

**EPA Responses to Public Comments on draft Modification to
Excelsior Mining, Inc. Class III Underground Injection Control (UIC) Permit
UIC Permit Number R9UIC-AZ3-FY16-1**

Description of Draft Permit Modification Changes

Pursuant to Title 40 Code of Federal Regulations (40 CFR) § 124.17(a)(1), EPA’s final permit decision includes changes to certain provisions of the Draft Permit Modification, as specified below in items 1-3. In addition to the description of changes, EPA provides the reasons for the changes in this final permit decision.

1. EPA added “the....plan and” procedures in the first line of Section II.E.7 to clarify what will be submitted to EPA and ensure that the detailed proposal for stimulation activities will be considered. EPA also added “and the proposed schedule” to the second sentence of Section II.E.7 to clarify that Excelsior must submit this schedule information to EPA 30 days prior to performing the stimulation procedure. For consistency, EPA added “and plan” to the 3rd paragraph of Appendix J for advance notice and plan of stimulation activities to be provided to EPA. This addition clarifies that Excelsior is required to submit more detail to EPA for approval prior to performing stimulation activities
2. EPA added a sentence to Section II.E.7 at the end of the second paragraph to clarify that the Permittee may not commence stimulation activities without prior written approval to proceed from EPA. EPA includes this clarification to address comment #5 described in the summary of comments below.
3. EPA added the following paragraph at Section II.G.6 titled Public Website to ensure that stimulation information is made readily available to the public on a website provided by Excelsior. The addition of this paragraph also addresses comment #5 below.

Public Website. Within thirty (30) days after this Permit modification becomes effective, the Permittee shall establish a website or portal for the Project accessible to the general public (the “Website”) and shall provide to EPA the Website IP address. EPA will share the IP address of the Website with the public on EPA’s website. The Permittee shall post on the Website copies of the proposed and approved stimulation plans and procedures with any EPA conditions and reporting of results, as described in Part II.G.2.m of this Permit, including appendices and exhibits, within 15 days of submission to or receipt from EPA.

Summary of Significant Public Comments and EPA Response to Comments

Pursuant to 40 CFR § 124.17(a)(2), below in items 1-8, EPA briefly describes and responds to all significant comments raised during the public comment period and during the public hearing held on December 15, 2022.

1. **Comment:** Commenters assert that EPA's issuance of the UIC permit for the Excelsior project in 2018 was not appropriate. They assert that the unanticipated formation of carbon dioxide bubbles within the orebody is evidence that Excelsior did not understand the geochemistry of the orebody or potential interaction with the sulfuric acid lixiviant when they applied for their UIC permit. They request that EPA revoke the existing Class III permit and issue a new permit, asserting that the proposed stimulation represents a modification that fundamentally alters the design, performance, and structure of the mining project.

EPA Response: The comment that the UIC permit was inappropriately issued in 2018 because it was based on an incomplete understanding of the site, and thus needs to be reissued, is outside the scope of what is properly before EPA in its consideration of Excelsior's request for modifying the existing UIC Permit. EPA's issuance of the 2018 Permit reflects EPA's year and a half-long review and evaluation of the extensive information that Excelsior provided in its UIC permit application and in response to EPA's requests to clarify, modify, or supplement the application. After completing a thorough technical review of all submitted information, EPA determined that the information provided by Excelsior was sufficient to issue a permit to construct, test, and inject at the Project site, followed by aquifer restoration, post-rinse monitoring, and closure operations. This determination was based on an extensive review of Excelsior's characterization of the site (including the properties of the orebody and formation geochemistry); extensive geochemical and site modeling; and Excelsior's planned operating, monitoring, and site closure procedures. The geochemical and site modeling evaluated chemical compositions of ISR solutions to estimate and forecast fluid concentrations and site-specific parameters to predict fluid movement and interactions between injected fluids and the orebody and variations in parameters to consider model sensitivity. In sum, this information provided EPA a complete understanding of the Site and sufficient basis for EPA's issuance of the Permit in 2018.

Despite the geochemical performance that is currently preventing Excelsior from achieving expected productivity, the existing UIC Permit's terms and conditions continue to ensure the protection of USDWs, the environment, and the health of persons. The existing Permit conditions at Part II.E.6 require injection solution reporting to identify any additional constituents to ensure representative data on its characteristics and expand the groundwater monitoring program, if needed. In addition, the Permit requires Excelsior to operate injection and extraction wells to maintain hydraulic control of project operations and retain injected lixiviant within the orebody, as confirmed by site monitoring. Water quality monitored at the monitoring and POC wells continues to ensure that underground sources of drinking water (USDWs) beyond the exempted zone are protected. No monitoring or other information indicates that Excelsior's activities conducted pursuant to the 2018 Permit have endangered a USDW or show that the Permit is (or was) based on an inaccurate understanding of site geology.

EPA disagrees that stimulation activities will “fundamentally alter” the site, as commenters assert. In fact, stimulation will be a short-duration event, and hydraulic control will continue to be required during stimulation operations to maintain the inward gradient between observation well (OW) pairs as specified in Part II.E.1 of the Permit. Excelsior will also continue project monitoring to confirm that injected fluids (including stimulation fluids) remain within the designated zones and are not endangering USDWs.

The extent of the fracturing in the ore body of the bedrock due to stimulation activities is not expected to be significantly different from the extent of fracturing that already exists in the ore body. Aquifer testing presented in the UIC Permit application demonstrated good connectivity within the bedrock due to faulting, fracturing, and bedding plane pathways. Well testing and core data indicate that the fracturing is so extensive that the bedrock acts essentially as an equivalent porous media with faults providing preferential pathways through the bedrock.

2. **Comment:** Commenters raised general objections to hydraulic fracturing technology. They consider the planned stimulation activities to be an experiment. Commenters also raised concerns about the safety of hydraulic fracturing technology, alleging that it can cause earthquakes that can affect groundwater flow patterns, change subsurface formations, or damage wells or infrastructure in nearby communities.

EPA Response: EPA disagrees with commenters that stimulation is an experimental procedure. Stimulation, or hydraulic fracturing, has been performed in a variety of geologic scenarios without causing adverse effects on water quality or endangering USDWs. Planning and implementation of stimulation activity will be based on a site-specific understanding of the geologic setting and extensive modeling to optimize the extent and orientation of the fractures that are created such that stimulation achieves the goals of increasing injectivity without damaging injection or extraction wells.

EPA understands the commenters’ concerns about injection activities causing earthquakes as referring to “induced seismicity,” which is generally associated with Class II disposal wells that inject large volumes of fluids (produced water) related to oil and gas production into sandstone formations directly above crystalline basement rock. Under certain conditions, disposal of such fluids through injection wells has the potential to cause induced seismicity. However, in most areas of the country with injection wells, induced seismicity associated with fluid injection is uncommon, as the conditions necessary to cause seismicity are not typically present. A decision model developed by EPA’s UIC National Technical Workgroup¹ found that earthquakes caused by injection wells are likely to occur only when all the following conditions are present: (1) stressed faults; (2) pressure build up due to disposal activities; and (3) a pathway for increased pressure to communicate with the fault. None of these conditions are known to be present in the area of review (AOR) for the Excelsior project.

In the unlikely event of seismic activity, EPA does not expect that the movement of existing faults in the project area will affect containment of in situ recovery (ISR) fluids to the

¹ Minimizing and Managing Potential Impacts of Injection-induced Seismicity from Class II Disposal Wells: Practical Approaches. EPA, 2014.

wellfield since EPA requires Excelsior to maintain an inward gradient and over-extraction of fluids under the UIC Permit.

EPA also does not expect seismic activity to damage infrastructure and wells that could affect a USDW because no USDWs exist in the area where Excelsior's wells and surface facilities are located, *i.e.*, no USDWs are within the project's AOR and aquifer exemption boundaries. Moreover, EPA already has in place regulatory permit requirements at 40 C.F.R. 144.51(q) for monitoring and testing the mechanical integrity of Class III injection wells that are intended to detect any leaks or damage. If a leak were to occur, it would become evident during injection operations and/or detected during an EPA required mechanical integrity test (MIT). In that event, Excelsior would be required to immediately cease injection until the well is fixed and the repair is confirmed to EPA's satisfaction through MIT of the well, per Part II.E.3 of the Permit. If an injection well cannot be repaired, it would have to be plugged and abandoned according to the EPA-approved plan in the Permit.

Finally, EPA notes that earthquakes do not alter geology, except for the shifts of strata immediately adjacent to a fault that has been disrupted by an earthquake. Even near major faults, such as the San Andreas of California, disruption of geologic strata is confined to a zone a few meters from the fault where offset of strata can occur.

- 3. Comment:** Commenters questioned the appropriateness of hydraulic fracturing at ISR mining sites, which they assert has never been performed. They expressed concerns about the interactions of stimulation fluids with the orebody and the sulfuric acid lixiviant and the potential for toxic substances to be mobilized. Commenters also assert that Excelsior pledged to the public that it would not perform hydraulic fracturing.

EPA Response: EPA acknowledges that stimulation at ISR mining is a rarely used application of the technology. However, as EPA describes more fully in its response to Comment #4 below, Excelsior's permit requires that it design and implement stimulation activities following a carefully planned process that considers the modeled extent of the fractures based on site-specific information about orebody geology and formation fluid characteristics. The operator must submit a stimulation plan, including a description of the fluid that will be used and modeled predictions of how operations will proceed to EPA prior to gaining approval to perform stimulation. EPA will review the plan and will not authorize stimulation unless the Permittee can demonstrate that USDWs will not be endangered.

EPA also notes that the intent of its Class III ISR Permit requirements are to ensure that injected fluids or any reactants produced by the interaction of stimulation, injection, or native fluids do not mobilize or migrate out of the orebody. The Permit requires that Excelsior demonstrate hydraulic control during ISR operations by an inward gradient and an extraction to injection ratio sufficient to prevent any fluids from migrating outside the orebody. This hydraulic control will continue to be maintained during stimulation to maintain the inward gradient between observation well pairs as specified in Part II.E.1 of the Permit. Operational monitoring required in the UIC Permit will confirm hydraulic containment. Hydraulic control monitoring of the Oxide Bedrock Zone will be performed using thirty (30) HC wells and twenty-two (22) paired observation wells (OWs) at the perimeter of the wellfield. In addition, Excelsior will continuously monitor specific conductance in the outer OWs to verify that

hydraulic control is maintained and to detect excursions of ISR or stimulation fluids from the wellfield.

If any unanticipated geochemical reactions between stimulation fluids, lixiviant, or formation fluids were to occur, EPA has authority to modify the testing and monitoring requirements of the Permit, including the parameters for which Excelsior must analyze.

The commenters statement that Excelsior pledged it would not perform hydraulic fracturing is outside the scope of the UIC Permit modification. EPA's role in issuing and overseeing the Class III UIC Permit is ensuring that the Class III wells and the ISR operation comply with EPA's UIC regulations and will be operated in a manner that protects USDWs.

4. **Comment:** Commenters raised specific concerns about stimulation at the Excelsior site. They assert that Excelsior did not provide a detailed plan for how they plan to perform stimulation or demonstrate that stimulation can be done safely. Commenters also expressed concerns about the potential impacts of injecting at elevated pressures on site equipment and infrastructure, geologic formations, and groundwater quality. They asked if EPA will have observers onsite to verify that the infrastructure is not compromised.

EPA Response: Prior to performing any stimulation, Part II.E.7.a and Attachment J of the Permit require Excelsior to submit a stimulation plan to EPA for approval that includes: a list, description, and maximum quantities of stimulation additives or chemicals to be used; modeled predictions of the extent and orientation of fractures; a demonstration that stimulation will be contained to the intended area and will not interfere with hydraulic containment; and recommendations for constituents of the stimulation fluids to be added to the groundwater monitoring program.

Prior to authorizing any stimulation activities, EPA will review the stimulation plan and ask clarifying questions, as needed, or request that Excelsior modify the plan to ensure that stimulation activities will occur in a manner that does not endanger USDWs. EPA may specify additional conditions of approval, if needed to ensure protection of USDWs.

EPA notes that only the injection wells in the center of a 5-spot pattern (i.e., an injection well surrounded by four production wells) will undergo well stimulation, and that stimulation operations will be for a limited time and scope (i.e., involving fluid volumes lower than operational injection volumes). Because of pressure bleed-off (i.e., reduction) between wells, the fractures created by stimulation are unlikely to extend beyond the production wells that surround any stimulated injection wells. In addition, the injection/recovery wellfield will be bound in downgradient areas by a series of hydraulic control (also referred to as hydraulic containment) wells that will ensure net positive pumping for the project. Therefore, the stimulation event (and associated fluids) will be contained within the permitted injection interval.

Regarding concerns about the potential impacts of stimulation on site equipment and infrastructure, EPA notes that stimulation will occur in the open borehole portion of the wells. Therefore, the cased portion of the wells and well equipment will not be exposed to fracturing pressures. Additionally, Excelsior will monitor well operations for evidence of damage (such as abnormal changes in the relationship between injection pressure and injection flow rate). If any such evidence is found, Excelsior will be required to perform

MITs pursuant to the procedures in Part II.E.3 of the Permit to verify that mechanical integrity of the wellbore is maintained or, if necessary, repair or plug the well. EPA may also require that an MIT be conducted at any time.

Regarding concerns about the effects of elevated pressures during stimulation, EPA notes that operators performing stimulation typically only inject at the minimum pressure that is needed to achieve fracturing. This is because excessive fracturing of the rock beyond what is needed to improve injectivity could potentially be detrimental to the efficiency of the mining operations. As described above, EPA will review Excelsior's proposed stimulation procedures in the context of site-specific geologic and geochemical information to confirm that USDWs would not be endangered by stimulation activities.

In response to questions regarding whether EPA will have observers onsite during stimulation, Part II.E.7 of the Permit requires Excelsior to provide 15 days' notice of any stimulation activities, which would provide EPA an opportunity to witness stimulation activities. At EPA's discretion, it will witness stimulation operations or communicate with the Permittee during stimulation. As noted above, operational monitoring would detect pressure changes in wells that could indicate that a well is damaged. In such an event, Excelsior must immediately cease injection until the well is repaired to EPA's satisfaction, as demonstrated by MIT of the well, per Part II.E.3 of the Permit.

5. **Comment:** Commenters expressed concerns about the review and approval of the stimulation plan. They assert that, as written, the requirement to submit a plan may not allow sufficient time for EPA to review and analyze the information provided. Commenters also requested that the public be provided an opportunity to review the draft stimulation plan.

EPA Response: Under Section II.E.7 of the Permit, as modified, a stimulation plan must be submitted at least 30 days in advance of performing any stimulation activities. This language effectively prevents the scenario raised by one comment that EPA could approve a stimulation plan submitted only one day in advance of Excelsior performing stimulation activities. EPA's Permit modification at Part II.E.7.a and Attachment J also makes clear that stimulation may not occur without EPA approval, and that Excelsior's 30-day advance notice of proposed stimulation activities must include an extensive review of the chemicals and procedures that Excelsior proposes to use for stimulation and a description of the predicted effects, *i.e.*, modeling showing the extent and orientation of fracture propagation and containment of injected materials (*see* Appendix J). See the response to Comment #4 for additional information about EPA's review of the proposed stimulation plan.

EPA understands the public's interest in being informed about well stimulation activities. For this reason, Part II.G.6 of the final modified permit requires that Excelsior create a public website and post stimulation plans, procedures, and results to that website as the information is provided to EPA. EPA will provide a link to this website on its web page, and this information will be available to the public.

6. **Comment:** Commenters expressed concerns about potential effects on water quality and drinking water sources, citing the potential for fluid movement through subsurface pores, fractures, or faults and adverse interactions between the lixiviant and chemicals used during stimulation. Commenters also raised concerns about changes in water quantity (but did not identify any specific concerns).

EPA Response: EPA acknowledges commenters' concerns about water quality and drinking water protection. Prevention of USDW endangerment is the primary focus of the UIC Program regulations and the purpose of the conditions in Excelsior's UIC permit. Class III ISR projects, including the Excelsior project, are designed and operated to prevent the movement of fluids outside of the orebody. Due to the 5-spot pattern of injection and extraction wells at the ISR project, where only wells in the center of the pattern will undergo well stimulation (*see* Attachment J), any solution mining fluids, formation fluids, and stimulation fluids will be recovered by the extraction wells surrounding the injection well.

During ISR operations and stimulation activities, Excelsior will maintain hydraulic containment to prevent injection or stimulation fluids from migrating outside of the wellfield. More fluid is extracted than injected in the process, thus preventing fluids from moving out of the wellfield area. Excelsior ensures maintenance of hydraulic containment by hydraulic control monitoring of the Oxide Bedrock Zone using thirty (30) HC wells and twenty-two (22) paired OWs at the perimeter of the wellfield.

Excelsior will conduct quarterly monitoring for Level 1 parameters (constituents of ISR solutions that are most likely to provide an early indication of groundwater impacts) and annual monitoring of Level 2 parameters (probable constituents of the ISR solutions for which primary maximum contaminant levels, or MCLs, have been established and other constituents that are likely to appear in greater concentrations in groundwater impacted by ISR solutions). Based on information provided in the proposed stimulation plan, including Excelsior's recommendations for revising the monitoring program, EPA may require Excelsior to expand the Level 1 and Level 2 parameters to include constituents of the stimulation fluid.

Monitoring wells at the site are spaced around and within the wellfield to protect offsite resources. This spacing is based on an assessment of geology and hydrology as documented in Excelsior's Class III permit application. The intermediate monitoring wells (IMWs), OWs, and point-of-compliance (POC) wells provide three perimeters of defense and detection of any potential contaminant migration beyond the wellfield within the AOR. The IMWs, HC wells, and OWs surrounding the mine blocks and wellfield perimeter would intercept any contaminants before they can migrate outside of the AOR and protect the area beyond the AOR. The POC wells, which are placed within the AOR boundary, add a redundant line of defense against the escape of contaminants from the AOR.

EPA assumes that commenters' concerns about water quantity reflect the large volumes of water associated with some hydraulic fracturing operations at Class II wells. However, EPA notes that Excelsior anticipates stimulation activities at the ISR project will involve fluid volumes that are much lower than the operational injection volumes in the existing Class III permit.

7. **Comment:** Commenters asked how EPA plans to monitor for water quality changes or other adverse effects of stimulation activities. They also asked what would happen if there was evidence of contamination, i.e., whether Excelsior would be allowed to continue additional stimulation.

EPA Response: As noted in EPA's response to Comment #6 above, Excelsior must monitor water quality and water levels throughout its injection and stimulation activities to confirm

hydraulic control, and EPA's oversight includes evaluating this monitoring to confirm that USDWs are not endangered. Part II.E.7.b of the modified Permit requires Excelsior to expand the groundwater and injectate monitoring programs (including adding Level 1 and Level 2 parameters) as necessary to address potential water quality changes associated with stimulation activities. In addition, Excelsior must monitor injection well pressure and perform MITs to confirm that neither injection nor stimulation activities are damaging the injection wells.

Excelsior will submit the results of this extensive monitoring to EPA in the quarterly monitoring reports required in Part II.G of the Permit. In addition, under Part II.G.2.m of the Permit, Excelsior must report its well stimulation activities to EPA. The report must include a narrative description, well(s) name, range of depth, changes to injection well configuration, a summary of collected data and stimulation results, the stimulation fluids used, quantity of each injected material, total stimulation volume and pressure, method(s) to demonstrate that the well has mechanical integrity (as applicable), and any deviations from the approved plan (as applicable).

If the quarterly monitoring reports indicate damage to a well or endangerment of a USDW, EPA will require that Excelsior take appropriate actions to undertake corrective action(s). In the unlikely event that any monitoring conducted during or following well stimulation detects an exceedance or there is other evidence of USDW endangerment, Excelsior would be required under the contingency provisions in Part II.H of the Permit to initiate corrective actions within 24 hours. The activities that EPA may require Excelsior to perform would be specific to the event, but may include ceasing injection, modifying injection or extraction operations to restore hydraulic control, repairing and performing MITs on affected injection or extraction wells, or performing additional monitoring. Excelsior must submit a written report to EPA within thirty (30) days of Excelsior's verification of any exceedance that describes the cause, impacts, and any mitigation of the discharge responsible for the exceedance.

EPA notes that Excelsior must provide notification prior to each stimulation event. If prior stimulation activities provided evidence that stimulation did not proceed as planned or cannot be performed in a manner that does not endanger USDWs, EPA will not authorize additional stimulation.

8. **Comment:** Commenters requested a 30-day extension of the public comment period. They assert that notice of the draft permit modification was issued just before the end-of-year holiday season, which affected their ability to retain experts to analyze the draft permit modification.

EPA Response: EPA disagrees that an extension of the public comment period was necessary. The public comment for this Class III permit modification lasted 45 days, from November 14 to December 30, 2022, which exceeded the minimum 30-day timeframe that is required in 40 CFR Part 124, to accommodate the holidays and allow sufficient time for public review.