Project Title: Intake Gantry Crane Controls System Upgrade

Dam and Reservoir Project: Ice Harbor

Estimated Total Cost: $3-$7 million

Estimated Schedule for Completion of the Project:

Phase 1a: None for this project

Phase 1: FY 18-20

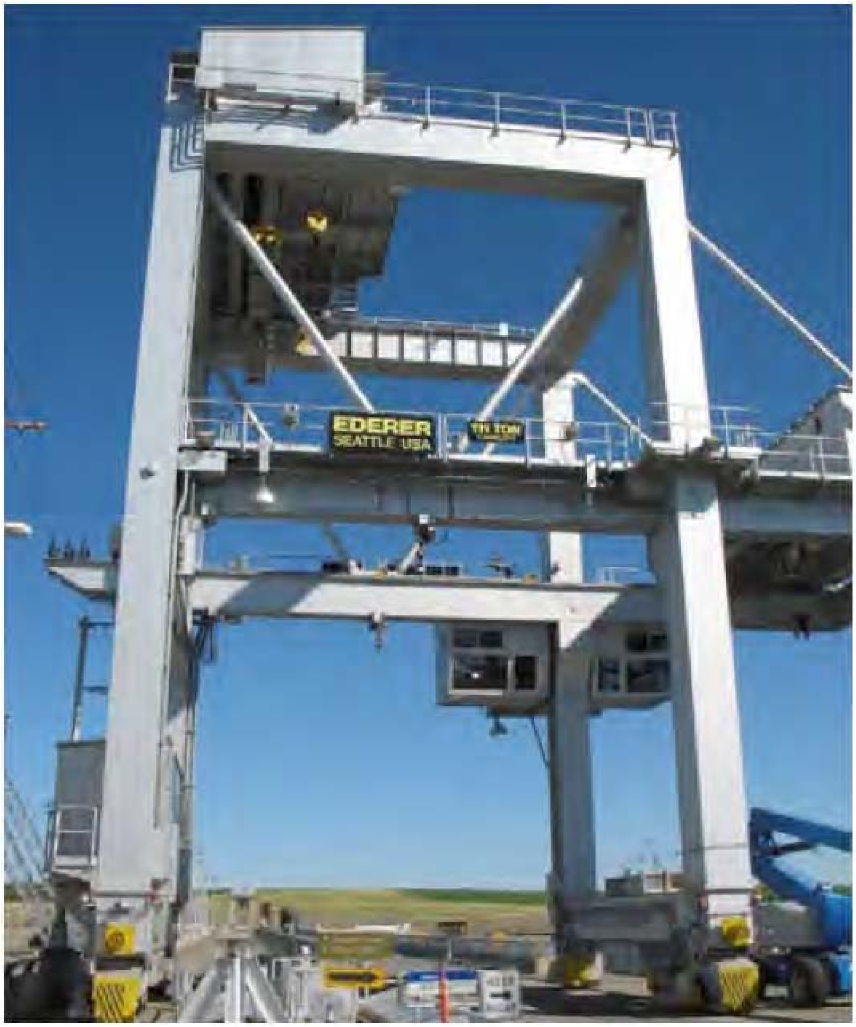
Phase 2: FY 20-21

Expected Physical Completion: FY 21

Project Background:
This is a new project to upgrade the controls system for the 111-ton intake gantry crane at Ice Harbor dam and reservoir project (Project) in order to mitigate the risks presented by the current controls system. The current intake gantry crane at the Project was installed in 1993 and replaced the original intake gantry crane. An intake gantry crane is critical for operation and maintenance activities for multiple dam components. The intake gantry crane installs and removes the trash racks, fish screens, and bulkheads. Bulkheads are installed when dewatering of the hydropower generating units (units) and other systems associated with unit operation is necessary for maintenance activities and emergency repairs. The ability to install bulkheads is essential to the safety of the Project's staff because they protect the staff from incoming water while they are working on the units and other associated systems. The existing crane's drives and controls present a safety risk for the Project's personnel due to electrical hazards, including shock, ArcFlash (a type of electrical explosion), and exposure to energized equipment. The drives and controls are also antiquated technology. The existing Direct Current (DC) motors and associated controls are obsolete and do not meet current industry practices. Alternating Current (AC) motors and variable frequency drives (VFDs) are readily available, less expensive to purchase and easier to install, require less maintenance over time, and are now standard. The Corps' Hydroelectric Design Center (HDC) inspected the intake gantry crane and prepared a structural report in 2013. The report concluded that the Project's intake gantry crane frame is safe for continued use so the frame is not being replaced.

Project Justification:
It is critical for the Project to have a reliable intake gantry crane to support all aspects of project operations, assure safety for project staff, and maintain fish passage. Upgrade of the crane controls will improve safe work conditions for personnel at the dam in multiple ways: by addressing risks from electrical hazards and for those working beneath the crane during removal and installation of the trash racks, fish screens, and bulkheads. The intake gantry crane is also essential for fish passage because it is utilized to support any necessary repairs to the fish screens during the fish passage season because it is used to install and remove the fish screens. This capability is necessary to allow for unit operation and to guide juvenile fish away from turbines and to the juvenile bypass system in order to minimize risk of injury. To mitigate these risks, the crane controls must be replaced.

Strategic Context:
This investment aligns with the 2018 System Asset Plan and is budgeted from FY18-FY21.



Existing Project Intake Gantry Crane.

Objective(s):
The primary objective of this project is to upgrade and modernize the intake gantry crane to provide a reliable intake gantry crane in order to support operations and maintenance, and emergency activities for trash racks, fish screens, bulkheads, main units and other associated systems, which require dewatering. The project includes all materials and labor necessary to return the equipment to acceptable functional level and place it into service.

Summary:
This new project upgrades and modernizes the controls system for the intake gantry crane at the Project.

The existing intake gantry crane was installed in 1993, including the controls and the electrical equipment. The HydroAMP assessment of this equipment results in a condition score of 4.9 out of 10 (marginal). Technical support is no longer available for the controls system. An unplanned outage of the crane would adversely impact fish passage and powerhouse operations, increase Project personnel safety risks, and place the Project at risk if the crane cannot be relied upon to address emergencies. In order to avoid these continued risks, the crane controls must be replaced.

The proposed betterment and modernization will replace the entire controls and drive systems with new AC motors, controlled with VFDs, (a type of AC motor controller that drives an electric motor by varying the frequency and voltage supplied to it), and assorted controls system components. The upgraded components provide improved and more refined control of all crane operations. The new technology also results in electrical efficiencies associated with VFD control and AC motors, and reduces operation and maintenance costs compared to the existing system. The VFD technology will also reduce impacts to the intake gantry crane structure by eliminating shock loading (instantaneous loading and unloading), which can result in shock and associated metal fatigue that are currently occurring with the existing controls system. VFD technology provides for soft-start and soft-stop of all crane operations reducing the metal fatigue stresses that are placed on the crane structure.

Proposed Alternatives:
Recommended Alternative – Controls System Upgrade
This alternative includes complete crane controls system replacement. Electrical work will include new AC motors, VFDs, and assorted controls system components. The existing three-wire overhead power supply must be replaced with a four-wire system or cable reel that is capable of operating the full range of the intake deck. Anticipated Phase 1 work will include the review of fall protection as well as analyzing whether all trolley functions are properly aligned. Initial tests indicate no mechanical or structural work is necessary.

The scope of work will include a variety of electrical controls system components: new VFD rated Squirrel cage induction motors for all motions; new shoe brakes for all hoists and disk brakes for all travel; Flux Vector AC Drives with encoder feedback for all hoisting applications, and necessary travel functions; new Programmable Logic Controller; Human Machine Interface (touch screen); operator control chair; radio remote control; load cells, limit switches; wind speed monitoring; and new trolley line conductor system with collectors or cable reel. The crane's operating capabilities and size will dictate the electrical requirements for individual functions and these requirements will drive the sizing of power supply conductors to the crane.

Calculations for the auxiliary hoist, which serves as a backup to the main hoist, were conducted by HDC in 2016 and determined that mechanical work on the auxiliary hoist equipment will be minimal. Preliminary draft calculations on the main hoist, actuating hoist, and trolley drives have also been performed. These indicate that no major mechanical equipment (i.e. drums, speed reducers) will need to be replaced during the upgrading of the controls. Anticipated Phase 1 work would include review of load rating, mechanical components of hoists, trolley and gantry drives, and horsepower ratings for the motors. Given the low age of the crane, the excellent mechanical condition observed, the results of recently performed auxiliary hoist calculations and preliminary draft main hoist, actuating hoist, and trolley drive calculations, expected mechanical scope is minor. Anticipated Phase 2 work includes a slight uprating of some motors when they are replaced based on recent calculations, replacement of wire rope, replacement of drum gear and pinion bearings with extended shear blocks and welds, and replacement of seals, oil/grease, and couplings.

Pros: Crane efficiency will be significantly improved due to replacement of antiquated components with new ones. Overall safety will be significantly improved and in compliance with code due to the dedicated ground conductor in the four-wire system, rather than relying on the rail as a ground to avoid electrocution as is currently the case. Maintenance requirements and the initial cost of installation will be lower than the Next Best Alternative, which utilizes DC drives.

Cons: Crane downtime during rehabilitation.

Next Best Alternative - Controls System Replacement Using New DC Drives
Replace the existing controls system with new DC drives and associated controls.

Pros: Reduced crane downtime.

Cons: DC motor replacement is more expensive than AC motor replacement. DC motors require additional expertise and time to program and troubleshoot versus AC VFDs. DC motors for crane controls are not currently standard; other cranes and experience elsewhere in industry support the use of AC drives. The use of non-standard DC drives increases risk to long-term maintainability due to the requirements for specialized knowledge. DC motors require more maintenance and repair time than equivalent AC motors.

Rationale for Not Selecting: DC drives, while available, are not as widely used or readily available as AC drives due to their limited applications. Installation of new DC drives are limited to existing installations where it is impractical to convert to AC drives. The existing DC motors may or may not be able to be reused for this option. Motors and other DC control components require additional testing and maintenance versus their AC counterparts. DC motors typically require more space to install and more time and labor to manufacture and maintain once installed. The initial cost is higher and they are more susceptible to the ingress of water and moisture when compared to a comparable AC motor. Virtually all of the existing controls systems would require replacement regardless of whether AC or DC drives are installed. The initial increased cost of the DC motors, due to their limited use/availability in industry, would be repeated any time a new motor purchase was required; lead times could also be significant. Additionally, due to higher market volume of AC drives, future advances in reliability and performance are likely to be concentrated on the AC drive market.

Process:

Phase 1a: this phase is not required because scoping of the project was completed in FY16 with costs and alternatives addressed in an investigative report prepared by Walla Walla District (NWW) and HDC staff.

Phase 1: FY18-20 activities involve Ice Harbor, NWW and HDC personnel including operations, engineering and project management offices, as well as BPA's Generating Assets personnel.

- Utilize the initial scoping performed by NWW and HDC for development of plans and specifications.
- Prepare contract documents to Biddability, Constructability, Operability, Environment and Sustainability (BCOES) levels (*See* Corps' Engineering Regulation 415-1-11).
- Based on the BCOES level contract documents, prepare a total project cost estimate.
- Advertise construction contract and pre-award activities.

Phase 2: FY20-FY21 activities involve Ice Harbor and NWW personnel including operations, engineering, project management, contracting and construction offices, BPA's Generating Assets personnel, and contracted personnel and equipment for construction.

- Award and execute the construction contact.
- Contract administration, submittal reviews and development of as-built drawings.
- Conclude with contract closeout and sub-agreement closeout.

Performance Metrics:
Modernization of the crane controls will improve reliability, efficiency and personnel safety, and lower maintenance costs in support of the project's operation and maintenance activities. This investment will result in returning the Intake Gantry Crane to operable service, which will allow the fish screens to be removed and installed as needed for repairs.