Coquitlam-Buntzen Project Water Use Plan

Flow Release Valve Modification

Reference: COQWORKS#1


BC Hydro Engineering

April 2009
1.0 COQWORKS#1 Flow Release Valve Modification

1.1 Introduction

This final construction report in response to Order (File No. 0241200, 0241202, and 0084341), received on April 21, 2005, which ordered the submission of plans for the modification of discharge facilities on the Coquitlam Dam to make the controlled release of water as specified in Schedule C of the Order.

Following schedule delays due to dam seismic upgrade requirements and related budget increase, the installation of the modified flow release valve was successfully completed in October 2008 with the modified instream flow release initiated 22 October 2008. This accounted for an approximate 2-year delay from which was approved initially by the Comptroller's office on 2 Dec 2005 requiring modification of the release valve in August 2006 with initiation of the modified flow regime in September 2006.

The modified flow will extend for 9 years as a component of the Coquitlam/Buntzen Consultative Committee’s Consensus Adaptive Management Agreement (2002). Based on the 23 March 2009 Comptroller approval of the Ordered monitoring program TOR addendums, the fisheries benefits of the two flow regimes will extend through 2017 as a component of the 15-year Water Use Plan review.

1.2 Background

Prior to flow release valve (low level outlet – LLO) replacement in October 2008 the existing intake tower at Coquitlam Dam consisted of three isolated sluiceways controlled by 60” circular sluice gates. In addition to the main sluice gates, there are two 12” knife gate valves (one in sluiceway no. 1 and one in sluiceway no. 2) that were added in 1994 to provide fish flow releases. These valves were kept in their fully open position to provide required base flow conditions until October 2008.

Options for the provision of increased Coquitlam River flows were evaluated through an alternatives assessment in 2000. The alternatives evaluated included additional fish release valves (as per existing); resizing the existing fish release valves (FRV); or, modifying one LLO with a gate suitable to provide fish flow release. The first two alternatives would provide fish flow release over a narrow range and may not be sufficient to meet future needs and do not provide other benefits to the facility such as improved operation, lower maintenance, and increased flexibility. Modifying the existing LLO would provide reliable and accurate controlled flow as well as a mechanism to control reservoir level in the event a reservoir evacuation is required.

Modifying the LLO in sluiceway No. 3 was shown to provide the greatest flexibility in controlled releases. Several alternatives were investigated for modification of LLO No. 3 including installation of a new knife gate or sluice gate as well as upgrading of the existing gate so that it would be suitable for flow control service.

Based on an internal engineering evaluation, installation of a new knife gate in LLO No. 3 was recommended. Although more costly, this alternative offered the least impact on the watershed during installation and provides the best predicted flexibility and reliability while providing accurate
flow control. Installing a new sluice gate in LLO No. 3 was discounted due to the suitability for partial opening not being clearly established through operating experience and sluice gate valve reliability is predicted to be worse than the knife gate option. Upgrading the existing gate was also discounted as an option due to the many unknowns involved with the deficiencies of the current gate and issues related to vibrations at partial openings.

The advantages of installing the knife gate valve are summarized as follows:

- Predictable flow control;
- Relatively simple installation with minimal impact to the watershed;
- Designed for low vibration;
- Designed for minimal debris entrapment;
- Ease of maintenance (by design as well as from newer corrosion resistant materials);
- Predicted low maintenance and high reliability; and,
- Improved isolation capabilities.

1.3 Scope

Installation of a 48” knife gate will provide a maximum flow capacity similar to the existing and will require a steel insert anchored and set inside the existing LLO discharge works.

The 48” knife gate valve will be operated in a manner similar to the existing discharge parameter arrangement that utilizes a new electric operator in the intake tower house to drive a valve stem extension.

1.4 Installation Details

1) A lifting Monorail was fabricated installed and tested to provide for safe removal of the 60 inch sluice gate and installation of the new valve.

2) Removed existing cast iron gate and frame and exposed the existing 60” dia. thimble embedded in the concrete wall. The thimble was found solidly welded to the gate frame which was also attached to the wall. All parts of the frame except around the thimble were cut out. The wall thimble projected a total of 1 1/2” from the concrete wall. This was 1” more than originally estimated but was accepted as within misalignment tolerance of the universal joint coupling for lining up the stem of the valve with the drive shaft. Therefore the wall thimble was not cut back to reduce the amount of projection.

3) Installed scaffolding for the installation of Martin hanger assemblies and the drive shaft. Drilled four for each of the 5 Martin hangers 5/6” dia. 16” deep holes in the concrete wall, set the 1/2” dia. threaded rods with Hilti HIT RE 500 high strength adhesive epoxy and fastened the Martin hangers to the concrete wall.

4) The threaded rods for the hanger nearest to the valve were added with adjusting nuts behind the bracket plate for making final re-alignment required to maintain proper spacing of the hanger out from the concrete wall.
5) Existing opening through the concrete floor was grouted up and re-cored to new alignment through which the upper 2" dia. 72" long keyed drive shaft is run and held in place by a bearing which in turn is supported by a 3/4" thick steel plate anchored to the floor.

6) The bearing is attached to the plate with four stainless steel bolts. A 2" split shaft collar is installed immediately above flush to the upper face of the bearing. Installed the four drive shaft segments, each supported by a Martin hanger with a 2" dia. urethane split bushing. The hanger assemblies act only as a restraint for the drive shaft from whipping. This upper overhang drive shaft is clamped to a universal joint with a 2" keyed couplings which in turn clamped to the top item # 13 drive shaft using another 2" keyed coupling. Removed the scaffolding.

7) Cored thirteen 2" dia. holes through the chamber concrete wall 3'-11/2 " thick using a plywood template to match the anchor bolt holes on the flange adapter plate. Lowered the flange adapter plate onto the chamber floor and installed a scaffolding to access the downstream face of the chamber wall. Cleaned all the surfaces to be covered by the flange adapter plate and the anchor rods backing plate with high pressure water. Set 1 1/8 “ dia. 45” long threaded anchor rods with the 6” sq. x 1 1/4 “ thick backing plates in the 2” dia. holes with centralizers. Coated sikaflex sealant onto the thimble surface and lined up the flange adapter plate in position with the anchor rods making sure the bottom edge rested on the chamber floor. Tightened the anchor nuts slightly to secure the flange adapter plate in correct vertical position. Introduced flowable Microsil anchor grout into all the cored holes and behind the flange adapter plate having covered up the extra anchor bolt holes in the plate and plate vertical sides. Removed the access platform. After the grout was set the anchor rods were tightened with a torque wrench to approx. 500 ft-lbs.

8) Lowered the knife gate valve onto the chamber floor. The bolted topwork of the valve was removed previously and a lifting lug specially fabricated attached to the top of the valve to lift it with the new 5 tonne hoist and safely lowered down onto the chamber floor. Initially ran from the downstream side of the valve 14 -11/2” dia. 61/2” long studs into tapped holes 2 1/2” into the top valve body and studs ending 1” short in the holes at the gate end. After cleaning the flange of the adapter plate placed on it the 1/8 “ thick cloth-inserted rubber gasket and with come along attached the valve to the flange adapter plate with the bevel on the gate facing away from the wall. Then ran the remaining 30 studs through the body of the valve and the flange adapter plate and the hex nuts tightened. All the fasteners were torqued to approx. 600 ft-lbs. Shims were added between the chamber floor and bottom of the flange adapter plate and the gate and the floor area underneath grouted.

9) Installed the 2” dia. valve stem having 1/2" keyway and with a 2” keyed coupling clamped it to the second universal joint which in turn with another 2” keyed coupling was clamped to the lower first drive shaft. Previously installed four drive shaft segments were found horizontally misaligned and therefore the bolt holes in the bracket plate of the first three from the bottom Martin hangers had to be adjusted to correct the misalignment. This was carried out using the hoist and a man basket. To save time it was decided to proceed with the installation of the drive shafts first instead of the knife gate valve since the valve was not available as it was being painted at that time since it did not come factory painted. Completed installation of the topworks of the valve. Finally coupled the 36” long drive shaft and the 72” long drive shaft with the Kop-Flex gear coupling. This will allow the actuator to be removed without disturbing the bearing supporting the drive shafts. The valve actuator stand then slid over the gear coupling and drive shaft and attached to the 3/4 “ thick steel plate anchored to the concrete floor. Limitorque actuator was then mounted onto the stand with bolted flange connections.
10) The valve was tested throughout its range and found to be smooth and quiet in operation. The electronic position indicator was calibrated. A leak test was carried out with a visual inspection in the outlet tunnel, no leakage was noted from the valve.

11) A local position indicator was fabricated and installed by means of a cable attached to the gate with a pulley and scale in the tower for use in blackout conditions. An adaptor for the handwheel with a 1/4 inch drive shaft was installed for electric drill operation in emergency.

Progress photos can be viewed in Appendix A with final as-built drawings pending BCH approval.

1.5 Project Actuals

The project is largely complete with all associated expenditures, however, an added mechanical position indicator and drive spindle to provide for "black" operation is due for installation in June 2009. Based on approved budget of $1,299K and expenditures to date of $840K, it expected $20K will be required to complete the final LLO upgrade requirements.

<table>
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<th>Approved Budget</th>
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<th>Variance $</th>
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<tr>
<td>$1,299K (June 2008)</td>
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<td>459K</td>
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<td>Remaining BCH project management, site calibration of mechanical position indicator and drive spindle installation.</td>
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<td>426k</td>
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Appendix A: Progress Photos

Monorail being tested prior to the lifting out of the old valve.
Photos 1 & 2: Removed existing CI gate and exposed the 60” dia. wall thimble and gate frame.

Photo 3: Modular scaffolding with access opening and door/fixed ladder at each landing used to install the Martin Hangers and the drive shaft.
Photo 4: Martin Hangers installed.

Photo 5. Drive shafts installed.

Photo 6. Drive shaft through the concrete floor held in place by the bearing supported by steel plate anchored to the floor.
Photo 7: Plywood template used to set the location of 2” dia. holes for anchor rods for anchoring flange adapter plate.

Photo 8: 2” dia. holes seen through the 36” thick chamber concrete wall on the downstream side.
Photo 9: Anchor rods and plate placed in the 2" dia. holes by centralizers ready to receive the Microsil grout.

Photo 10: Flange adapter plate installed with anchor rods in place to receive the grout in the cored holes and behind the plate. Note the scaffolding to access downstream side of the chamber wall.
Photo 11: Running from downstream side of the valve into tapped holes 14 short studs on top valve body before the valve is attached to the flange adapter plate.

Photo 12: 48” dia. knife gate valve installed complete with all the 30 fasteners torqued.
Mesh added to keep debris from slide area

Photos 13 & 14: 48” dia. knife gate valve stem connected to the drive shaft and topworks installed.
Photo 15: Valve stem clamped with keyed couplings to the drive shaft with a universal joint in between. Martin hanger with urethane split bushing attached to the wall act as a restraint for drive shaft from whipping.

Photo 16: Two separate segments of drive shaft field welded together and with an intermediate Martin hanger.
Photo 17: The Limitorque Actuator and its stand.