



SMRI Request for Proposal (RFP2023-05) “Research on repurposing existing caverns for H₂-storage”

1. Background

Hydrogen is regarded worldwide as a crucial energy carrier in a future energy system with a high share of variable renewable energy sources, especially in order to balance fluctuations in electricity generation, as an alternative for fossil resources in the industry and for mobility applications etc. These fluctuations can be compensated for by flexibility measures such as large-scale energy storage, namely in salt caverns.

Interest from SMRI members in the underground storage of hydrogen and related research has increased significantly in the last years. SMRI initiated a research report “Hydrogen Storage in Salt Caverns - Current Status and Potential Future Research Topics” (RR2023-1). The research report identified several topics for potential research with regard to hydrogen storage, where one of the key areas of research was on repurposing of caverns for hydrogen storage.

As the use of fossil fuels reduces and the use of hydrogen increases there will be an impact on the cavern storage market. Currently, many caverns are in use for the storage of hydrocarbon energy carriers. A part of the demand for hydrogen storage could be met with repurposing existing caverns. Both existing storage caverns and brine production caverns could qualify. Research is needed to define clear guidelines for repurposing existing caverns to hydrogen storage caverns.

The research interest for this RFP is to define guidelines, attention points and key criteria for repurposing existing caverns to safe, stable, and tight hydrogen caverns. Basic principles will be the same for any type of cavern repurposing. On top of that some specific issues may need to be addressed due to the unique properties of hydrogen. Points to address include:

- What factors determine suitability of an existing cavern or cavern field for hydrogen storage?
- What determines if existing wells are suitable or can be made suitable for hydrogen storage?
- How do the current cavern fluids influence suitability?
- What could be done to make caverns and wells suitable?
- Regulations and permitting

Different categories of repurposed caverns can be considered depending on the point that is addressed, such as former natural gas, liquid/liquified hydrocarbon storage, or brine production cavern(s).

Therefore, the SMRI is requesting proposals that will enhance industry understanding and recommend practices for repurposing of existing caverns intended for future hydrogen storage.



2. Scope of Work

The overall objective of the study is to define guidelines for the repurposing of caverns. This will create a Solution Mining Industry Standard that can be used by operators, consultants and regulators alike to address the specific challenges of repurposing existing caverns to hydrogen storage and to check if and how these challenges are addressed.

To achieve this objective, SMRI expects the scope of work should strive to develop the following components related to repurposing of caverns:

- Review of the current knowledge on repurposing caverns in general, including challenges and lessons learned.
- Review of the reasons why (if any) repurposing caverns to hydrogen storage has additional attention points due to the properties of hydrogen.
- Overview of technical requirements for repurposing caverns to hydrogen storage (for example geological, cavern stability and integrity, well integrity, (bio)chemistry, current cavern fluids, abandonment).
- Recommended guidelines for repurposing existing caverns to hydrogen storage.
- Identification of possible gaps in technical knowledge or regulations that may require follow-up action.

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

- Task 1: Review of knowledge on repurposing of caverns in general
- Task 2: Review of possible reasons for additional attention points regarding hydrogen storage
- Task 3: Generate overview of technical requirements for repurposing caverns to H₂-storage
- Task 4: Draft recommended guidelines for repurposing of existing caverns to H₂-storage
- Task 5: Test recommended guidelines on a hypothetical or planned repurposing project
- Task 6: Identify possible gaps in technical knowledge and/or regulations
- Task 7: Results/conclusions, recommendations for follow-up work, and final report

Within the tasks, at least the following topics should be dealt with:

- Existing knowledge on repurposing of caverns.
 - Review of literature to summarise previous guidance / standards / information on repurposing of caverns.
 - Market review / operator engagement to determine past experience in cavern conversion and case studies (general review does not need to be specific to hydrogen).
 - Identification of key lessons learned which may be applicable to conversion to hydrogen storage operation.
- Differences between known and reported repurposing of cavern experience and hypothetical repurposing to H₂-storage.
 - What makes H₂-storage different (if anything) and why?
 - Which additional attention points can be identified (if any) for repurposing a cavern to H₂-storage?
- Technical requirements to be assessed for repurposing caverns in general and per topic for hydrogen specifically (if needed).
 - How to define technical boundaries to assess suitability of a cavern for repurposing?

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- How to test if a cavern complies with a defined technical boundary?
- Identification of ‘red flags’ which would prohibit potential for cavern conversion to hydrogen storage.
- What steps need to be performed to make a cavern suitable (for example changes to the well, or exchanging the current cavern fluids) and why are these steps necessary?
- What can be done to make a currently unsuitable cavern suitable?
- Outline guidelines for repurposing caverns to H2-storage.
 - What guidelines would be generic for any repurposing project?
 - What would be (if any) additional guidelines specifically for H2-storage?
 - The guidelines should be generic as to apply to a wide range of existing caverns, but specific and complete in order to cover all important aspects that determine the success of a repurposing project.
- It would be very interesting to apply the proposed guidelines on a case study for a planned or hypothetical repurposing project to show their suitability.
 - A case study would help to identify possible gaps in technical knowledge and/or regulations that require follow-up.
- Results and conclusions, recommendations for possible follow up. The proposed guidelines can be used (after a formal acceptance) as a Solution Mining Industry Standard.

At the completion of the project, the project team will develop a comprehensive report that describes the guidelines for a successful repurposing of existing caverns to H2-storage caverns. The project duration is expected to be about 0.5 – 1 years. Longer duration projects may be considered, depending on the scope of work and the value of the research results.

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 31 January 2024. Please email a statement of your interest or intentions to respond to this RFP before 29 December 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.

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4. 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 3 January 2023, 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, 2023 SMRI President
Daniel Noack, 2023 SMRI Research Chairman
Members of the SMRI Research Committee

**ATTACHMENT
STANDARD TERMS AND CONDITIONS**