



Long-Term Corrosion Protection of Existing Hydraulic Steel Structures

When: Planned Launch Spring 2017

Problem Statement: How can we protect steel structures from corrosion in water for fifty or more years of service life without significant maintenance or replacement of the protection method?

Common hydraulic steel structures include hydroelectric penstocks and gates. These steel structures corrode, or degrade, without a properly applied corrosion control method. This degradation produces a localized or general thinning of material, which reduces the structure's ability to support load, carry water, etc. Failure of hydraulic steel structures can cause extensive downtime, loss of productivity, property damage, and even loss of life.

The annual estimated cost of corrosion in the U.S. is \$451 billion or 2.7% of the nation's GDP (IMPACT Study, NACE International, 2016). This enduring cost is in spite of the development of numerous technologies dedicated to providing corrosion protection. The most widely used technologies are coatings and cathodic protection systems. Protective coatings are the first line of defense against the corrosion of steel structures. Coal tar enamel and solution vinyl coatings provide superior protection for hydraulic structures. Their use today is limited to reduce associated health, safety, or environmental risks. Commercial alternatives are available, but the trade-off is a reduced service life, making them very expensive to replace on these short life cycles. Cathodic protection systems can be used in conjunction with coatings. These systems prevent corrosion by making the steel structure a cathode in an electrochemical circuit. Cathodic protection works for gates only while they are in the water, and it may not provide adequate protection in the high-flow conditions of penstocks. Furthermore, it also requires routine maintenance and replacement, which is easily neglected.

Brief description of the potential impact from a successful solution to this problem: The cost of maintenance and replacement of existing corrosion control systems has increased greatly in recent decades due to increasing health, safety, and environmental concerns associated with coatings that have performed well in the past as well as the decreased life cycles of commercially available alternative coatings. New long-term solutions to protect steel structures in water immersion service will help to reduce the high cost incurred to keep steel infrastructure reliable and functional.

Prize Competition Scope: This is a prize competition is envisioned to consist of 2 main stages. The decision to proceed to Stage 2 will depend on the results of Stage 1 and other considerations.

- **Stage 1** is a Theoretical Challenge requiring a white paper submittal with a total prize purse of \$75,000.
- **Stage 2** is envisioned as a subsequent Reduction-to-Practice (RTP) Challenge to demonstrate and validate their methods in the lab or at a field testing site with a total prize purse of at least \$250,000.

Reclamation also plans to invite industry, non-profit organizations, and venture capital representatives to participate as partners and/or, official judges of this competition and seek potential business deals with competition participants.

Collaborators:

RECLAMATION
Managing Water in the West



<https://www.usbr.gov/research/challenges/corrosion.html>