

## Summary Background Document for New Capital Hydropower Improvement Project

Project Title: Powerhouse Sequence of Event Recorder, Annunciation, and Diesel Generator Controls Upgrades

Dam and Reservoir Project: Lower Granite

Estimated Total Cost: \$3-7 Million

Estimated Schedule for Completion of the Project:           Phase 1a: FY2019  
Phase 1: FY2020-2021  
Phase 2: FY2022-2023  
Expected Physical Completion: FY2023

### Project Background

In September 2016, the Corps' Hydroelectric Design Center (HDC) completed a Phase 1a Report for McNary Powerhouse Controls (Report) that evaluated the aging control and annunciation systems at McNary dam and reservoir project and provided recommendations for upgrading each system. Control systems are a general term that describes the various inputs, outputs, operational controls and alarms related to powerhouse functions. The Report found that the control system and annunciation technology currently in place is obsolete and allows for limited expansion or reconfiguration. The Report followed the guidelines from the *Regional Philosophy on Control Room System Control Consoles* document prepared by HDC.

In September of 2017, the Corps' Walla Walla District (NWW) commissioned HDC to prepare a Scoping Documentation Report (SDR) for the remaining five powerhouses in NWW: Dworshak, Ice Harbor, Lower Granite, Lower Monumental, and Little Goose. The intent of the SDR was to conduct a similar evaluation of the control and annunciation systems at the other five powerhouses and provide a list and priority of recommended upgrades. The ultimate goal was to evaluate and recommend design options that best address current operation and maintenance (O&M) requirements; reduce maintenance costs; ensure compliance with relevant cyber security guidelines; decrease outage time; and promote consistency throughout the district.

Dworshak, Ice Harbor, Lower Granite, Lower Monumental, and Little Goose dam and reservoir projects each have their own unique combination of older hardwired control systems and newer digital systems. These systems are in various states of usability, and in some cases, disrepair or obsolescence. For Lower Granite dam and reservoir project (Project), the highest priority upgrades resulting from the SDR were the annunciation systems, SER, and PLC and the installation of updated HMI diesel generator (DG) controls. The annunciator panel includes a main warning lamp or audible signal to draw the attention of operating personnel to the annunciator panel for abnormal events or condition. A SER is a component of the control system that provides a date and time stamp for all events that are monitored by Project staff, down to the millisecond. Staff use fault tree analysis, a deductive failure analysis of the undesired state of the system, to determine the order in which alarm conditions occurred. Updated PLC and HMI DG controls would replace existing discrete wiring systems and would allow for operation, control, and alarm monitoring. Project staff could then make changes via programming functions instead of making hardwired configuration changes. The PLCs and HMIs are highly configurable for the changing needs at the Project.

### Project Justification

Annunciation and SER systems are imperative in hydroelectric facilities to ensure dependable unit operation and personnel safety. Project's control room is missing adequate annunciation systems, SER systems, and visual and audible indication. Modern control system technology has undergone a significant transformation

in the years since Project was constructed. The Project has not kept up with the rapid pace of change, and these powerhouse systems are obsolete or non-functional. By analyzing fault event data, SER systems allow personnel to find the exact source of a fault or control system issue so that personnel can address the issue appropriately. This system is imperative to personnel safety as it allows crews to quickly troubleshoot and isolate problem areas without the need to search through secondary evidence that may require inspection and troubleshooting work in confined spaces, or areas of high voltage. The Project's existing SER is obsolete.

Modern annunciation systems keep the Project from experiencing unexpected outages by allowing Project operators greater insight into the current state of the operating systems so that they can monitor and address issues before they become critical. For example, early warning of a high temperature alarm may indicate the beginning of a serious problem for generation equipment, like windings or bearings. Without proper annunciation, a warning may go unnoticed by the Project personnel until the fault condition causes major damage to the unit. This upgrade would help operators make more informed decisions during both normal operations and emergency situations. The Project's existing annunciation systems are obsolete and do not adequately monitor the number of devices required in modern powerhouses.

The existing PLC and HMI DG controls at the Project only include partial control of the 4160 volt station service breakers. Station service is currently one of the least visible systems from the control room. If station service fails due to this lack of visibility, the power that is required to operate electrical components of the Project, including the spillway and some fish passage equipment, will not be available. The current systems have the ability to trip the main and non-critical feeder breakers, and the ability to close the DG breakers, but they lack the ability to restore the station service breakers back to normal conditions, or to shift loads to distribute power to critical control, safety and unwatering systems. They also do not monitor the Truck-Operated Contact (TOC) breaker contacts that would allow indication of a racked out condition, a situation where a breaker is mechanically disconnected from the feeder bus. This deficiency poses a safety concern as without proper indication, operators could potentially expose personnel to an arc-flash situation. An arc flash is the light and heat produced as part of an arc fault, a type of electrical explosion or discharge that results from a low-impedance connection through air to ground or another voltage phase in an electrical system.

### **Strategic Context**

This investment aligns with the 2018 System Asset Plan.

### **Objective(s)**

The primary objectives of these upgrades are to provide fully functional SER and annunciation systems, and to increase the functionality of the diesel generator PLC and HMI systems to allow for increased visibility of plant functions. These upgrades will improve safety, reliability, and reduce O&M costs.

### **Summary**

This project will ensure an integrated SER and Annunciation System and also upgrade the diesel generator PLC and HMI Systems. The integrated annunciation and SER systems will include network-capable equipment and a robust/expandable communication infrastructure. This includes fiber cables, a conduit or tray system, network switches with high port density, Global Positioning System (GPS) time synchronization, and a redundant or failsafe infrastructure.

### **Proposed Alternatives**

#### **Status Quo – Do Nothing, Fix as Fails**

**Summary:** This alternative would leave the existing systems as is.

**Alternative 1 – Prioritized Approach, replace SER, Annunciation, and upgrade Diesel Generator PLC/HMI**

**Summary:** This alternative would provide Lower Granite dam and reservoir project with an integrated SER and annunciation system and would also upgrade the diesel generator PLC and HMI systems. The integrated annunciation and SER systems would include network-capable equipment and a robust/expandable communication infrastructure. This includes fiber cables, a conduit or tray system, network switches with high port density, GPS time synchronization, and a redundant or failsafe infrastructure.

**Alternative 2 – Total Powerhouse Control System Upgrade**

**Summary:** In this alternative, all recommended powerhouse control systems at Lower Granite dam and reservoir project are upgraded at once. Generic Data Acquisition and Controls System (GDACS) would be expanded to have indication and control of all powerhouse systems. Units would be controlled through new System Control boards, which include a networked HMI. System (S)-boards would be upgraded to modern digital components, where appropriate. The annunciation and SER systems are combined and would be networked to the main control systems. The control room would be reconfigured, unnecessary hardware and wire would also be removed. HMI screens would be installed in the control room for annunciation, SER reporting, and unit control. This solution would still maintain control systems that were recently updated; it would update the same control systems as the “prioritized solution,” but it would do it in a single project or contract.

**Process**

Phase 1a: FY2019 activities involve Lower Granite dam and reservoir project and NWW personnel including operations, engineering and project management offices, as well as BPA’s Generating Assets personnel.

- Develop initial design resource needs, project schedule and budgetary cost estimates for the alternatives.

Phase 1: FY2020-2021 activities involve Lower Granite dam and reservoir project and NWW personnel including operations, engineering and project management offices, as well as BPA’s Generating Assets personnel.

- Prepare Plans & Specification for 60% & 90% Design Reviews.
- Prepare contract documents to Biddability, Constructability, Operability, Environmental, Sustainability (BCOES) level.
- Revise/Update total project cost estimate.
- Advertise contract and pre-award acquisition activities.

Phase 2: FY2022-2023 activities involve Lower Granite dam and reservoir project and NWW personnel including operations, engineering and project management offices, as well as BPA’s Generating Assets personnel and contracted personnel and equipment for construction.

- Award and execute the contract.
- Contract administration, submittal reviews, and development of as-built drawings.
- Contract and subagreement closeout.

**Performance Metrics**

Upgraded SER systems, annunciation systems, and DG controls placed in service by FY23, within scope, schedule, and budget. These upgrades will improve reliability, efficiency and personnel safety, and lower maintenance costs in support of the Project’s operation and maintenance activities.



Existing Synchronizer and Hathaway SER system



Existing Emergency Diesel Generator Control



Annunciation Panel