



**SOLUTION MINING
RESEARCH INSTITUTE**

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SMRI Request for Proposal (RFP2023-1) “Deep or Tall Cavern Abandonment Testing and Analysis”

1. BACKGROUND

This Request for Proposals (RFP) is issued based on recommendations from SMRI Research Report RR2022-1 “Abandonment of Salt Caverns, Phase 1: Gap Analysis”. Discussions within the SMRI Research Committee have shown that there is critical data gap in understanding the behavior of deep and/or tall cavern abandonment (i.e., where conditions may promote fracturing in the surrounding rock mass). In particular, field tests and brine infiltration analysis are either incomplete or not understood well enough to assist with planning the abandonment of deep/tall caverns. Therefore, the SMRI is requesting proposals that will enhance industry understanding and recommending practices for deep/tall cavern abandonment.

For relatively shallow caverns, several abandonment field tests have been conducted during the past several decades. These shallow cavern abandonment field tests indicated that a long-term cavern fluid equilibrium pressure is reached, and that this equilibrium pressure is noticeably less than the geologic lithostatic pressure. Therefore, these observations have led to support the hypothesis that the pressure stabilizes because the brine permeation rate into the host rock formation is approximately equal to the cavern closure rate (i.e., volume loss rate) caused by salt creep.

In the case of deep/tall caverns, the experience from field tests is much more limited. It is expected that deeper/taller caverns will experience faster closure rates and potentially less brine permeation, which leads to the hypothesis that the equilibrium pressure will be close to the geostatic pressure. This behavior has been observed in at least one cavern (i.e., Etzel K102). Additionally, an SMRI-sponsored deep cavern abandonment test at the Barber’s Hill Salt Dome also investigated the equilibrium pressure. Although, the Barber’s Hill test indicated that the equilibrium pressure was approaching the geostatic pressure, the test had to be terminated due to regulatory pressure limitations.

The primary real research interest for this RFP is for deep/tall cavern abandonment, where a key question exists for the predominant brine infiltration mechanism and the potential transition from brine permeation to hydraulic fracturing as the cavern pressure increases due to long-term creep closure. Therefore, the primary goal of this RFP is to better monitor and characterize the brine infiltration mechanism(s) and rates for deep/tall caverns in an effort to develop recommended practices for cavern sealing and abandonment (CS&A). Secondary goals include determining the potential for hydraulic fracturing and how various conditions influence the brine infiltration rates and pressure increase rates. Monitoring plan and/or supporting modelling should help distinguishing between brine permeation in surrounding rocks and hydraulic fracturing during the test.

2. SCOPE OF WORK

The overall objective of the study is to provide a greater understanding of deep/tall cavern abandonment. To achieve this objective, SMRI expects that several possible experimental approaches can be used. The



ultimate experimental approach should involve an abandonment field test of an actual deep/tall cavern as the most direct investigation of the processes associated with deep/tall cavern abandonment. However, a deep/tall cavern field test is expected to require a substantial amount of time to plan, execute, and complete. Therefore, the SMRI is also interested in interim experimental approaches that can provide more timely results or test individual hypotheses. These interim experimental approaches could include laboratory-scale investigations of brine infiltration, field tests of deep boreholes within salt, or other methodologies applicable to understanding deep/tall cavern abandonment approaches.

Because there are several possibilities for the experimental approach, the scope of work will likely vary project-to-project. However, the scope of work should strive to answer the following questions related to deep/tall cavern abandonment:

- What is the predominant brine infiltration mechanism?
- What conditions influence brine infiltration and/or fracturing?
- What is the equilibrium pressure?
- What factors impact the pressure increase rate and time to reach equilibrium?

The general scope of work is expected to generally align with the following tasks:

- Task 1: Desktop review of deep/tall cavern abandonment processes and testing hypothesis development
- Task 2: Modelling as a theoretical basis to show the relevance of the discussed issue
- Task 3: Experimental/in situ test planning
- Task 4: Discussion on further procedure to agree on framework conditions for test execution
- Task 5: Experimental/in situ test execution
- Task 6: Results interpretation, conclusions, and final report

The in-situ test and measurements shall include at least the two following phases:

- Brine outflow test: measuring the brine outflow from the cavern at halmostatic pressure to evaluate the cavern creep and possible remaining brine thermal expansion contribution.
- Shut-in pressure test: plugging the cavern and measuring the cavern pressure build-up to evaluate the brine permeation and/or hydro-fracturing brine migration when the cavern pressure is close to the lithostatic pressure.

The SMRI is also interested in working with potential partners that may have existing data (e.g., pressures, brine outflow volumes) for deep/tall cavern abandonment tests and are willing to share this data as a component of a research project. Additionally, the SMRI may consider supporting the collection of future, long-term data from existing deep/tall cavern abandonment tests. Sharing this data with the SMRI membership could promote diverse groups to analyze and interpret the behavior of deep/tall cavern abandonments.

At the completion of the project, the project team will develop a comprehensive report that discusses the background, approach, results, and conclusions of the deep/tall cavern abandonment testing. Depending on the proposed testing approach, the project duration is expected to vary between 1 and 5 years. Longer



duration projects may be considered, depending on the scope of work and the value provided by additional project years.

3. PROPOSAL INSTRUCTIONS

Responses to this RFP should be reasonably brief (less than 10 pages), describe the proposed effort and offer a succinct discussion of the technical approach.

This RFP anticipates that a fixed-sum contract will be used, and a project schedule and cost plan will be submitted.

The qualifications and experience of the proposed researcher(s) in the technical field described within the Scope of Work are likely the most significant proposal-evaluation criteria.

Teaming and subcontracting to bolster qualifications are encouraged, but a strong lead researcher (project manager) must be identified in the proposal and will be named in the research contract as key personnel. The level of commitment of the lead researcher to the research effort must be itemized in the proposal.

Proposals should be submitted in electronic form via email to Tim Bauer, SMRI Research Coordinator, (tbauer@solutionmining.org), by 1 August 2023. Please email a statement of your interest or intentions to respond to this RFP before 16 June 2023, so you can receive any updates or modifications to this RFP. Questions relating to this RFP should be directed in writing (via email) to the Research Coordinator. Answers to questions that apply to all potential proposers will be forwarded to all identified proposers.

4. CONTRACT AWARD AND SPECIFICS

Proposals will be evaluated solely based on information contained in the proposal. The proposer selected for negotiation of a contract will be the one that best meets SMRI’s needs and is economically sound. SMRI has the right to select or reject any or all proposals.

The research contract will be negotiated between the selected contractor and SMRI. The contractor will be solely responsible for coordination of any subcontracted work and for all payments to any sub-contractor(s).

1. SMRI contract for this Work will be fixed sum for the defined statement of work. The proposed fixed-sum payment must be clearly defined in the proposal. Payment will be made upon acceptance by the Research Committee of the final research report. No other progress or interim payments would normally be made.
2. SMRI’s Project Sponsor will be named after contractor selection. The Project Sponsor will be the contact for any project-related communications.
3. The research project is to be completed within the time frame agreed on for the project (1 to 5 years are expected, as above described) of the project start date.
4. The contractor shall present progress reports at each SMRI Research Committee meeting during the project and an oral research report at the end of the project. The costs for these presentations, if any, are to



be included in the fixed-sum cost of the project. The Project Sponsor or Research Coordinator may present one of the two required progress reports per year to the Research Committee using materials (text and PowerPoint) prepared by the project team.

5. A final research report is required in the form of a standard scientific or technical report. The research report will provide standard information such as background and purpose for the research, theoretical basis and methods, data collected, analysis, references, and research conclusions. Depending on the amount of information used, either lists of information in appendices or separate electronic files of the information, or both, might be required. All report submittals (drafts-for-review and final) will be as electronic files, both MS-WORD (*.doc) and PDF (*.pdf). SMRI will supply formats/contents for its standardized report covers, title pages, and forward/disclaimer for its research reports. The research report will be reviewed by the Project Sponsor, the Research Coordinator, and the Research Committee. Before final report acceptance, the researchers must satisfactorily address all review comments.

6. The enclosed Standard Terms and Conditions for SMRI Research Contracts, dated 30 June 2017, shall apply. Additional limitations or modifications are possible before contract negotiation.

7. SMRI retains ownership and copyright of the work products resulting from this research. Limitations on publishing and release of information are listed in the Terms and Conditions.

Tim Bauer
Research Coordinator

Enclosures:
Standard Terms and Conditions for SMRI Research Contracts, dated 3 January 2023

cc: John Nadeau, Executive Director
Andreas Reitze, SMRI President
Dan Noack, SMRI Research Chairman
Members of the SMRI Research Committee



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Standard Terms and Conditions for SMRI Research Contracts **3 January 2023**

1. The contractor shall perform the scope of work and submit the contract deliverables specified in the Request for Proposals (RFP) and the contractor's proposal. If differences exist between the RFP and the contractor's proposal, the RFP shall govern, unless otherwise specified in the contract. All written or electronic communication regarding the research is to be in English.
2. The SMRI Project Sponsor(s) will provide technical oversight to include review of project plans, will assist in resolution of any technical issues which might impact the project or research results, will approve contractor progress reports, and will review all invoices for accuracy.
3. During the project, progress reports may be given by the contractor during Research Committee meetings generally on the Saturday before SMRI conferences begin, or the brief progress reports must be given to the Project Sponsor prior to the Research Committee meetings for informing the Committee.
4. After the first draft report is approved by SMRI's Research Committee, SMRI will provide a report number, a cover page, a disclaimer regarding the report contents, and a copyright notice which will become part of the final report. A filename and format will then be designated for the final report. All draft and final versions of the research report must include the date at the end of the filename
5. The final report shall be provided in electronic format in Adobe Acrobat word searchable (.pdf) format. The electronic report may consist of text, figures, tables, maps, data files, etc. Reports in electronic format may contain color, (such that colors will print visibly in black and white). Files too large for email attachment may be sent to SMRI via an FTP site.
6. The final results of the research shall be presented in a 30-minute oral report at an SMRI meeting. The report may, at the discretion of SMRI, be at a members-only meeting, or as part of a technical conference. Any and all costs associated with the presentation are part of the contract and included in the contractor's proposal.
7. Upon SMRI acceptance of the final report, the Contractor shall send an invoice electronically to the SMRI Executive Director, Assistant Executive Director, Research Coordinator, Project Sponsor, and copy to accounting@solutionmining.org for approval and payment.
8. SMRI owns the copyright and has the sole right to distribute the report and research products in all versions and formats, including the right to charge for it. The Contractor may distribute the report without charge within the Contractor's organization.
9. SMRI has the right to cancel the contract for any reason and at any time. Should SMRI elect to do so, it shall reimburse the contractor for all costs incurred through the cancellation, unless the cancellation is due to inadequate or late performance.
10. SMRI will not pay any costs or reimburse any expenses not specifically included in the contract. Any changes to the contract must be approved in writing by SMRI and the researcher prior to such additional work or expense. Full costs of the project will be paid by SMRI upon acceptance of the final report by the Research Committee, unless partial payments are specified in the proposal and contract.