Summary Background Document for New Capital Hydropower Improvement Project

Project Title: Lower Monumental Powerhouse Bridge Crane Wheel and Drive System Upgrade

Dam and Reservoir Project: Lower Monumental

Estimated Total Cost: $3-7 Million

Estimated Schedule for Completion of the Project:

Phase 1a: FY20

Phase 1: FY21

Phase 2: FY22-FY24

Expected Physical Completion: FY24

Project Background

The primary function of the Lower Monumental 600 ton powerhouse bridge crane is to provide lifting capability within the powerhouse for general maintenance and to service the six main generator units. The bridge crane is the only method available to perform necessary lifts associated with main unit overhauls and rehabilitation or routine maintenance of machinery in the powerhouse. Loss of the use of this crane could negatively affect power generation, return to service of fish priority units, and safe movement of large apparatus.

The bridge crane was last rehabilitated in 2011 which included new drive wheels for crane mobility. Since that time the drive wheels have experienced problems with wheel alignment and rubbing between the crane rail and wheel flanges. When the wheel flanges rub the crane rail it makes a noticeable metal-to-metal grinding sound that is an indicator of wheel material loss (see Photo 1). This circumstance necessitates the dedication of Project staff time to monitor the wheel flanges for excessive wear and monitor the degradation so that the crane can be safely used for its multiple purposes.

Also subsequent to the 2011 crane rehabilitation, design commenced to complete the major overhaul of the main generator Unit 1. The overhaul required the service of the bridge crane. To help posture the crane for intense use during the overhaul new wheels were purchased and installed by project staff on four of the drive wheel axel assemblies. This replacement was anticipated to correct the problems with the wear and metal degradation.

During the overhaul of Unit 1 the wheel flange rubbing continued and accelerated to a severe state. This included critical flange wear on the new wheels as well as the original 1968 wheels (see Diagram Bridge Crane Wheel and Identification Numbers). Project staff performed monthly measurements of wheel flange thickness starting in July 2015 as part of a monitoring program. Only the three outside/corner wheels on each corner of the crane were monitored on a monthly/bi-monthly frequency. Wheels measured included 1 to 3, 10 to 12, 13 to 15, and 22 to 24.

In the diagram and table below, all 24 of the bridge crane wheels are shown and listed. Wheels 2, 11, 14, and 23 are the drive wheels. The other wheels are referred as idler wheels.

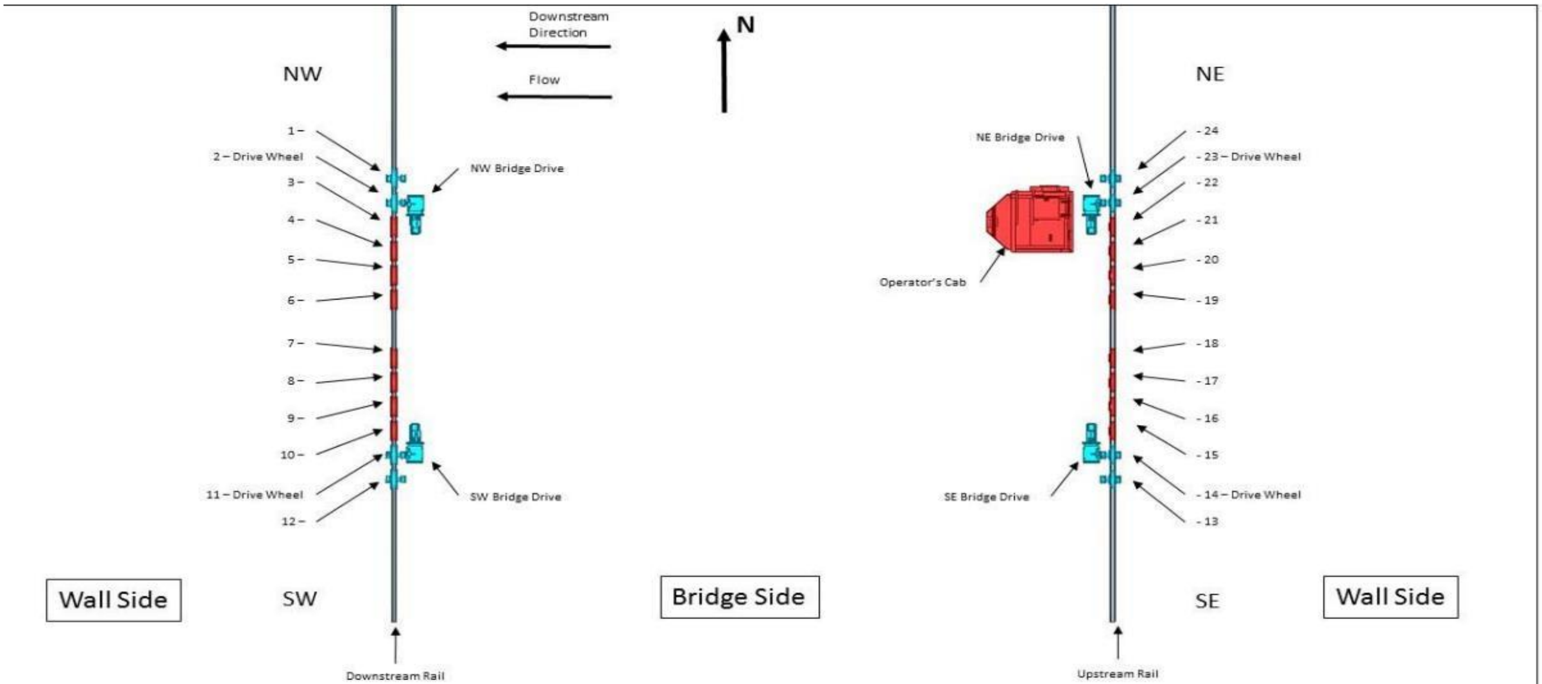

Diagram of Bridge Crane Wheel with Identification Numbers

Wheel Number	***Wheel Description***
1	NW - Downstream North Idler Wheel
2	NW - Downstream North Drive Wheel
3	NW - Downstream North (original 1968 wheel) - 1st Idler Wheel
4	NW - Downstream North (original 1968 wheel) - 2nd Idler Wheel
5	NW - Downstream North (original 1968 wheel) - 3rd Idler Wheel
6	NW - Downstream North (original 1968 wheel) - 4th Idler Wheel
7	SW - Downstream South (original 1968 wheel) - 4th Idler Wheel
8	SW - Downstream South (original 1968 wheel) - 3rd Idler Wheel
9	SW - Downstream South (original 1968 wheel) - 2nd Idler Wheel
10	SW - Downstream South (original 1968 wheel) - 1st Idler Wheel
11	SW - Downstream South Drive Wheel
12	SW - Downstream South Idler Wheel
13	SE - Upstream North Idler Wheel
14	SE - Upstream North Drive Wheel
15	SE - Upstream North (original 1968 wheel) - 1st Idler Wheel
16	SE - Upstream North (original 1968 wheel) - 2nd Idler Wheel
17	SE - Upstream North (original 1968 wheel) - 3rd Idler Wheel
18	SE - Upstream North (original 1968 wheel) - 4th Idler Wheel
19	NE - Upstream South (original 1968 wheel) - 4th Idler Wheel
20	NE - Upstream South (original 1968 wheel) - 3rd Idler Wheel
21	NE - Upstream South (original 1968 wheel) - 2nd Idler Wheel
22	NE - Upstream South (original 1968 wheel) - 1st Idler Wheel
23	NE - Upstream South Drive Wheel
24	NE - Upstream South Drive Truck - Idler Wheel

On June 1, 2017 all 24 wheels were measured. This latest measurement continued to show a reduction in wheel flange thicknesses and a growing concern for the criticality of this wear and safety of staff while crane is in use.

According to the measurements and using the current wear rate, approximately 40% (8 of 20) of the idler wheels are projected to reach 50% of their original flange thicknesses in the next 5 years. The worst worn idler wheels are 3, 4, 5, 20 and 21 which are projected to reach 50% in December 2019.

Overall, the average remaining thickness left on the downstream idler wheel flanges (wheels 1, 3 through 10, and 12) is 78%, with the thinnest flange thickness at 63% of its original thickness (wheel 3). The average remaining thickness left on the upstream idler wheel flanges (wheels 13, 15 to 22, and 24) is 76%, with the thinnest flange thickness at 67% of its original thickness (wheel 20).

Photo 1: Wheel 6 Flange Wear – Bulk Material "Sheared" Off from Wheel

Photo 2: Wheel 6 Flange Visual Inspection (70% of Original Thickness)

Photo 3: Wheel 3 Flange Visual Inspection Thinnest (63% of Original Thickness)

Photo 4: Wheel 4 Flange Visual Inspection (66% of Original Thickness)

Photo 5: Wheel 1 Flange Visual Inspection (97% of Original Thickness)

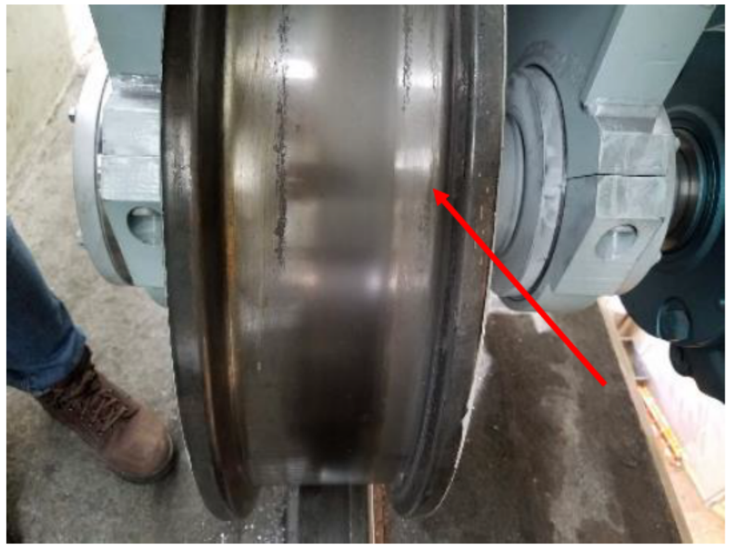

Photo 6: Wheel 2 Flange Visual Inspection (No Signs of Wear)

Photo 7: Wheel 20 Flange Visual Inspection (67% of Original Thickness)

Photo 8: Wheel 21 Flange Visual Inspection (68% of Original Thickness)

Photo 9: Downstream rail filleting and metal dust generated from the wheel and rail contact.

Photo 10: Metal dust generated from the wheel and rail contact during crane movement.

Project Justification
Based on data gathered during the monitoring and failed rehabilitation and replacement efforts the wheel drive assembly and wheels need to be replaced with a wheel control system that aligns with the use of the crane and rail system. Without correcting the drive wheel control configuration, the wheels will continue to degrade to the critical flange section (less than 50% of design wheel flange thickness) and will lead to a significant safety hazard within the powerhouse.

Strategic Context
This investment is included in the current (2019) System Asset Plan see page A21. The cost outlined in the asset plan aligns with the current business case. The asset plan completion year is FY 2024, which is consistent with the business case timeline.

Objective(s)

- Restore reliability to the bridge crane to perform intended purposes
- Increase worker safety while using the bridge crane
- Upgrade wheel drive control systems and replace all crane wheels

Project Summary
This project will upgrade the powerhouse bridge crane wheel and drive system and will increase the reliability of the crane to perform lifting in the powerhouse for general maintenance activities and potential unplanned requirements for main units.

Proposed Alternatives

Status Quo – Do Nothing, Fix as Fails

Summary:
This alternative is unacceptable because leaving the drive system and wheels as is will lead to a significant safety hazard within the powerhouse. The powerhouse bridge crane would be placed out of service due to worker safety concerns, and project staff could not perform general maintenance or address unanticipated work requirements for main units.

Rationale for not selecting this alternative: The quarterly monitoring of the wheel wear is 80 hours, and this alternative would force increased wheel wear monitoring. When the bridge crane is removed for service due to unsafe conditions, a typical outage for repair of a main unit thrust bearing failure would increase from two weeks to six months.

Alternative 1 – Powerhouse Bridge Crane Wheel and Drive System Upgrade (Recommended)

Summary:
The recommended alternative would upgrade the bridge drive configuration to closed loop control with flat tread drive wheels and replace all drive and idler wheels (all 24 wheels). This project will design and install four new flat drive wheels, new gear motors with encoder motors, new 20 Horsepower (HP) Variable Frequency Drives (VFD) for each motor configured in closed loop control, and all new idler wheels. The project would also provide the programming for new drives and bridge controls.

Rationale for selecting this alternative:
This project will upgrade the powerhouse bridge crane wheel and drive system and will increase the reliability of the crane to perform lifting in the powerhouse for general maintenance and unanticipated requirements for main units. The project will increase worker safety while using the bridge crane.

Alternative 2 – Replace all 20 Idler Wheels and Re-use 2015 Flat Tread Drive Wheel and Truck Frames (Not Recommended)

Summary:
This alternative would replace all 20 idler wheels and re-use the 2015 flat tread drive wheel and truck frames.

Rationale for not selecting this alternative:
This alternative is not a viable solution to the problem because the bridge drive control/configuration is the root cause of the crane alignment and wheel rubbing problems. Replacing wheels alone will not solve the crane alignment problem.

Process
Phase 1a:

- Investigate all of the identified subsystems and develop a list of recommended alternatives for replacement, rehabilitation, or repair.
- Develop initial design resource needs, project schedule and budgetary cost.
- Phase 1a check-in at 60% completion at Capital Workgroup to review project alternatives.

Phase 1:

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

Phase 2:

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