

Reservoir Lining Study for Pumped Storage Hydropower Plants

Scope of Work

Introduction

The members of the National Hydropower Association (NHA) have emphasized the need to study new lining methods and materials, especially for closed loop pumped-storage hydropower (PSH) projects. PSH projects are generally characterized by fast and significant changes in reservoir water levels, and they may benefit from new lining methods and materials that would provide less-expensive solutions for this type of operation. Additionally, closed-loop PSH projects are not continuously connected to natural water bodies or inflows, so they would benefit from lining materials that would minimize water leakage or seepage losses and reduce the needs for makeup water. Considering these industry needs, the DOE Water Power Technologies Office (WPTO) has decided to fund a scoping study on PSH lining methods and materials, with the focus on new polymeric geomembrane liners and their applicability for use in PSH reservoirs. The core project team for the study consists of Argonne National Laboratory (ANL), Oak Ridge National Laboratory (ORNL), and Stantec. The project team will be collaborating with an Advisory Group, consisting of industry experts as well as regulatory agencies and other stakeholders.

Technical Approach

The technical approach for this scoping study will include different activities and types of analysis. The study will focus on the US, but examples from other countries can be provided for illustration and comparison purposes. The study will start with an extensive literature review to provide information on the current reservoir lining practices, new lining methods and materials, and relevant regulatory issues. The literature review will also provide information on the reservoir leakage/seepage in the US, how it is measured and how do estimated losses during the project design compare to actual losses during operation. Based on the information gathered from literature review on reservoir lining materials and practices, an assessment of polymeric geomembrane liners will be performed to determine their suitability for closed- and open-loop PSH reservoirs. The assessment will include a discussion of design issues related to polymeric liners, current FERC and other regulatory practices and requirements, cost estimates, and comparisons with other lining materials. A technical report will be published for this scoping study, which will summarize the activities performed and the key findings and conclusions.

Project Tasks

The key tasks to be performed for this scoping study can be summarized as follows:

Task 1: Establish Advisory Group (ANL lead, Stantec and ORNL support)

Establish and coordinate the Advisory Group (AG) for the project. Organize and conduct AG meetings on quarterly basis. It is envisioned for AG to include experts from USACE, USBR, ICOLD, Black & Veatch, McMillen Jacobs Associates, CEATI, Ames Construction, SNC Lavalin, and other stakeholders.

Task 2: Literature Review (Stantec lead, ANL and ORNL support)

Perform literature review on reservoir lining materials and practices and on polymeric geomembrane liners. The review should cover, but not be limited to the following:

- Brief overview of technologies and materials used for lining of hydropower and PSH reservoirs in the past
- Current practices and new trends in reservoir lining
- Leakage/seepage challenges faced by existing reservoirs, comparison of estimated values during project design and actual values during operations, metrics used by the industry, etc.
- Regulatory issues related to reservoir lining
- Polymeric/geomembrane-type liners and their use for hydropower applications.
- The information collected can include terminology and types of polymeric materials, their chemical properties, material and engineering properties, testing results of geomembrane liners (from literature), etc.

Task 3: Assessment of Polymeric Liners for PSH Reservoirs (Stantec lead, ANL and ORNL support)

Perform an assessment of suitability of polymeric lines for PSH reservoir. The assessment should include the discussion of engineering design, construction practices and standards, regulatory issues and requirements, cost estimates of polymeric liners and comparison with other types of liners, etc. The assessment should also cover the failure modes of geomembrane liners and mitigation measures, and monitoring of performance, detection of failures and repair techniques, and other relevant information.

Task 4: Technical Report (ANL lead, Stantec and ORNL support)

The project team will prepare a technical report to document the information, results and findings of the assessments performed during the project. The report will be publicly available and released under the WPTO's HydroWIRES initiative. This task will include:

- Writing of sections of the full report (per agreed upon report outline)
- Assembly and internal review of the full report
- Final editing of the assembled full report based on the internal reviews
- Review of the final report by AG and (selected) stakeholders
- Final editing and submission

Task 5: Project Management and Reporting (ANL lead, Stantec and ORNL support)

This task will include overall technical and financial project management, with the principal tasks:

- Management of individual tasks
- Organization of project team meetings and meeting notes
- Organization of AG meetings on quarterly basis
- Managing interactions with AG and stakeholders
- Maintaining an electronic environment for documents, communication, and references
- Regular monthly and/or quarterly project reporting to DOE

Project Team

The project team for this study consists of two DOE national laboratories, Argonne National Laboratory (ANL) and Oak Ridge National Laboratory (ORNL), and a well-known engineering company Stantec. Stantec has significant experience with the reservoir lining methods and materials.

Budget

The budget needed for this project is estimated at \$xxx,xxx. According to the scope of work for each participating team member, the budget allocations are estimated as shown in Table 1.

Table 1: Project Team Responsibilities and Estimated Budget by Task

	Task	Lead (L) or Supporting (S) Role			Budget (\$K)		
		ANL	ORNL	Stantec	ANL	ORNL	Stantec
1	Establish Advisory Group	L	S	S			
2	Literature Review	S	S	L			
3	Assessment of Polymeric Liners for PSH Reservoirs	S	S	L			
4	Technical Report	L	S	S			
5	Project Management and Reporting	L	S	S			

Schedule

The period of performance for this project is 12 months from the project start.