SOLUTION MINING RESEARCH INSTITUTE

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SMRI Request for Proposal (RFP2026-01): "Investigation and Analysis of Subsidence on Salt Cavern Facilities"

1 Objective

This Request for Proposal (RFP) seeks qualified researchers, consultants, or organizations to investigate the effectiveness of current salt cavern storage sites subsidence modelling and monitoring techniques to better understand where unpredicted behaviours have occurred, identify the consequences of these, determine the cause of the anomalous behaviour and propose recommendations to inform future predictions or monitoring requirements. The intent is to aid operators, regulators, and consultants in providing safe and efficient cavern operations.

2 Background

Subsidence is an unavoidable effect of cavern leaching and operation (as well as of conventional mining). It has the potential to affect surface structures (e.g., buildings, roads, pipelines) as well as environmental and agricultural aspects (e.g., soil waterlogging, drainage of ditches). Thus, subsidence prediction, limitation and monitoring are major topics of cavern regulations and support stakeholder confidence and the long-term viability of salt cavern projects.

The analysis of subsidence for any cavern field involves the analysis of past subsidence, the prediction of future subsidence, monitoring, and assessment of possible effects at surface. Since subsidence is one of the few, and often the only, measurement that gives information about the status of the rock mass, its analysis is crucial to assess the status of the field and to detect possible problems early. Monitoring data can also be used to support cavern operators from liability claims for damage to surface structures if the relevant quantities (e.g., tilt or compression) are below suitable limits.

Most jurisdictions around the world require the collection of subsidence data, however once collected the interpretation and use of the results is less prescribed. Furthermore, public databases on subsidence exist in both the U.S. and the EU (e.g., Copernicus data) providing open access to the public for independent interrogation and analysis.

Historically subsidence has been thought of as a gradual and smooth sinking of the ground surface and as an unavoidable effect of cavern leaching and operation (as well as of conventional mining). With modern subsidence data collection efforts, there are examples where the traditional gradual and smooth subsidence has not occurred in the manner predicted by models. For example, there are existing salt cavern storage sites where negligible subsidence (effectively zero) has been realised at surface despite the scale of operation predicting much larger subsidence. Alternatively, there are examples of an unpredicted increase in subsidence when compared to neighbouring sites. The reasons for such discrepancies are not widely documented.

Furthermore, there have been instances of wellbore integrity issues including vertical parting of casing, deformation and shearing of casing. Such failures suggests that the subsurface is not only moving vertically but also horizontally, which introduces an additional challenge for the prediction of future subsidence impacts.

There are different levels of sophistication regarding the prediction of subsidence where traditional methods, in some instances, may be too simplified for complex geology associated with salt structures. Therefore, this RFP seeks to better understand the instances where this may be the case and to determine what the potential impact of this may be.

3 Key Questions

3.1 What are the current state of the art techniques for predicting and monitoring subsidence

- What techniques are used to model and monitor subsidence?
- What advances have occurred in the last 20 years?
- Where have these techniques been deployed?

3.2 Where has subsidence behaviour occurred which deviates from that traditionally expected?

- What case studies exist that demonstrate a difference in realised subsidence behaviour to that expected?
- What were the key parameters of the caverns associated with the subsidence including aspects such as geological setting, operating conditions, cavern conditions and medium?
- What technologies were used to model and monitor the predicted subsidence?
- What were the consequences of the realised subsidence?

3.3 Why did these differences occur?

- Are these isolated incidents or is there a pattern?
- Are there conditions (e.g. overburden structure) which impact predictability of subsidence?
- Are there links between subsidence behaviour and well failure mechanisms?
    - When does subsidence cause well bore integrity issues?
- Did the behaviour at surface reflect the behaviour downhole, if not why?
- Did the method of monitoring or modelling contribute to the discrepancy between predicted and reality?
- In instances where subsidence is negligible or non-existent what could be the cause of this?
    - What impact does this have to well integrity?

3.4 What lessons can be learned from the cases presented?

- Can future well integrity issues (such as shearing of casing) be predicted through consideration of subsidence behaviour?
- What information should be collected during the construction of a cavern that can support a robust subsurface model such that subsidence can be accurately predicted?
- How can models be calibrated to support future predictions?
- What can be / has been done to resolve the differences (e.g., more detailed site characterisation, more sophisticated modelling)?
- What future research activities could be undertaken to further understand the reason for these discrepancies?

4 Scope of Work

The project essentially involves a compilation of existing knowledge and data. SMRI envisages a duration of about 12-18 months. The selected contractor will be responsible for the following tasks:

Summary of modelling and monitoring subsidence techniques

- Compile overview of subsidence modelling and monitoring approaches currently adopted in industry.
- Engage with technology providers to identify latest state of the art developments.
- Outline key features of each approach including scale capability, accuracy, technical limitations, vertical / horizontal capability, key outputs etc.

Case studies

- Compile sources of available subsidence data from public and private sources in the U.S. and EU.
- Assess cavern configurations, geological settings, and operational histories to identify patterns and anomalies in subsidence behaviour.
- Review available data and identify areas which conform with a ‘normal’ subsidence behaviour and those that deviate from expected norms.
- Approach existing site operators to request feedback on subsidence behaviour vs predicted and also to provide insight into wellbore conditions.
- Prepare referenceable case study database including data on aspects such as (but not limited to):
    - Salt dome or salt layer size
    - Depth to caprock
    - Caprock properties
    - Depth to top of salt
    - Number of caverns in area
    - P/D ratios
    - Cavern size
    - Cavern location in cavern field
    - Times cavern is cycled annually / cavern operating history
    - Max and Min operating pressures
    - Annual measured subsidence changes
    - Number of wells entered into salt/caprock/adjacent to dome / formation
- Down select case studies into representative set for further consideration in the study.

Investigation into cause of difference

- Review available information and identify trends or similarities between cases.
- For the down selected case studies / trends identify key contributors and differentiators.
- Develop prognosis / theories as to cause of difference.
- Optional: Undertake analytical assessment to replicate actual behaviour and further understand where differences in modelling conditions exist.

Investigation of wellbore failures and correlation to subsidence

- Identify wellbore failure modes which may be linked to subsidence
- Undertake back analysis numerical modelling of representative case study wellbores to better understand failure mechanisms and ability of modelling to predict these.
- Identification of mitigation measures which can be adopted to reduce risk.

Methodology for future monitoring

- Provide recommendations for future subsidence modelling processes including identification of suitable tools, required input data, data to be collected during cavern construction etc.
- Provide recommendation on how such processes can be calibrated based on local data or lessons learned.

Provide recommendations on the most appropriate measurement methods based on site-specific conditions and project needs.

5 Deliverables

1. **Subsidence Case Study Database**: Tabulated database which provides searchable summary information of all case studies identified in study.
2. **Comprehensive Report:** A detailed report addressing the key questions and scope of work.
3. **Presentation:** SMRI Research committee and SMRI Conferences.
4. **Recommendations for Future Research:** Key areas requiring further investigation.

6 Proposal Requirements

Interested parties must submit a detailed proposal including:

- Organizational background and expertise
- Experience with subsidence monitoring and numerical modelling
- References and relevant project examples
- Budget breakdown and resource allocation
- Proposed methodology and timeline

7 Evaluation Criteria

Proposals will be evaluated based on:

- Technical expertise and experience in subsidence monitoring and modelling.
- Feasibility and innovativeness of the proposed approach.
- Cost-effectiveness and resource allocation.
- Ability to deliver actionable insights and practical recommendations.

8 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) with copy to John Nadeau, (Jnadeau@solutionmining.org) by 15 May 2026. Please email a statement of your interest or intent to respond to this RFP before 1 April 2026, 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.

9 Contract Award and Contract 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.
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, 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 1 January 2026

cc: John Nadeau, Executive Director
Members of the SMRI Leadership and Research Committee

ATTACHMENT

STANDARD TERMS AND CONDITIONS FOR SMRI RESEARCH CONTRACTS, DATED 1 January 2026

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Standard Terms and Conditions for SMRI Research Contracts 1 January 2026

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 agreed upon contract language shall govern. 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 con- tractor'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.

11. The contractor shall obtain and maintain for the period of performance of this Agreement the following insurance:

- Worker's Compensation, including Employer's Liability Insurance, and/or all other insurance required by law in accordance with the statutory requirements of the jurisdiction in which the work will be performed.
- Commercial General Liability Insurance and shall maintain such insurance coverage during the term of this Agreement. Such insurance shall cover the entire work product created by the contractor and all operations performed under this Agreement. Insurance policies procured in accordance with the terms of this Agreement shall have a minimum limit of One Million Dollars ($1,000,000.00) per occurrence. In addition, the contractor's insurance policies shall clearly indicate such policies will act as primary insurance in case of a claim made under this Agreement.

12. SMRI warrants that performance of this agreement will not infringe any intellectual property rights of the contractor or sub-contractors. SMRI will acquire no rights in any of the contractor's or its sub-contractors' intellectual property. SMRI shall use the contractor intellectual property solely and to the extent necessary for the performance of this Agreement. SMRI shall not disclose any of the contractor's intellectual property to any third party. The contractor's intellectual property includes but is not limited to information and knowledge, including, without limitation, any processes, parameters, methods, procedures, designs, drawings, specifications, formulations, trade secrets, know-how (including confidential information), research and development obtained by SMRI from or concerning The contractor or its sub-contractors developed by SMRI in the performance of this agreement. The final report is excluded from this clause.