

September 11, 2023

Stephen H. Lee, Director  
Louisiana Department of Natural Resources  
Injection and Mining Division  
617 N. 3<sup>rd</sup> Street  
Baton Rouge, Louisiana 70802

**Re: Proposed “De-Pressure” Plan for Sulphur Mines Cavern No. 6  
Westlake US 2, LLC – Well PPG 6X (SN 57788)**

Dear Mr. Lee,

This letter is submitted on behalf of Westlake US 2, LLC (“Westlake”) to propose the “de-pressure” of Cavern No. 6 at the Sulphur Mines facility. This letter outlines the basis for the de-pressure activity, execution plan, active monitoring, and long-term plan for Cavern No. 6.

Westlake is comfortable with proceeding with the de-pressure of Cavern No. 6 based upon the plan and supporting analysis herein. Westlake is seeking the approval of the Injection and Mining Division to execute this plan.

### **Basis of Proposed Plan & Request**

Cavern No. 6 with entry well PPG No. 6X underwent an inspection workover in July of 2023 in preparation for the design of microseismic geophone array installation. One aspect of the inspection workover was to complete a sonar survey of the cavern. This was not possible due to an obstruction that was identified within the salt cavern neck (between the 7 5/8” cemented casing shoe and the cavern roof). A coiled tubing remedial workover was attempted but not successful at removing the obstruction.

It is important to understand whether Cavern No. 6 can be “de-pressured” (at least for a temporary period) in support of the final feasibility for utilizing the PPG 6X wellbore as a microseismic monitoring well. The geophone array can be installed in the well with the cavern pressure being isolated from the wellbore/wellhead, however, removal of the geophone array would require that the wellhead pressure be zero.

As Cavern No. 6 has a pressure relationship with Cavern No. 7, the current operating strategy for Cavern No. 6 is to observe and maintain a constant cavern pressure, which has generally been measured between 180 to 190 psig (surface casing pressure – saturated brine filled) since December of 2022. To remediate the cavern neck obstruction efficiently and safely, a conventional well servicing rig will be utilized to convey a milling assembly into the well for removal of the obstruction. This remedial operation requires the surface wellhead pressure to be zero (or very

nearly zero). Once the obstruction is cleared, a sonar survey of the cavern and a 4-arm caliper of the salt cavern neck will be obtained.

### **Proposed De-Pressure Plan**

The current wellhead pressure of PPG 6X is approximately 180 psi which equates to a pressure gradient at the 7 5/8” cemented casing shoe (2,505’) of 0.60 psi/ft. The wellhead pressure will be reduced by no more than 20 psi in each consecutive 24-hour period. The pressure will be reduced by flowing back brine from the well. The flow back operation will be controlled by dedicated personnel during daylight hours. The bleed down rate will be approximately 2.0 to 2.5 psi/hour, which is estimated to be a brine withdrawal flow rate of 0.75 to 1.00 bbls/min. The cavern well will then be shut-in throughout the night. This daily de-pressure operation will continue for approximately 9 to 10-days until the PPG 6X wellhead pressure reaches approximately 0 psi.

Brine injection operations and tubing surface pressure maintenance of PPG 7B will continue as normal. It is not expected that the wellhead and cavern pressure of Cavern No. 7 would be impacted by the de-pressure operation executed on Cavern No. 6.

The instrumentation that would be continuously monitored would be:

- PPG 6X Casing Pressure Gauge at Wellhead
- PPG 6X Brine Withdrawal Flow Rate & Cumulative Volume
- PPG 7B Casing Pressure Gauge at Wellhead
- PPG 7B Tubing Pressure Gauge at Wellhead
- PPG 7B Downhole Pressure Gauge

Additionally, two surface seismic detection arrays will be operational during the de-pressure operations. We will monitor potential seismicity using 1) the existing seven-station 4.5 Hz geophone array which has been in operation since late January 2023 and 2) a new, co-located broadband five station array expected to be operational September 20. Current seismic array has detection capability of about magnitude -0.25 to 0.2, depending on the background noise levels. The broadband array will likely have similar detection levels, in addition to the ability to resolve lower-frequency seismic activity, and it will have the capability of reporting event detections to Westlake within 15 minutes (during the de-pressure operation of Cavern No. 6). All anomalous seismic activity of an event magnitude >1 will be reported to IMD immediately upon identification, and additional communication with IMD about the event will be provided as available or at 24-hour intervals, whichever comes first. If an anomalous event is detected, then the de-pressure operation on Cavern No. 6 will be halted.

### **Geomechanical Model**

RESPEC was contracted to perform geomechanical modeling of the proposed de-pressure plan predicting stresses leading to salt dilation around Cavern No. 6 & Cavern No. 7. A summary presentation developed by RESPEC is included as Attachment A of this document.

### Concluding Remarks

Westlake believes, based upon the presented plan and geomechanical analysis, that Cavern No. 6 can be safely de-pressured to a wellhead pressure of zero, equating to a cemented casing shoe pressure of ~0.53 psi/ft (a fully saturated brine pressure gradient). The de-pressure operation is planned to be completed over 10 consecutive calendar days, and the brine flowback operations to decrease the cavern pressure would be performed during daylight hours and actively monitored by dedicated personnel on site. There will be two surface-based seismic detection arrays actively monitoring for seismic events. The Trillium broadband array will be monitored “real-time” and have the capability to report seismic detections to Westlake within 15 minutes. If anomalous pressure responses are observed on the instrumentation on PPG 6X or PPG 7B, or if any anomalous seismic event of magnitude >1 is detected, then the de-pressure operations on Cavern No. 6 will be halted and the data reviewed prior to making any further operational decisions.

Upon approval from the Injection and Mining Division, Westlake plans to begin execution of the de-pressure operation as soon as possible. Upon successful completion of the de-pressure operation, the remedial workover will be conducted as soon as possible thereafter (including the cavern sonar survey). After the remedial workover, the cavern will be pressurized with saturated brine to achieve a surface casing pressure of 10 psi. Cavern No. 6 will then be monitored until the custom geophone arrays are delivered to site (anticipated for February/March 2024) at which time the cavern would be de-pressurized for the installation of the geophone arrays. During the monitoring period, it is anticipated that the pressure of Cavern No. 6 will increase due to salt creep closure of the cavern, and the pressure magnitude achieved would be dependent on the pressure balance relationship with Cavern No. 7.

If there are any questions, please contact Josh Bradley (Westlake US 2, LLC), Coleman Hale (Lonquist & Co., LLC) or Ben Bergman P.E (Lonquist & Co., LLC).

Sincerely,

Coleman Hale and Ben Bergman, P.E.



Certified By:  
Lonquist & Co., LLC  
Louisiana Registration No. EF-5937

*Ben H. Bergman* 9/11/2023 P.E.

Ben H. Bergman, P.E.  
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**LONQUIST & CO. LLC**

**PETROLEUM  
ENGINEERS**

**ENERGY  
ADVISORS**

## **ATTACHMENT A**

### **RESPEC Geomechanical Evaluation Summary Presentation**