt Flow	ASTM D 1238 <sup>3</sup>	g/10 min.	1	1	1	Minimum
Density	ASTM D 1505	g/cm <sup>3</sup>	0.94	0.94	0.94	Minimum
Transmissivity <sup>1</sup>	ASTM D 4716	m <sup>2</sup> /sec.	2x10 <sup>-3</sup>	2x10 <sup>-3</sup>	2x10 <sup>-3</sup>	MARV <sup>2</sup>
<b>Composite</b>						
Ply Adhesion (Minimum)	ASTM D7005	lb/in	0.5	0.5	0.5	MARV
Ply Adhesion (Average)	ASTM D7005	lb/in	1	1	1	MARV
Transmissivity <sup>1</sup>	ASTM D 4716	m <sup>2</sup> /sec	1x10 <sup>-4</sup>	1x10 <sup>-4</sup>	9x10 <sup>-5</sup>	MARV
<b>Geotextile</b>						
Fabric Weight	ASTM D 5261	oz/yd <sup>2</sup>	6	8	10	MARV
Grab Strength	ASTM D 4632	lbs	160	225	270	MARV
Grab Elongation	ASTM D 4632	%	50	50	50	MARV
Tear Strength	ASTM D 4533	lbs	65	90	100	MARV
Puncture Resistance	ASTM D 4833	lbs	95	130	165	MARV
CBR Puncture	ASTM D 6241	lbs	475	650	825	MARV
Water Flow Rate	ASTM D 4491	gpm/ft <sup>2</sup>	125	100	75	MARV
Permittivity	ASTM D 4491	sec <sup>-1</sup>	1.63	1.26	0.94	MARV
Permeability	ASTM D 4491	cm/sec	0.3	0.3	0.3	MARV
AOS	ASTM D 4751	US Sieve	70	80	100	MARV

**Notes:**

1. Transmissivity measured using water at 21 ± 2°C (70 ± 49°F) with a gradient of 0.1 and a confining pressure of 10000 psf between stainless steel plates after 15 minutes. Values may vary between individual labs.
2. MARV is statistically defined as mean minus two standard deviations and it is the value which is exceeded by 97.5% of all the test data.
3. Condition 190/2.16

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www.inlandtarp.com

### Geotextile Product Description Sheet 8oz ONG Nonwoven Geotextile

8oz ONG is a needle-punched nonwoven geotextile made of 50% polypropylene and 50% polyester staple fibers, which are formed into a random network for dimensional stability.

#### PROPERTY TEST METHOD UNIT

Weight (Typical) ASTM D 5261 oz/yd <sup>2</sup> (g/m <sup>2</sup> )	7.75 (220)
Thickness ASTM D 4491 mils (mm)	87 (2.21)
Grab Tensile ASTM D 4632 lbs (kN)	151 (0.673)
Grab Elongation ASTM D 4632	80%
Trapezoid Tear Strength ASTM D 4533 lbs (kN)	65 (0.287)
CBR Puncture Resistance ASTM D 6241 lbs (kN)	351 (1.56)
Permittivity* ASTM D 4491 sec-1	1.57
AOS* ASTM D 4751 US Sieve (mm)	140 (0.102)
UV Resistance ASTM D 4355 %/hrs	70/500

#### PACKAGING

Roll Dimensions (W x L) – ft 15 x 300

Square Yards Per Roll 500

Estimated Roll Weight - lbs 250

\* At the time of manufacturing. Handling may change these properties.

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#### U.S. Fabrication & Distribution Centers

Moses Lake, Washington . . . 4172 North Frontage Road E, Moses Lake, WA 98837 • 800.346.7744 • Fax 509.766.0414

Fostoria, Ohio . . . 1600 North Main Street, Fostoria, OH 44830 • 888.377.5640 • Fax 419.436.6007

Odessa, Texas . . . 8784 W. Interstate 20, Odessa, TX 79763 • 432.272.9413

**Select SOP**

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## **BEST MANAGEMENT PRACTICES FOR ABOVE GROUND STORAGE TANKS**



Select Energy Services  
1820 N I-35  
Gainesville TX 76240

# BEST MANAGEMENT PRACTICE FOR ABOVE GROUND STORAGE TANKS

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## Section 1.0 Introduction and Summary

### 1.1 Introduction and Purpose

Select Energy Services, LLC (and all its affiliated and subsidiary companies, hereinafter collectively referred to as “Select”) is committed to providing its employees a safe working environment and avoiding injury to our contractors, customers, and neighbors. As part of our overall commitment to safety, Select seeks to prevent acts or conditions that could result in injury and/or illness to any employee, customer, contractor, neighbor, and/or the environment.

In an effort to prevent potentially harmful acts or conditions, Select has developed this *Best Management Practice* (BMP) that focuses on above ground storage tank (AST) systems including planning, set up, operations, and take down. This BMP will discuss steps to be taken to promote a safe process, as well as a list of potential hazards that should be identified and remediated prior to beginning this procedure.

### 1.2 Background

*AST* is the industry term for an above ground storage tank. At Select, AST’s are used for a variety of field applications within the fluids management operations. AST’s can be used in place of traditional tank farms and in-ground water impoundments, and are suitable for fresh water as well as production water. At Select, AST’s are available in several standard sizes, ranging from 4,500 barrel (bbl) capacity to 62,000 bbl capacities. Select currently uses three basic styles of AST’s. One is referred to as a “pin” tank that uses large diameter steel pins to attach tank panels together. The second type of AST is a “plate” tank. Steel panels of a plate tank are attached using steel plates. Lastly, the “bolt” tank that connects using one-inch diameter bolts.

### 1.3 Intended Use

This BMP will be part of training provided to all affected employees when they begin their employment with Select and any time the plan is changed. This BMP will also be reviewed with an employee if his/her responsibilities change under the plan. A written copy of this plan will remain in the regional Safety Office, and will be available for employee review. The Vice-President of Health Safety and Environment, or his agents, may be contacted by any employee if he/she needs additional information about this BMP.

This BMP has been developed to assist affected employees with the operational steps that may be used to complete the task safely. **It must be noted, however, that the experience and background of a trained containment employee is essential to the success of any project or task.**

Nothing contained in this BMP is a substitute for each employee’s individual judgment in any given situation. In the event that any employee believes that any task outlined in any BMP cannot be completed safely, then that employee should immediately halt the performance of such task and notify their direct supervisor.

This BMP may also be used to inform customers about Select’s typical equipment and procedures for setting up an AST system. This BMP will be reviewed and revised on an ongoing basis to keep pace with best oilfield practices and applicable OSHA regulations.

### 1.4 Customer Environmental Health and Safety Programs

This BMP recognizes that oil and gas operating companies have developed their own health, safety, and environmental (HSE) programs that contractors who work at customer’s sites like Select, must comply with. In addition to this BMP, Select personnel will strictly observe the policies and procedures of each operating company.

### 1.5 Summary

This BMP is divided into four separate phases, each organized in chronological order. First is the planning phase that includes a customer-Select meeting and close coordination to be sure Select complies with all of customer’s

Health, safety, and environmental requirements and that **the site is ready for the AST setup**. This BMP then presents the specific tasks and safety requirements during the second phase - the AST setup phase. The third phase is the AST operation during which periodic checks of the tank are made per customer's requirements. The fourth phase addresses AST takedown during which all materials are removed from the site.

## Section 2.0 Planning for AST Rig-Up

The planning phase for AST systems includes several important activities that can impact the safety and success of an AST project. Step by step procedures are presented below for each of the following activities during the planning phase of an AST project:

- AST order information
- Customer meeting
- Site soil and pad preparation (by customer)
- Pre-mobilization on-site meeting
- Notifications
- Job Safety Analysis(JHA)
- AST material deliveries

### 2.1 AST Order Information

Select AST Manager/Account Representative will record general AST order information including the customer's site location information (911 Address, NOT only coordinates), specific tank requirements (size, number, liner type, candy canes, etc), desired schedule, customer's order reference number, and site specific customer contact information. The AST Manager/Account Representative provides this information, along with customer's contractual and safety requirements, to the appropriate personnel.

### 2.2 Customer Meeting

Prior to finalizing the delivery schedule, a meeting or conference call is held with Select and customer representatives including the customer's purchase agent and the customer's health, safety, and environmental (HSE) representative.

This meeting is best done in person, but must at least be covered in a phone call, followed up by a brief email confirming the AST order details, delivery schedule, and noting special conditions, safety requirements, **verification of pad preparation**, etc.

The following key topics will typically be discussed.

- Select site specific staff/roles
- Review AST intended use and customer safety requirements.
- Review AST scope of work, what is normally included, what is not.
- Permitting for AST (as needed)
- Site access and truck route requirements
- Time line for AST to be operational
- Confirm AST size(s) to be used
- AST layout on pad

NOTE: It is preferable to maintain a 30' clear work area around the perimeter of the tank to provide access for equipment. Regardless of manufacturer, the minimum footprint should be a circle with a radius of at least 24' greater than the radius of the tank.

Current site conditions, status/schedule for site preparation, and soil preparation requirements.

Responsibility for filling the tank, to a minimum of 2 feet deep, immediately after it is set up to protect from wind.

Responsibility for AST inspections during AST operation, any time tank is fully emptied, and the frequency of inspections.

Conditions that could result in standby time charges or additional charges, and what prior customer approvals are required.

Confirm customer is responsible for the used liner, residual solids left in the tank, and site reclamation.

Understand customer's OSHA Process Safety Management – Contractor safety and notification requirements for all activities on customer controlled sites.

Note any special PPE or safety requirements at site.

Notifications: Establish a list of notifications/communications that Select will be responsible for and timing for each. Select standard procedure is to notify owners of buried utilities in the AST site area using state-wide or Canadian Province "one-call" services at least one week in advance of AST setup. Identify any other notifications that Select will need to make (e.g. Truck routes, neighbors, etc). Also identify customer's procedures for notifying them if conditions arise that could impact scope, schedule, cost) and get email addresses as needed.

#### Other Topics

Any additional site preparation to be completed by customer prior to setup  
Underground material needs to be taken into account for site preparation.

Other Activities: Discuss AST site activities that will be ongoing during the AST set up. Select personnel will be aware and courteous of simultaneous operations at all times. **However, Select prefers very limited, if any, simultaneous operations near AST during set-up phase.**

#### Follow Up

After customer meeting, Select will document any changes to the AST scope of work, as needed, for the specific AST site and customer requirements in a brief email.

#### 2.3 Site Soil Preparation

Preparation of the soils on site is required to form a dependable base for the AST. **Preparation of the tank pad is solely the responsibility of the customer/operating company.** The key requirements are:

Select requires a minimum soil compaction of 95% compaction. Soil testing results shall be shared with Select. In order to meet industry standards, site preparation requirements must be deemed satisfactory by a Select representative.

Select recommends soil compaction testing to be conducted via Standard Proctor Test (American Society for Testing and Materials {ASTM} Standard D698) or Modified Proctor Test (ASTM Standard D1557).

Compaction test results must be provided to Select prior to the commencement of AST construction.

A proof roll test may be used if observed and documented by qualified Select personnel.

Grade AST footprint and 30 ft work area to 0.25 % or 3” drop per 100 feet, toward sump location.

Site shall be graveled and rolled prior to tank installation, utilizing gravel size 2B or smaller. (3/4” road grade preferred, or coarse sand with minimum thickness of 4 inches).

Do not use crushed rock as sharp edges could puncture the tank liner.

After completion of these steps the tank setup can be approved.

#### 2.4 Pre-Mobilization Onsite Meeting

Select’s AST team and customer will conduct a pre-mobilization onsite meeting that documents the customer requirements for the specific pad location and AST system.

#### 2.5 Notifications

Even though the customer or their subcontractor may have already called for utility locates for the sump hole, the AST Manager/Assistant should call the local or state underground utility location service again at least one week in advance before construction/digging begins. Select AST Manager/Assistant should document the ticket or reference number provided by the one-call service.

The following web site has contacts for all the states and provinces.

<http://www.call811.com/state-specific.aspx>. The website link below is provided for smart phones:



Call 811 in United States

#### 2.6 AST Material Deliveries

Once the delivery route and schedule are established and the pre-project onsite inspection is completed, the AST materials can be delivered. Notifications will be made as agreed to during the customer meeting. Select delivery personnel should unload all materials safely and taking care to avoid damage to liners, plates, and all other AST components. They will also stay out of the way of ongoing site activities, and notify the AST Manager/Assistant if site conditions are not suitable for delivery.

## Section 3.0 AST Setup

The Crew Leader will fill out the “AST Post Inspection Checklist” during and after the set up of the AST system. The checklist can be found in iScout under forms.

### 3.1 Job Hazard Analysis (JHA)

A job hazard analysis must be completed on site prior to beginning work. The JHA will be completed following Select approved procedures. Customer’s safety requirements will also be communicated during the JHA. All Select personnel, 3<sup>rd</sup> party contractors, and customer representatives are expected to participate and sign the JHA when the JHA is completed. Please refer to iScout for the digital JHA.

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### 3.2 Check Soil Condition

**Preparation of the tank pad is solely the responsibility of the customer.** However, weather and rain/snow events can change the soil conditions quickly. Therefore, Select will check soil compaction prior to setting up the AST.

### 3.3 Tank Layout

- Check proposed AST site to confirm a 30’ clear work area around the perimeter of the tank is possible to provide access for equipment and laydown area for AST materials and erection equipment.
- Check that the minimum distances to existing wells, power lines, etc. are met.
- Regardless of manufacturer, the minimum footprint should be a circle of at least 24’ or greater than that of the radius of the tank.
- Establish final location for the suction tube(s) and stairs.

### 3.4 Equipment (Select provided)

All equipment is subject to daily inspection. (Check condition, rigging, oil, water, fuel and cleanliness.) Here is a list of the recommended equipment needed to set a tank. Actual equipment used will vary among region and specific projects.

- Two 40’ and/or 60’ extending straight boom man-lifts.
- 10,000 lb or greater capacity, rough terrain forklift (telehandler).
- 17,000 pound or greater excavator with bucket and thumb attachment.

- Skid steer

### 3.5 Hand Tools Recommended

All hand tools are subject to daily inspection.

- Two 16' ladders
- Four 4 lb. sledgehammers
- 100' or 200' tape measure
- 1 case of marking paint – minimum
- Set of wrenches ¼" – 1 ½"
- Set of sockets ¼" – 1 ½"
- Two 36" pry bars
- 8' rock bar (digging bar)
- Five safety harnesses with retractable tethers (Select owned)
- Five retractable lanyards
- 100' of 3/8" rope
- Duct tape
- Covered hook bladed knife
- Three 40' lifting straps (minimum of 5,000 lb capacity)
- Three 20' 3/8" chains (must have visible certification tags)
- Two rolling head pry bars
- 150' strap
- Two ½" impact guns
- Two sets of rigging chains
- Patch tape
- Rubbing alcohol
- Patch roller
- Leather gloves
- Wire brush or wheel with 4" angle grinder
- Generator
- Steel toed rubber boots
- Fire retardant clothing (FRs)

### 3.6 AST Tank Setup Steps

- There must be a Select company representative on site the day prior to setup in order to approve everything for setup.

#### Tank Layout

- Determine center of tank and mark with paint. Place a non-abrasive item on the center point; preferably a sandbag. This will be used to find the center of tank after liners have been placed.
- Measure and double check minimum distance from tank center to existing wells.
- Measure and paint a line to mark the circumference of tank for panel placement.
- Also mark the circumference of the liner laid out flat to ensure the liner is properly placed.

#### Suction Pit

- Determine where tank suction is to be placed.

- Dig at least 6' wide x 6' long x 24" deep sump hole for the suction tube to set in and taper the edges so there are no sharp corners of the excavation.
- Remove any sharp stones and add at least one layer of geotextile.
  - If multiple suction manifolds are required, the sumps should have a minimum of 8' of separation.

**Attention!**

**Barricade any sump pit with appropriate cones, tape, equipment, and/or have a hole watch if left open.**

- All tank set-ups will require the use of a Select approved underlayment and liner. Depending on situational factors, 10oz or 16oz geotextile and 30 mil or 40 mil liner will be used. Additionally, multiple layers of each may be installed in both freshwater and produced water situations.
- Check customer specifications and regulatory permit liner and containment requirements for ASTs that may hold produced water.
- The crew walks the entire tank base area to pick up any sharp stones or other sharp debris that could damage the liner.
- Lay out the geo pad prior to the liner.
- Perform a visual inspection of the liner – repair any defects as necessary.
- Place the liner and align to the center of the tank and painted line for the tank walls. The preferred 30 ft area around tank allows the liner to be laid out flat so that fold back can be uniform.
- Secure liner from wind using sand bags.
- Fold the liner toward inside the painted tank edge line to allow placement tank panel walls.

**Tank Wall Erection**

- Ensure all tank parts and pieces are accounted for.
- Crew Leader will complete a visual inspection of each panel as it is prepared to be placed.
- Stand the first tank panel in place and secure it with the excavator bucket with thumb attachment. Keep connected to the excavator until the last panel is being set.
- Monitor equipment and first panel closely to ensure they remain stable, especially during higher wind situations.
- Begin placing the remaining panels in place.

- Personnel secured on man lift or using a ladder (depending on customer policies) then secure the panels in place with 4 pins each (for pin tanks) or (for plate tanks) with the connecting plates and lug busses, secured with chained cotter pins. Bolt tanks are connected using 1" diameter bolts.

**ATTENTION:** Proper hand and foot placement is crucial when connecting AST panels. Keep hands and feet a safe distance from pinch points. Discuss where these pinch points are located when reviewing the JHA. Proper ergonomics is required. Keep the joints in mid-range; i.e. palms are located between waist and shoulders. Create an awareness that never goes away and designate one individual to enforce the awareness when setting panels.

- Roll up excess geo pad into minimum 6" diameter cylinders around the inside of the tank ring to help support the liner at the base of the tank wall as the tank is being filled.
- Prior to lifting liner into place against inside panel, add geo strips over all panel gaps for plate and bolt type tanks.
- Prior to covering sump with the geo pad or liner, confirm sump excavation has smooth sides and corners, and that no sharp stones are present.

#### Liner Placement and Securing Top with Clamps

- After 4 or 5 panels are set, and all liner protection as described above is in place, unfold the liner in sections, toward the base of each panel, making sure the rolled up geo pad will provide padding at the base of the inside of each panel.
- Crew of 2 inside the tank wall unfolds and pulls the liner toward each panel (final connection of last panel will not be made until all liner to that point is pulled and secured to avoid confined space, all personnel must be out of tank before walls are closed) . Working in small liner sections, this inside crew works with a crew of 2 on a man lift located outside and above each tank panel to pull the liner edge up and over the top of each panel. The man lift crew lifts the liner edge using ropes/straps gently lowered and attached (by the inside crew). The man lift crew lifts a small liner section to the top of the panel and folds it over the top of the panel, being sure there is enough slack in the liner inside the panel wall.

**ATTENTION:** Never place hands on the railing of the man basket that faces the AST panel. Proper hand placement would be the side or back rail.

- Once a section of liner is positioned properly (with liner slack inside the tank) and over the top of each panel wall, the man lift crew secures the top of the liner with clamps. (Tools in basket secured with tool lanyards) NOTE: A minimum of 5 clamps or more are required at the top of each tank panel to secure the liner. Add additional clamps as needed to secure liner.
- Both inside and man lift crews continue this process, working around the tank, one or two panels at a time, until the entire liner is in place.
- NOTE: The crew must allow sufficient slack in the liner at the wall to allow for liner movement during filling and draining.

#### Stairs, Fill Tubes, and Suction Tubes

- Install safety stair system, fill tubes, and suction tubes. Ensure that stair system and tubes are appropriately secured to the tank walls with 2" ratchet straps or 3/8" chains and ratchet binders.

#### Final Steps, Filling, and Inspection

- Close final panel and secure with pins, plates, or bolts as needed.
- Trim liner and allow approximately 3' of liner to hang over edge of tank.
- Secure liner with sufficient clamps and be sure a 2" seatbelt strap (supplied with liner) is installed around the cut

edge of liner on the outside of tank. Pull tight with a ratchet.

- Inspect all connections and equipment, confirming at least 5 liner clamps (or more as needed) are in place on top of each panel.
- Have a minimum of 24 inches of water put in the tank to hold liner in place.
- Fill tank and monitor.
- Perform periodic inspections of the tank to ensure everything is in proper working order.
- Every time a tank is fully emptied and refilled, an inspection must be performed.
- Visibly inspect all tank panels and stairs for cracking, dents, burrs on the inside of the panels, chipping paint on welds or sharp edges on panels.
- Look for any cracked or broken valves, damage on pipes and tubes, missing D-Rings, damage to chains or ratchets, and bent clips.
- Pay close attention to hinge plates for chipping paint and cracking.
- Water should not go below 12 inches at the LOWEST level in the tank. (Mark liner as a caution).

## Section 4.0 AST Operation

### 4.1 Inspections and Monitoring

AST Operation Phase includes periodic AST monitoring, leak detection, and identifying potential hazards that may have developed, change on-site conditions or tank use. If the tank is drained, it should be secured from wind impacts and the liner inspected and re-positioned (to provide sufficient slack during filling) prior to refilling. Specifically, it may be necessary to rearrange the liner folds at the walls prior to refilling if the wind has shifted the liner folds when the tank was empty.

If changes are noted, they should be communicated to the Select AST Manager/Assistant Manager.

CAUTION – If conditions are observed that could indicate an imminent tank failure, clear the area immediately. Advise others in the vicinity to do so also and contact the customer to drain the tank.

### 4.2 Initial Leak Detection and Liner Repair

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In the event of a leak in the tank due to a hole in the liner, the following steps should be followed.

- If there is a question that it is in fact a leak from the AST, a dye test or a pH balance test may need to be performed on both the water in the tank and on the ground using approved dye or a properly calibrated pH meter. Third party test results are recommended.
- If the leak is found to be coming from the tank, narrow down from which panel the leak is originating.
- Use a strap or rope to mark the point where the water is coming out of the tank.
- Determine if the water is coming out high or low on the tank.
- Locate the puncture or hole in the liner.
- Empty the tank to the point of damage in liner if necessary.
- Clean area of liner that needs to be repaired.
- Cut out piece of material (patch or tape) to overlay liner.
- Either weld the patch to the injured area in the liner or stick the tape (2 types – dry or underwater) over the leak.
- Make sure puncture is completely covered.
- Monitor as needed.

## Section 5.0 AST Breakdown

The AST breakdown follows the reverse order of the setup steps presented in Section 3.0 above. The sump will be filled in with the same material taken out during excavation.

The customer is responsible for draining and disposing of all liquids and residual solids that have accumulated in the tank. Additionally, the customer is responsible for proper off site management or recycling of the liner and geo pad materials, and final grading and/or reclamation of AST site.

The Crew Leader will perform a visual inspection of AST panels and accessories for defects.

Attachment 1



**Above-Ground Storage Tank (AST) Reference Chart**

**Pin Style Panels**

	Panels	D (ft)	R(ft)	Trim Line (R+18')	Top of Wall (R+13')	Total V (bbls)	2' FB (bbls)	bbls/in	bbls/ft	Liner Size	Geo Size
9600k 20.08' Width 12'4" Height 5040lbs	12	76.7'	38.35'	56.35'	51.35'	10151.32	8505.16	68.59	823.08	118' x 118'	98' x 98'
	13	83.09'	41.55'	59.55'	54.55'	11915.83	9983.24	80.51	966.12	124' x 124'	104' x 104'
	14	89.48'	44.74'	62.74'	57.74'	13819.07	11577.88	93.37	1120.44	130' x 130'	110' x 110'
24k 18.77' Width 12' 4" Height 5040lbs	20	119.5'	59.75'	77.75'	72.75'	24646.95	20649.72	166.53	1998.36	160' x 160'	140' x 140'
	22	131.45'	65.76'	83.76'	78.76'	29822.81	24986	201.5	2418	172' x 172'	152' x 152'
	23	137.43'	68.72'	86.72'	81.76'	32597.98	27312.24	220.26	2643.12	178' x 178'	158' x 158'
	24	143.4'	71.7'	89.7'	84.7'	35491.62	29736.44	239.81	2877.72	184' x 184'	164' x 164'
40k 17.46' Width 12' 4" Height 5040lbs	24	153'	76.5'	94.5'	89.5'	40402.69	33850.9	272.99	3275.88	193' x 193'	173' x 173'
	28	178'	89'	107'	102'	54316.00	45508.00	367.99	4415.93	218' x 218'	198' x 198'
	30	193'	96.5'	114.5'	109.5'	62000.00	50270.27	418.91	5027.02	233' x 233'	200' x 200'

**Plate Style Panels**

	Panels	D (ft)	R(ft)	Trim Line (R+18')	Top of Wall (R+13')	Total V (bbls)	2' FB (bbls)	bbls/in	bbls/ft	Liner Size	Geo Size
9k (T) 32.72' Width 12'2" Height 5480lbs	7	73'	36.5'	54.5'	49.5'	9056.00	7457	62.9	754.7	113' x 113'	93' x 93'
	8	84'	42'	60'	55'	11843.55	9869.62	82.2	986.96	124' x 124'	104' x 104'
18k (P) 32.72' Width 12' 2" Height 5310lbs	9	94.58'	47.29'	65.29'	60.29'	15014.88	12512.4	104.27	1251.24	135' x 135'	115' x 115'
	10	105'	52.5'	70.5'	65.5'	18427.0	15356.0	128	1535.6	145' x 145'	125' x 125'
	11	115.6'	57.8'	75.8'	70.8'	22430.0	18692.08	155.77	1869.21	156' x 156'	136' x 136'
26.5k-41k (A) 32.72' Width 12' 2" Height 6500lbs	12	126'	63'	81'	76'	26660.57	22216.8	185.14	2221.67	166' x 166'	146' x 146'
	13	136.62'	68.31'	86.31'	81.31'	31329.39	26107.83	217.57	2610.78	177' x 177'	157' x 157'
	14	147.13'	73.565'	91.565'	86.565'	36340.00	30283.33	252.36	3028.33	188' x 188'	168' x 168'
	15	157'	78.5'	96.5'	91.5'	41382.0	34485.0	287.40	3448.5	197' x 197'	177' x 177'
	16	168.15'	84.075'	102.075'	97.075'	47464.49	39553.74	329.61	3955.37	209' x 209'	189' x 189'
	18	188.6'	94.3'	112.3'	107.3'	59721.00	49774.00	415.08	4976.75	229' x 229'	209' x 209'

# Design and Construction Plan Above Ground Tank (AST) Containments

## General

Examination of the engineering drawings and the SOP for set-up (Engineering Drawings, Liner Specifications, Set Up) plus the history of solid performance of these AST Containments demonstrates that the AST Containment is designed and will be assembled to ensure the confinement of produced water, to prevent releases and to prevent overtopping due to wave action or rainfall. As the AST Containments are generally less than 190 feet in diameter, wave action is not a meaningful consideration.

These AST Containments are constructed of 12-foot high steel panels, are netted (netting no larger than 1.5 inch per square per BLM COA) ~~and employ the Mega Blaster Pro avian deterrent system~~ to prevent ingress of migratory birds. AST Containments will be enclosed by a 4-strand barbed wire fence or better. Thus, complies with the Rule to fence or enclose a recycling containment in a manner that deters unauthorized wildlife and human access and shall maintain the fences in good repair.

The operator shall post an upright sign no less than 12 inches by 24 inches with lettering not less than two inches in height in conspicuous places surrounding the containment. The operator shall post the sign in a manner and location such that a person can easily read the legend. The sign shall provide the following information: the operator's name, the location of the site by quarter-quarter or unit letter, section, township and range, and emergency telephone numbers.

## Site Preparation

### *Foundation for AST Containment*

Preparation of the soils on site is required to form a dependable base for the AST Containment in accordance with NMAC 19.15.34 and the SOP and is the responsibility of the operating company. If the location of the AST Containment is on an existing pad, the operator has stripped and stockpiled the topsoil for use as the final cover or fill at the time of closure. If the pad is new construction, the operator will strip and stockpile the soil for reclamation upon cessation of site activities.

19.15.34.12 A

(1) The operator shall design and construct a recycling containment to ensure the confinement of produced water, to prevent releases and to prevent overtopping due to wave action or rainfall.

19.15.34.12 D

(1) The operator shall fence or enclose a recycling containment in a manner that deters unauthorized wildlife and human access and shall maintain the fences in good repair. The operator shall ensure that all gates associated with the fence are closed and locked when responsible personnel are not onsite.

19.15.34.12 C

Signs. The operator shall post an upright sign no less than 12 inches by 24 inches with lettering not less than two inches in height in a conspicuous place on the fence surrounding the containment. The operator shall post the sign in a manner and location such that a person can easily read the legend. The sign shall provide the following information: the operator's name, the location of the site by quarter-quarter or unit letter, section, township and range, and emergency telephone numbers.

19.15.34.12 B

Stockpiling of topsoil. Prior to constructing containment, the operator shall strip and stockpile the topsoil for use as the final cover or fill at the time of closure.

## Design and Construction Plan Above Ground Tank (AST) Containments

The foundation soils must be roller compacted. Compaction characteristics must meet or exceed 95% of Standard Proctor Density in accordance with ASTM D 698 or modified Proctor Test (ASTM Standard D1557).

Examination of the SOP shows that the AST Containment contractor will conform to the following mandates of the Rule:

- the AST Containment will have a properly constructed compacted earth foundation and interior slopes (vertical steel) consisting of a firm, unyielding base, smooth and free of rocks, debris, sharp edges or irregularities to prevent the liner's rupture or tear.
- Geotextile will be placed under the liner where needed to reduce localized stress-strain or protuberances that otherwise may compromise the liner's integrity.
- If the AST containment is within a levee, the inside grade is no steeper than two horizontal feet to one vertical foot (2H: 1V) and the outside grade no steeper than three horizontal feet to one vertical foot (3H: 1V). The vertical steel walls of the AST Containment are the subject of *a variance included in Volume 3* of this submission. OCD.

The Operator will ensure that at a point of discharge into or suction from the recycling containment, the liner is protected from excessive hydrostatic force or mechanical damage and external discharge or suction lines shall not penetrate the liner.

### *Liner and Leak Detection Materials*

The liner and geotextile specifications show that all primary (upper) liners in a recycling containment shall be geomembrane liners composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. All primary liners shall be *an equivalent liner [to that stated in Rule 34] and are pursuant to a requested variance*. The liner system is presented in an earlier section of this submission.

All secondary liners shall be *an equivalent liner [to that stated in Rule 34] approved by OCD pursuant to a*

19.15.34.12 A

(2) A recycling containment shall have a properly constructed foundation and interior slopes consisting of a firm, unyielding base, smooth and free of rocks, debris, sharp edges or irregularities to prevent the liner's rupture or tear. Geotextile is required under the liner when needed to reduce localized stress-strain or protuberances that otherwise may compromise the liner's integrity. The operator shall construct the containment in a levee with an inside grade no steeper than two horizontal feet to one vertical foot (2H:1V). The levee shall have an outside grade no steeper than three horizontal feet to one vertical foot (3H:1V). The top of the levee shall be wide enough to install an anchor trench and provide adequate room for inspection and maintenance.

19.15.34.12 A

(6) At a point of discharge into or suction from the recycling containment, the operator shall insure that the liner is protected from excessive hydrostatic force or mechanical damage. External discharge or suction lines shall not penetrate the liner.

19.15.34.12 A

(4) All primary (upper) liners in a recycling containment shall be geomembrane liners composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. All primary liners shall be 30-mil flexible PVC, 45-mil LLDPE string reinforced or 60-mil HDPE liners. Secondary liners shall be 30-mil LLDPE string reinforced or equivalent with a

## Design and Construction Plan Above Ground Tank (AST) Containments

*variance.* The liner system is presented in an earlier section of this submission.

Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.

*Variance request for liner system (two 40 mil LLDPE for primary and secondary liners) included in Volume 3.*

The AST Containment will have a leak detection system between the upper and lower geomembrane liners that shall consist of 200-mil geonet to facilitate drainage.

### *Install Secondary Liner, Leak Detection System and Secondary Containment*

All AST containments holding produced water will have a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions. The rule states that the edges of all secondary liners shall be anchored in the bottom of a compacted earth-filled trench. The anchor trench shall be at least 18 inches deep. The lack of an anchor trench with an AST Containment *is pursuant to a requested variance.*

The AST Containment Contractor will cause the recycling containment will have a leak detection system between the upper and lower geomembrane liners that shall consist of 200-mil geonet to facilitate drainage. The leak detection system shall consist of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped to facilitate the earliest possible leak detection (see attached drawing).

The presence of the secondary containment levee ~~or pre-fabricated secondary containment~~ meets the OCD Rule mandate that a recycling containment shall design the containment to prevent run-on of surface water. The containment shall be surrounded by a berm, ditch or other diversion to prevent run-on of surface water.

### **AST Containment Setup**

As with the secondary liner, AST Containment contractor will minimize liner seams and orient them up and down, as much as possible, not across, a slope.

hydraulic conductivity no greater than  $1 \times 10^{-9}$  cm/sec. Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.

19.15.34.12 A

(3) Each recycling containment shall incorporate, at a minimum, a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions. The edges of all liners shall be anchored in the bottom of a compacted earth-filled trench. The anchor trench shall be at least 18 inches deep.

19.15.34.12 A

(7) The operator of a recycling containment shall place a leak detection system between the upper and lower geomembrane liners that shall consist of 200-mil geonet or two feet of compacted soil with a saturated hydraulic conductivity of  $1 \times 10^{-5}$  cm/sec or greater to facilitate drainage. The leak detection system shall consist of a properly designed drainage and collection and removal system placed above the lower geomembrane liner in depressions and sloped to facilitate the earliest possible leak detection.

19.15.34.12 A

(8) The operator of a recycling containment shall design the containment to prevent run-on of surface water. The containment shall be surrounded by a berm, ditch or other diversion to prevent run-on of surface water.

## Design and Construction Plan Above Ground Tank (AST) Containments

Factory welded seams shall be used where possible. AST Containment contractor will employ field seams in geosynthetic material that are thermally seamed. Prior to field seaming, AST Containment contractor shall overlap liners four to six inches and minimize the number of field seams and corners and irregularly shaped areas. There shall be no horizontal seams within five feet of the AST Containment bottom. Qualified personnel shall perform field welding and testing.

### *Fluid Injection/Withdrawal Flow Diverter*

The injection or withdrawal of fluids from the containment shall be accomplished through a header, diverter or other hardware that prevents damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes.

19.15.34.12 A

(5) The operator of a recycling containment shall minimize liner seams and orient them up and down, not across, a slope of the levee. Factory welded seams shall be used where possible. The operator shall ensure field seams in geosynthetic material are thermally seamed. Prior to field seaming, the operator shall overlap liners four to six inches. The operator shall minimize the number of field seams and corners and irregularly shaped areas. There shall be no horizontal seams within five feet of the slope's toe. Qualified personnel shall perform field welding and testing.

19.15.34.13 B

(3) The injection or withdrawal of fluids from the containment shall be accomplished through a header, diverter or other hardware that prevents damage to the liner by erosion, fluid jets or impact from installation and removal of hoses or pipes.

## **Variations and/or Equivalency Demonstrations for Above Ground Steel Tank Modular Recycling Storage Containments**

- **Slope and Anchor Trench**
- **Freeboard**
- **40 mil LLDPE for Primary and Secondary Liners**
- **Applicability of Variations for Modular AST  
Containments in the Permian Basin of New Mexico**

***Slope and Anchor Variance Request for Above Ground  
Steel Tank Modular Recycling Storage Containments***

## STATEMENT EXPLAINING WHY THE APPLICANT SEEKS A VARIANCE FOR SLOPE AND ANCHOR FOR MODULAR STEEL AST CONTAINMENT

### Statement Explaining Why the Applicant Seeks a Variance

**The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of NMAC 19.15.34.12.**

**NMAC 19.15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT:**

A. An operator shall design and construct a recycling containment in accordance with the following specifications.

(2) A recycling containment shall have a properly constructed foundation and interior slopes consisting of a firm, unyielding base, smooth and free of rocks, debris, sharp edges or irregularities to prevent the liner's rupture or tear. Geotextile is required under the liner when needed to reduce localized stress-strain or protuberances that otherwise may compromise the liner's integrity. *The operator shall construct the containment in a levee with an inside grade no steeper than two horizontal feet to one vertical foot (2H:1V). The levee shall have an outside grade no steeper than three horizontal feet to one vertical foot (3H:1V).* The top of the levee shall be wide enough to install an anchor trench and provide adequate room for inspection and maintenance.

(3) Each recycling containment shall incorporate, at a minimum, a primary (upper) liner and a secondary (lower) liner with a leak detection system appropriate to the site's conditions. *The edges of all liners shall be anchored in the bottom of a compacted earth-filled trench. The anchor trench shall be at least 18 inches deep.*

**The applicant requests a variance to prescribed slope and anchor in the setting of above ground modular steel containments.**

With respect to storage of produced water for use in lieu of fresh water, Rule 34 is written for earthen, lined pits, not free-standing modular impoundments that employ liners as their primary fluid containment system. A modular impoundment consists of a professionally designed steel tank ring with vertical walls. There is no slope to consider as the segmental steel sections are set vertical.

There is no anchor trench as envisioned by the Rule, liners are anchored to the top of the steel walls with clips, no anchor trench is required.

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

The following technical memorandum provides supportive data to demonstrate equal or better protection of fresh water, public health and the environment by providing the requisite containment and protection.

**R.K. FROBEL & ASSOCIATES**  
*Consulting Engineers*

**Technical Memorandum: Slope and Anchor Trench Variance for Above Ground Steel Modular Containments**  
**NMAC 19.15.34.12 A (2), (3)**

**Side Slope**

The design of soil side slope (inclination) is a geotechnical engineering design consideration. Liquid impoundments such as fresh water or process water containments are usually built within an excavation or with raised earthen embankments. For a liquid impoundment with an exposed liner system, the slope soils and construction dictate slope inclination and very detailed slope stability analysis may be required to determine if slope failure within the embankment will occur once loaded with impounded water. Slope failure may also occur during construction or when the impoundment is empty. A maximum slope is usually specified and is dependent on soil type and cohesive strength, saturated or unsaturated conditions, etc. Detailed analysis for slope stability can be found in “Designing with Geosynthetics” by R.M Koerner as well as many geotechnical books.

A modular impoundment, on the other hand, consists of a professionally designed steel tank ring with vertical walls. *There is no slope to consider as the segmental steel sections are set vertical.* Design of steel tanks, in regard to hydrostatic loading, wind loading, seismic loads, etc. are thoroughly referenced with detailed procedures in the design code - American Petroleum Institute (API) 650-98 “Welded Steel Tanks for Oil Storage”. *There are no requirements for maximum slope inclination other than perhaps 90 degrees or vertical wall.*

**Anchor Trench**

All earthen impoundments with a geomembrane lining system require some form of top of slope anchor, the most common of which is an excavated and backfilled anchor trench usually set back at least 3 ft from the top of slope. Again, there are detailed procedures for anchor trench design in “Designing with Geosynthetics” by R.M Koerner.

*A Modular Impoundment requires mechanical anchoring of the geomembrane at the top of the vertical steel wall using standard liner clips that prevent the geomembrane or geomembrane layers from slipping down the side wall.* These are detailed in the Tank Installation Manual. *There are no requirements for an “anchor trench” as this is not an in-ground impoundment.*

*In summary, based on the design and specifications of a modular steel impoundment, there is no requirement for a maximum interior slope angle of 2H:1V due to the fact that this impoundment is a steel tank with vertical walls. Additionally, there is no requirement for an anchor trench as the geomembrane is attached to the top of the Modular Impoundment vertical walls with large steel clips.* This provides the requisite protection of fresh water, public health and the environment for many years.

**R.K. FROBEL & ASSOCIATES**  
*Consulting Engineers*

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](mailto:geosynthetics@msn.com)

Sincerely Yours,

*R K Frobel*

Ronald K. Frobel, MSCE, PE



**References:**

NMAC 19 15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT

American Petroleum Institute (API) 650-98 "Welded Steel Tanks for Oil Storage"

Koerner, R.M., 2005 "Designing With Geosynthetics" Prentice Hall Publishers

**Attachments:**

R. K. Frobel C.V.

***Freeboard Variance Request for Above Ground Steel Tank  
Modular Recycling Storage Containments***

## **STATEMENT EXPLAINING WHY THE APPLICANT SEEKS A VARIANCE FOR FREEBOARD FOR MODULAR STEEL AST CONTAINMENT**

### **Statement Explaining Why the Applicant Seeks a Variance**

**The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of NMAC 19.15.34.13**

#### **19.15.34.13 OPERATIONAL REQUIREMENTS FOR RECYCLING CONTAINMENTS:**

**B.** The operator shall maintain and operate a recycling containment in accordance with the following requirements.

**(2)** The operator *shall maintain at least three feet of freeboard at each containment.*

**The applicant requests variance to allow for a freeboard of 2 feet as opposed to the prescribed 3 feet in the setting of an above ground steel tank modular system.**

Rule 34 did not take into consideration above ground steel tank modular containment systems. With respect to lined earthen impoundments that may hold 25-acre feet of produced water, a 3-foot freeboard stipulation makes sense. For example, wave action and other factors could focus stress on the upper portion of the levee or the liner system in these large impoundments. The smaller diameter steel tank (modular impoundment) does not share the same characteristics as these large earthen pits.

We believe 3-feet of freeboard is not necessary – especially during active hydraulic stimulation of wells when maximum storage volume provides the highest value. Moreover, meeting the 3-foot freeboard requirement at all times significantly reduces the storage capacity of a single modular impoundment – negatively impacting the economics of using produced water in lieu of fresh water for E&P activities.

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

The attached technical memorandum by Ron Frobel, PE, describes how the proposed 2-foot freeboard limit in the permit application for the modular impoundment provides the same protection afforded by the 3-foot freeboard mandate for a large earthen pit. The attached equations and supporting email from Mr. Jason Henderson, PE, shows that a 2-foot freeboard limit on the steel impoundment meets the manufacturer's design criteria.

**R.K. FROBEL & ASSOCIATES**  
*Consulting Engineers*

**Freeboard Requirements for Above Ground Steel Tank Modular  
Recycling Storage Containments**

**NMAC 19.15.34.13 B (2)**

Liquid impoundments such as fresh water or process water containments are usually built within an excavation or with raised earthen embankments. For a liquid impoundment with an exposed liner system, the slope soils and construction dictate slope inclination and very detailed slope stability analysis may be required to determine if slope failure within the embankment will occur once loaded with impounded water. Freeboard or the vertical height between the maximum water surface elevation and the top of slope is important for earthen impoundments. Specified freeboard requirements take into consideration high precipitation events and prevent wave run-up on slopes that result in over-topping and potential saturation of embankments. This is particularly important on large earthen impoundments. Detailed design considerations including freeboard requirements for lined earthen impoundments can be found in "Designing with Geosynthetics" by R.M Koerner as well as other publications on reservoir design.

A modular impoundment, on the other hand, consists of a professionally designed steel tank ring with vertical walls. There is no slope to consider as the segmental steel sections are set vertical. Design of steel tanks as regards hydrostatic loading, wind loading, seismic loads, etc. are thoroughly referenced with detailed procedures in the design code - American Petroleum Institute (API) 650-98 "Welded Steel Tanks for Oil Storage". There are requirements for operational freeboard to prevent over-topping but due to the relatively small surface area and fetch of cylindrical tanks, wave heights are much less than large earthen impoundments. Thus, freeboard is usually within the range of 0.5 to 2 ft. I have reviewed the Tank Design Calculation Summary and regarding the structural stability of the tank walls, a freeboard of 0.5 ft was assumed. Thus, the variance request of 2.0 ft for a Modular Impoundment is well within the Tank Design requirements.

*In summary, it is my professional opinion that the design freeboard of 2.0 ft will provide requisite storage volume and prevent overtopping due to wind and wave action, potential seismic events and high precipitation.*

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](mailto:geosynthetics@msn.com)

Sincerely Yours,

*R.K. Frobel*

Ronald K. Frobel, MSCE, PE

References:

NMAC 19.15.34.13 OPERATIONAL REQUIREMENTS FOR RECYCLING CONTAINMENTS



***R.K. FROBEL & ASSOCIATES***  
***Consulting Engineers***

American Petroleum Institute (API) 650-98 “Welded Steel Tanks for Oil Storage”

Koerner, R.M., 2005 “Designing With Geosynthetics” Prentice Hall Publishers

Attachments:

R. K. Frobel C.V.

The modular impoundment is designed for use with fluids that are 8.34 pounds/gallon (62.4 pounds per cubic foot) or lighter. Exceeding this specification for fluid weight at full tank capacity (12') could lead to failure at the connection plate(s).

Assuming a freeboard of 0.5 ft (minimum modular impoundment freeboard requirement) the Hydro Pressure (p) of water is 718 pounds per square foot (psf), where

$$\begin{aligned}
 p &= \text{Design Density} \times \text{Height} \\
 &= 62.4 \text{ PCF} \times 11.5 \text{ ft} \\
 (\text{design density} &= 8.34 \frac{\text{lb}}{\text{gal}} \times 7.48 \frac{\text{ft}^3}{\text{gal}})
 \end{aligned}$$

The density of the conditioned produced water is 9.3 pounds/gallon. Assuming a freeboard of 3-ft (19.15.17.12.F(3) NMAC) , the Hydro Pressure (p) of conditioned produced water is 626 psf, where

$$\begin{aligned}
 p &= \text{Design Density} \times \text{Height} \\
 &= 69.64 \text{ PCF} \times 9 \text{ ft} \\
 (\text{design density} &= 9.3 \frac{\text{lb}}{\text{gal}} \times 7.48 \frac{\text{ft}^3}{\text{gal}})
 \end{aligned}$$

Using conditioned produced water with the Pit Rule freeboard requirements of 3-feet results in a Hydro Pressure 92 psf less than the engineered design.

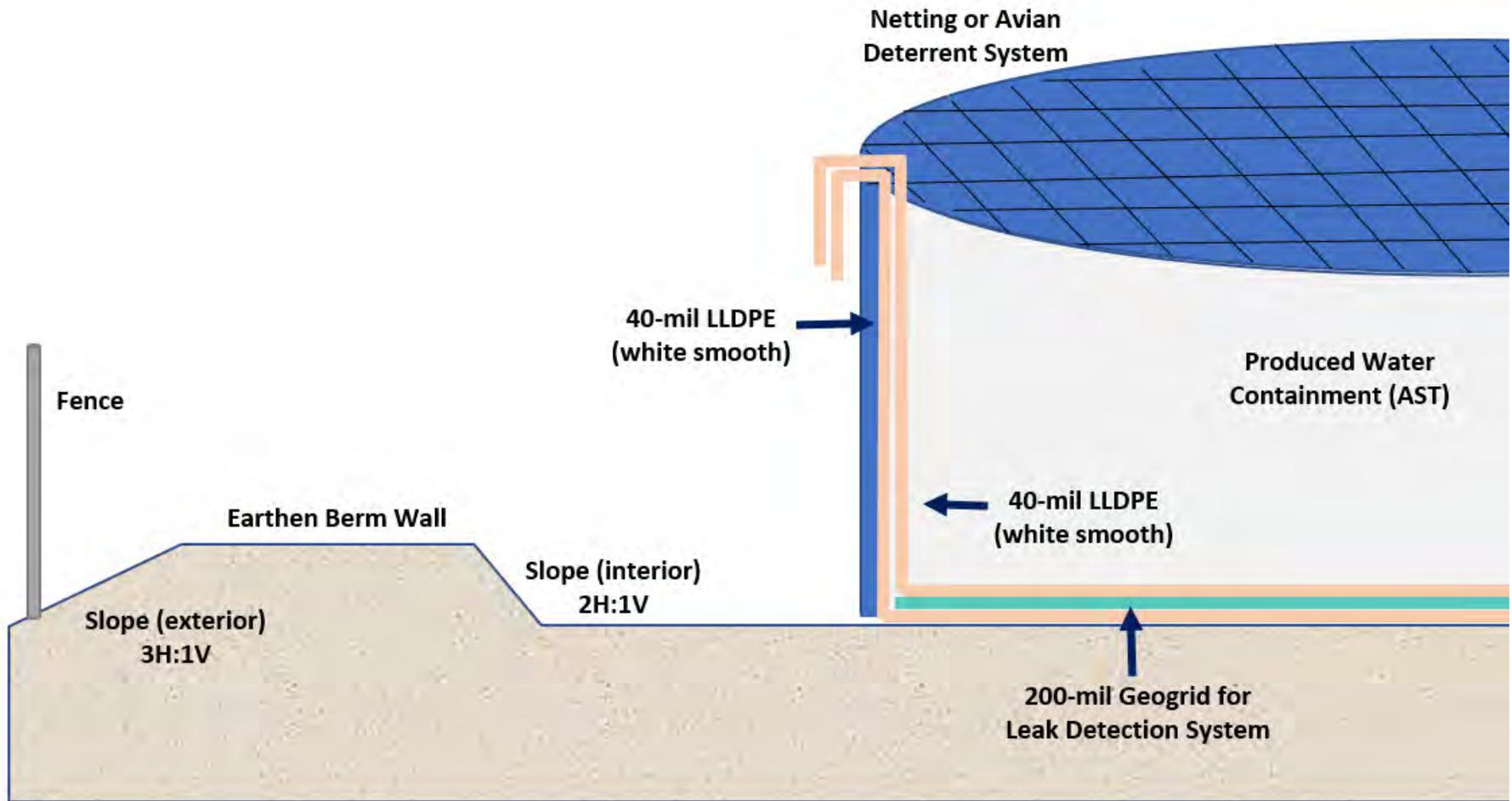
The operator asks the District Division to allow for a 2-foot freeboard, which yields a Hydro Pressure (p) of 696.4 psf, where

$$\begin{aligned}
 p &= \text{Design Density} \times \text{Height} \\
 &= 69.64 \text{ PCF} \times 10 \text{ ft} \\
 (\text{design density} &= 9.3 \frac{\text{lb}}{\text{gal}} \times 7.48 \frac{\text{ft}^3}{\text{gal}})
 \end{aligned}$$

March 2020

**Variances and/or Equivalency Demonstrations for  
Above Ground Steel Tank Modular Recycling  
Storage Containments (AST) Primary and  
Secondary Liners**

***Two 30-mil Non-reinforced LLDPE Liner as Alternate Primary Liner and 40-mil LLDPE as Secondary Liner for Above Ground Steel Tank Modular Recycling Storage Containments***



Not to Scale

R.T. HICKS CONSULTANTS, LTD.

901 Rio Grande Blvd NW Suite F142 Albuquerque, NM 87104  
Office Ph: 505.266.5004

AST Schematic

Typical Mustang-Extreme AST

Plate 1

June 2019

**STATEMENT EXPLAINING WHY THE APPLICANT SEEKS A VARIANCE FOR TWO 30 MIL LLDPE NON-REINFORCED GEOMEMBRANES AS AN ALTERNATIVE PRIMARY LINER AND 40-MIL LLDPE NON-REINFORCED GEOMEMBRANE AS AN ALTERNATIVE SECONDARY LINER FOR MODULAR STEEL AST IMPOUNDMENT**

**The prescriptive mandates of the Rule that are the subject of this variance request are the following subsections of NMAC 19.15.34.12**

**NMAC 19.15.34.12 A DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A RECYCLING CONTAINMENT**

**(4)** All primary (upper) liners in a recycling containment shall be geomembrane liners composed of an impervious, synthetic material that is resistant to ultraviolet light, petroleum hydrocarbons, salts and acidic and alkaline solutions. *All primary liners shall be 30-mil flexible PVC, 45-mil LLDPE string reinforced or 60-mil HDPE liners.* Secondary liners shall be 30-mil LLDPE string reinforced or equivalent with a hydraulic conductivity no greater than  $1 \times 10^{-9}$  cm/sec. Liner compatibility shall meet or exceed the EPA SW-846 method 9090A or subsequent relevant publications.

**The applicant proposes that two 30 mil LLDPE non-reinforced geomembranes will provide a primary liner system the is equal to or better than a single 60 mil HDPE, 30 mil PVC or 45 Mil reinforced LLDPE liner as prescribed in the Rule and a 40-mil LLDPE non-reinforced geomembrane is equivalent to the 30-mil LLDPEr liner described in the text of the Rule.**

Rule 34 did not consider Above Ground Steel Storage Tanks that employ liners as a primary or secondary containment method. Due to the vertical steel walls, 60-mil HDPE, 45-mil LLDPE string reinforced and 30-mil flexible PVC primary liners are not sufficiently flexible for use in these modular containments.

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

The following technical documents provide supportive data to demonstrate equal or better protection of fresh water, public health and the environment by providing the requisite containment and protection. Technical comparison of the proposed material is compared to what is advised through Rule 34 is discussed. A second memorandum provides clarification that the engineering requirements for site preparation, which ensures functionality of the liner system, is crosscutting to varied locations within the Permian Basin. Siting criteria and stamped plans from design engineer confirm applicability of this liner system to this specific site.

**R.K. FROBEL & ASSOCIATES**  
*Consulting Engineers*

**Technical Memorandum: 30 mil and 40 mil LLDPE Geomembranes as Alternative Primary/Secondary Liner System in a Modular Steel AST Recycling Containment NMAC 19.15.34.12 A (4)**

In consideration of the lining system application for Above Ground Modular Steel Impoundment (AST), size and depth of the impoundment, design details for modular tanks as well as estimated length of up to five years of service time, it is my professional opinion that two 30 mil LLDPE geomembranes with geonet and 40 mil LLDPE base liner will provide the requisite barrier against processed water loss. *The two 30 mil LLDPE liners and 40 mil base liner will function equal to or better than 60 mil HDPE, 30 mil PVC or 45 mil LLDPE (primary) and 30 mil LLDPE string reinforced (secondary) as a primary/secondary liner system.* The following are discussion points that will exhibit the attributes for using two 30 mil LLDPE geomembranes when used as the primary and a 40 mil LLDPE as the secondary lining system:

The nature and formulation of LLDPE resin is very similar to HDPE. The major difference is that LLDPE is lower density, lower crystallinity (more flexible and less chemical resistant). LLDPE will, however, resist aging and degradation and remain intact for many years in exposed conditions. Although the lifetime of LLDPE in covered conditions (i.e., secondary liner) will be somewhat reduced with respect to HDPE, a secondary liner of LLDPE will outlast an exposed HDPE liner. In fact, according to the Geosynthetic Research Institute (GRI) study on lifetime prediction (GRI Paper No. 6), the half-life of HDPE (GRI GM 13) exposed is > 36 years and the half-life of LLDPE (GRI GM 17) exposed is approximately 36 years. It is understood that in order to ensure compliance of materials, 60 mil HDPE must meet or exceed GRI GM 13. Likewise, the primary or secondary liner must meet or exceed GRI GM 17 for non-reinforced LLDPE. Adhering to the minimum requirements of the GRI Specifications, two 30 mil LLDPE geomembranes when used as a primary and a 40 mil LLDPE as a secondary liner system will be equally as protective as a 60 mil HDPE liner primary and 30 mil LLDPE string reinforced secondary.

Flexibility Requirements. 30 and 40 mil LLDPE geomembranes are less stiff and far more flexible than HDPE or 45 mil reinforced LLDPE and in this regard are preferred for installations in vertical wall tanks (AST). LLDPE provides a very flexible sheet that enables it to be fabricated into large panels, folded for shipping and installed on vertical walls transitioned to flat bottom. LLDPE will conform to the tank dimensions under hydrostatic loading.

Thermal Fusion Seaming 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 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

**R.K. FROBEL & ASSOCIATES**  
*Consulting Engineers*

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 Liners. Leakage through geomembrane liners is directly a function of the height of liquid head above any hole or imperfection. The drainage media provides immediate drainage to a low point or outside the Modular Impoundment and thus no hydrostatic head or driving gradient is available to push leakage water through a hole. In this regard, secondary geomembrane materials can be (and usually are) much less robust in both thickness and polymer type.

Leakage through any Primary geomembrane is driven by size of hole and depth and will be detected by the increase of wastewater in the drainage system and the volume being pumped out of the secondary containment. In this regard and for this variance, the AST liner system consists of 2 layers of 30 mil LLDPE geomembrane on the tank walls which will outperform a single layer of HDPE or LLDPE for potential leakage. Thus, if a leak occurs through the top layer, it will be effectively contained by the second layer and drained via the geonet drainage media. 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. Dependent on OCR requirements for Action Leakage Rate (ALR), the leakage 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 wastewater impoundments usually in the range of 100 to 500 gpad. However, New Mexico does not specify any ALR for wastewater impoundments (GRI Paper No. 15).

HDPE cannot be prefabricated into large panels and thus 30 and 40 mil LLDPE offers the following for Primary and Secondary Liners in AST Modular Containment:

- Prefabrication in factory-controlled conditions into very large panels (up to 35,000 sf) results in ease of installation, less or no thermal fusion field seams and less on site QC and CQA.
- Large prefabricated panels of LLDPE will provide better control of thermal fusion welding in a factory environment that will improve the liner system integrity for the long term.
- The LLDPE geomembrane provides superior flexibility, lay flat characteristics and conformability which allows for more intimate contact with the underlying drainage media and tank walls.
- Two layers of the 30 mil LLDPE provide redundancy. Additionally, the bottom layer and geonet provides protection for the top layer during installation as well reduction in leakage due to pinholes (no driving head on the lower 30 mil liner)

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- Ease of installation of large prefabricated custom size panels results in a greater reduction of installation time and associated installation and QC costs.
- The LLDPE geomembrane is easily repaired using the same thermal fusion bonding method without the need for special surface grinding/preparation for extrusion welding used in repair of HDPE geomembranes.

*In summary, it is my professional opinion that the double 30 mil LLDPE geomembrane with geonet as well as 40 mil LLDPE base liner will provide a Primary and Secondary liner system that is equal to or better than a single 60 mil HDPE, 30 mil PVC or 45 mil reinforced LLDPE liner (primary liner) and 30 mil LLDPE string reinforced (secondary liner) and will provide the requisite protection of fresh water, public health and the environment for many years.*

If you have any questions on the above technical memorandum or require further information, give me a call at 720-289-0300 or email [geosynthetics@msn.com](mailto:geosynthetics@msn.com)

Sincerely Yours,

*RK Frobel*

Ronald K. Frobel, MSCE, PE

References:

C-147 Supplemental Information  
Chisholm Energy AST Impoundment  
Prepared by Hicks Consultants

Title 19, Chapter 15, Part 34 NMAC (2015 Revision)

Geosynthetic Research Institute (GRI) Published Standards and Papers 2018

ASTM Standards 2020

Attachments:

R. K. Frobel C. V.

January 2020

***Applicability of Variances for Modular AST Containments  
in the Permian Basin of New Mexico***

**R.K. FROBEL & ASSOCIATES**  
*Consulting Engineers*

**Technical Memorandum: Applicability of Variances for Modular AST Containments in the Permian Basin of New Mexico**  
**NMAC 19.15.34.12 A (2)**

I have reviewed the most recent historical variances for AST Containments in the document titled “Variances for C-147 Registration Packages Permian Basin of New Mexico” (January 2020) and examined the applicable design drawings and permits for the following modular AST containments located in the Permian Basin of New Mexico.

- C-147 Registration Package for Myox Above Ground Storage Tank Section 32, T25S, R28E, Eddy County (January 20, 2020)
- C-147 Registration Package for Fez Recycling Containment and Recycling Facility Area (100+ acres) Section 8, T25-S, R35-E, Lea County, Volume 2 – Above-Ground Storage Tank Containments
- Hackberry 16 Recycling Containments and Recycling Facility Section 16, T19S, R31E, Eddy County

Locations of the modular containments range from west of the Pecos River to slightly west of Jal, NM. All locations exhibit different surface and subsurface geology, different topography and are of various sizes and volumes. *However, in regard to structural integrity of the base soils that support the AST and in particular the geomembrane containment system, the specification requirements are the same.* The foundation soils must be roller compacted smooth and free of loose aggregate over ½ inch. Compaction characteristics must meet or exceed 95% of Standard Proctor Density in accordance with ASTM D 698. This specification requirement is specific and causes the general or earthworks contractor to meet this standard regardless of the site- specific geology or topography. Provided that the design drawings and associated specifications call out the minimum requirements for subsoils compaction (i.e., 95% Standard Proctor Density – ASTM D 698), the design engineer or owners representative will carry out soils testing on the foundation materials to provide certainty to the AST containment owner that the earthworks contractor has met these obligations.

*Thus, provided that the contractor meets the minimum specified requirements for foundation soils preparation and density, the location, geology or depth to groundwater will make no difference in regard to geomembrane liner equivalency as demonstrated by the AST variances presented in this volume and are considered valid for meeting NMOCD Rule 34 requirements for all locations within the Permian Basin of New Mexico.*

If you have any questions on the above technical memorandum or require further information, give me a call at 720-289-0300 or email [geosynthetics@msn.com](mailto:geosynthetics@msn.com)

**R.K. FROBEL & ASSOCIATES**  
*Consulting Engineers*

Sincerely Yours,

*R.K. Frobel*

Ronald K. Frobel, MSCE, PE

References:

NMAC 19.15.34.12 DESIGN AND CONSTRUCTION SPECIFICATIONS FOR A  
RECYCLING CONTAINMENT

ASTM Standards 2019



**RONALD K. FROBEL, MSCE, P.E.**

**CIVIL ENGINEERING  
GEOSYNTHETICS  
EXPERT WITNESS  
FORENSICS**

**FIRM:** R. K. FROBEL & ASSOCIATES  
Consulting Civil / Geosynthetics Engineers

**TITLE:** Principal and Owner

**PROFESSIONAL  
AFFILIATIONS:**

American Society for Testing and Materials (ASTM) -  
Founding member of Committee D 35 on Geosynthetics  
Chairman ASTM D35 Subcommittee on Geomembranes 1985-2000  
ASTM Award of Merit Recipient/ASTM Fellow - 1992  
ASTM D18 Soil and Rock - Special Service Award - 2000  
Transportation Research Board (TRB) of The National Academies  
Appointed Member A2K07 Geosynthetics 2000 - 2003  
National Society of Professional Engineers (NSPE) - Member  
American Society of Civil Engineers (ASCE) - Member  
Colorado Section - ASCE - Member  
International Society of Soil Mechanics and Foundation Engineers  
(ISSMFE) - Member  
International Geosynthetics Society (IGS) - Member  
North American Geosynthetics Society (NAGS) - Member  
International Standards Organization (ISO) - Member TC 221  
Team Leader - USA Delegation Geosynthetics 1985 - 2001  
European Committee for Standardization (CEN) - USA Observer  
EPA Advisory Committee on Geosynthetics (Past Member)  
Association of State Dam Safety Officials (ASDSO) – Member  
U. S. Committee on Irrigation and Drainage (USCID) - Member  
Technical Advisory Committee - Geosynthetics Magazine  
Editorial Board - Geotextiles and Geomembranes Journal  
Fabricated Geomembrane Institute (FGI) – Board of Directors  
Co-Chairman International Conference on Geomembranes  
Co-Chairman ASTM Symposium on Impermeable Barriers  
U.S. Naval Reserve Officer (Inactive)  
Registered Professional Engineer – Civil (Colorado)  
Mine Safety Health Administration (MSHA) Certified

**ACADEMIC**

**BACKGROUND:** University of Arizona: M.S. - Civil Engineering - 1975  
University of Arizona: B. S. - Civil Engineering – 1969  
Wentworth Institute of Technology: A.S. Architecture – 1966

**PROFESSIONAL**

**EXPERIENCE:**

R. K. Frobel & Associates - Consulting Engineers  
Evergreen, Colorado, Principal and Owner, 1988 - Present

Chemie Linz AG and Polyfelt Ges.m.b.H., Linz, Austria  
U. S. Technical Manager Geosynthetics, 1985 - 1988

U.S. Bureau of Reclamation, Engineering and Research Center  
Denver, Colorado, Technical Specialist in Construction  
Materials Research and Application, 1978 - 1985

Water Resources Research Center (WRRC), University of Arizona  
Tucson, AZ, Associate Research Engineer, 1975 - 1978

Engineering Experiment Station, University of Arizona  
Tucson, AZ, Research Assistant, 1974 - 1975

United States Navy, Commissioned Naval Officer, 1970 - 1973

**REPRESENTATIVE**

**EXPERIENCE:**

R.K. Frobel & Associates: Civil engineering firm specializing in the fields of geotechnical, geo-environmental and geosynthetics. Expertise is provided to full service civil/geotechnical engineering firms, federal agencies, municipalities or owners on a direct contract, joint venture or sub-consultant basis. Responsibilities are primarily devoted to specialized technical assistance in design and application for foreign and domestic projects such as the following:

Forensics investigations into geotechnical and geosynthetics failures; providing expert report and testimony on failure analysis; providing design and peer review on landfill lining and cover system design, mine waste reclamation, water treatment facilities, hydro-technical canal, dam, reservoir and mining projects, floating reservoir covers; oil and gas waste containment; design of manufacturers technical literature and manuals; development and presentation of technical seminars; new product development and testing; MQA/CQA program design and implementation.

Polyfelt Ges.m.b.H., Linz, Austria and Denver Colorado: As U.S. technical manager, primary responsibilities included technical development for the Polyfelt line of geosynthetics for the U.S. civil engineering market as well as worldwide applications.

U.S. Bureau of Reclamation, Denver, Colorado: As technical specialist, responsibilities included directing laboratory research, design and development investigations into geosynthetics and construction materials for use on large western water projects such as dams, canals, power plants and other civil structures. Included were material research, selection and testing, specification writing, large scale pilot test programs, MQA/CQA program design and supervision of site installations. Prime author or contributor to several USBR technical publications incorporating geosynthetics.

University of Arizona, Tucson, Arizona: As research engineer at the Water Resources Research Center, responsibilities included research, design and development of engineering materials and methods for use in construction of major water projects including potable water reservoirs, canals and distribution systems. Prime author or contributor to several WRRC technical publications.

Northeast Utilities, Hartford, Connecticut: As field engineer for construction at Northeast Utilities, responsibilities included liason for many construction projects including additions to power plants, construction of substations, erection of fuel oil pipelines and fuel oil storage tanks. Responsibilities also included detailed review, inspection and reporting on numerous construction projects.

U.S. Navy: Commissioned Naval Officer – Nuclear Program

**PUBLICATIONS:** Over 85 published articles, papers and books.

**CONTACT DETAILS:**

**Ronald K. Frobel, MSCE, P.E.**  
**R. K. Frobel & Associates**  
**Consulting Civil/Geosynthetics Engineers**  
**PO Box 2633**  
**Evergreen, Colorado 80439 USA**  
**Phone 720-289-0300**  
**Email: geosynthetics@msn.com**

## **Additional VARIANCE FOR RECYCLING STORAGE CONTAINMENTS (Inground and AST)**

- **Alternative Testing Methods**

## Request for OCD Approval of Alternative Test Methods to Analyze Concentrations of TPH and Chloride

The prescriptive mandates of the Rule that are the subject of this request are the following subsections of NMAC 19.15.17.13 [emphasis added], 19.15.34.14 and 19.15.29. 12 D

### 19.15.17.13 CLOSURE AND SITE RECLAMATION REQUIREMENTS:

**D.(5)** The operator shall collect, at a minimum, a five point composite of the contents of the temporary pit or drying pad/tank associated with a closed-loop system to demonstrate that, after the waste is solidified or stabilized with soil or other non-waste material at a ratio of no more than 3:1 soil or other non-waste material to waste, the concentration of any contaminant in the stabilized waste is not higher than the parameters listed in Table II of 19.15.17.13 NMAC.

The referenced Table II, which is reproduced in part below, notes the Method with asterisk signifying: “\*Or other test methods approved by the division”.

Depth below bottom of pit to groundwater less than 10,000 mg/l TDS	Constituent	Method*	Limit**
25-50 feet	Chloride	EPA Method 300.0	20,000 mg/kg
	TPH	EPA SW-846 Method 418.1	100 mg/kg

### 19.15.34.14 CLOSURE AND SITE RECLAMATION REQUIREMENTS FOR RECYCLING CONTAINMENTS:

**C.** The operator shall test the soils beneath the containment for contamination with a five-point composite sample which includes stained or wet soils, if any, and that sample shall be analyzed for the constituents listed in Table I below.

**(1)** If any contaminant concentration is higher than the parameters listed in Table I, the division may require additional delineation upon review of the results and the operator must receive approval before proceeding with closure.

The referenced Table I, which is reproduced in part below, notes the Method with asterisk signifying: “\*Or other test methods approved by the division”.

Depth below bottom of containment to groundwater less than 10,000 mg/l TDS	Constituent	Method*	Limit**
51 feet - 100 feet	Chloride	EPA 300.0	10,000 mg/kg
	TPH (GRO+DRO+MRO)	EPA SW-846 Method 8015M	2,500 mg/kg

After sampling solids of more than 50 drilling pits in the Permian Basin, we have observed and reported to OCD on numerous occasions significant problems with non-petroleum drilling additives (e.g. starch) interfering with the laboratory method 418.1. It is not surprising that in many instances we found no correlation between the laboratory results using 418.1 and the results using Method 8015.

We request approval of Method 8015 (GRO + DRO + MRO) for Method 418.1.

**19.15.29.12 D. CLOSURE REQUIREMENTS.** The responsible party must take the following action for any major or minor release containing liquids.

**(1)** The responsible party must test the remediated areas for contamination with representative five-point composite samples from the walls and base, and individual grab samples from any wet or discolored areas. The samples must be analyzed for the constituents listed in Table I of 19.15.29.12 NMAC or constituents from other applicable remediation standards.

The referenced Table I, is reproduced in part below.

Table I Closure Criteria for Soils Impacted by a Release			
Minimum depth below any point within the horizontal boundary of the release to ground water less than 10,000 mg/l TDS	Constituent	Method*	Limit**
≤ 50 feet	Chloride***	EPA 300.0 or SM4500 Cl B	600 mg/kg
	TPH (GRO+DRO+MRO)	EPA SW-846 Method 8015M	100 mg/kg
	BTEX	EPA SW-846 Method 8021B or 8260B	50 mg/kg
	Benzene	EPA SW-846 Method 8021B or 8260B	10 mg/kg

We request approval of EPA 300.0 or SM4500 for the analysis of chloride.

### **Demonstration that OCD Approval Will Provide Equal or Better Protection of Fresh Water, Public Health and the Environment**

The purpose of TPH analyses in the Pit Rule is to measure total petroleum hydrocarbons not all non-polar compounds, such as starch or cellulose that can interfere with Method 418.1. While Method 418.1 may provide some useful data for transportation of crude oil or condensate spills to disposal, the addition of non-polar organic materials in drilling fluids, especially for horizontal wells, renders Method 418.1 highly problematic to determine compliance with the Rule. Using Method 8015 for TPH (GRO+DRO+MRO) provides a better measurement of what we believe the Commission intended operators to measure.

In hearings before the Oil Conservation Commission technical arguments were presented regarding the use of SM4500 in lieu of EPA 300.00 for chloride analysis for Rule 29. The Division and the Commission agreed that these two methods provide equal or better protection of fresh water, public health and the environment.