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Board briefing – DAM SAFETY QUARTERLY REPORT

Executive Summary

The purpose of this report is to update the Capital Projects Committee of the Board of Directors on key dam risk management activities during the period from April 1, 2019 to June 30, 2019, and to provide reasonable assurance that the safety of dams operated by BC Hydro continues to be managed to the established guidelines and criteria of the Dam Safety Program.

The Dam Safety Program has been executed in a manner that is consistent with its stated objectives throughout the reporting period. The overall Dam Safety risk profile is shown in Figure 1. There have been no changes in assessed risk this quarter.

Risk Profile of BC Hydro's Dam

Dam Safety Contribution to Enterprise Risk

Dam Safety is assigned a high "risk priority" within BC Hydro's Enterprise Risk report, as depicted below. This high rating is arrived at by recognizing that: (1) there can be extremely severe consequences from the failure of a dam; (2) a dam failure can progress quickly without leaving adequate time to take effective actions to reverse the failure; and (3) our ability to mitigate this risk is considered to be "moderate" given that upgrades to existing dams are typically expensive, time and resource intensive and frequently technically challenging. The nature of dam safety risk is that it can only be realistically managed by minimizing to the extent practicable the probability of occurrence through a well-constructed and well-executed Dam Safety Program.

Risk	Severity	Likelihood	Speed of Onset	Ability to Mitigate	F19 Q4 Risk Priority	Change from Last Quarter
Dam Safety *Risk of a dam safety incident*	**H**	**L**	**Fast**	**M**	**H**	• For F20 Q1 the overall Dam Safety risk is stable.

Given the nature described above, this Dam Safety component of the Enterprise Risk is not expected to change from quarter to quarter. Neither is it expected to diminish over time in response to dam upgrade projects delivered within the Capital Plan, such projects being intended to adequately manage this aspect of BC Hydro's risk rather than eliminate it.

Vulnerability Index Update

Identified physical deficiencies in BC Hydro's dams and the degree of concern that exists with respect to their impact on the integrity and performance of the dam are characterized by the Vulnerability Index. The higher the value of the Vulnerability Index, the higher the likelihood of that deficiency leading to poor performance. The aggregated Vulnerability Index for all deficiencies at a particular dam characterizes the extent of concern for the dam's poor future performance from all causes.

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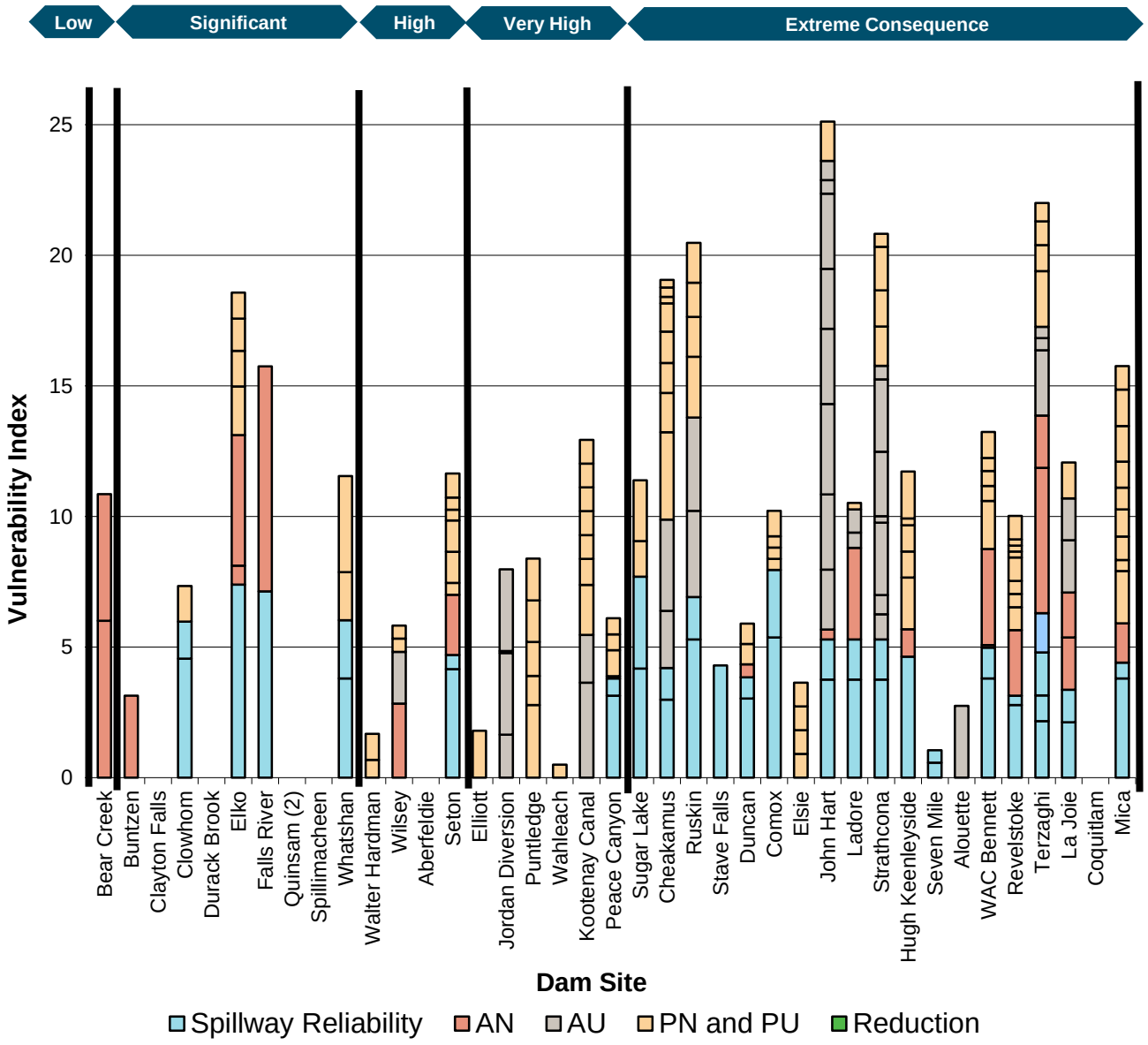

Figure 1 Dam Safety overall risk profile at the end of F2020 Q1, as represented by the Vulnerability Index. There were no changes in this quarter.

AN ***Actual*** deficiency (demonstrated to exist) under ***normal*** load conditions (associated with daily or short-term operations)

AU ***Actual*** deficiency (demonstrated to exist) under ***unusual*** load conditions (associated with flood and earthquake loading)

PN and PU ***Potential*** deficiency (requiring further investigation to demonstrate existence) under either normal or unusual conditions

Spillway Reliability Actual or potential deficiency related to reliability of the dam's spillway and/or other flood discharge systems

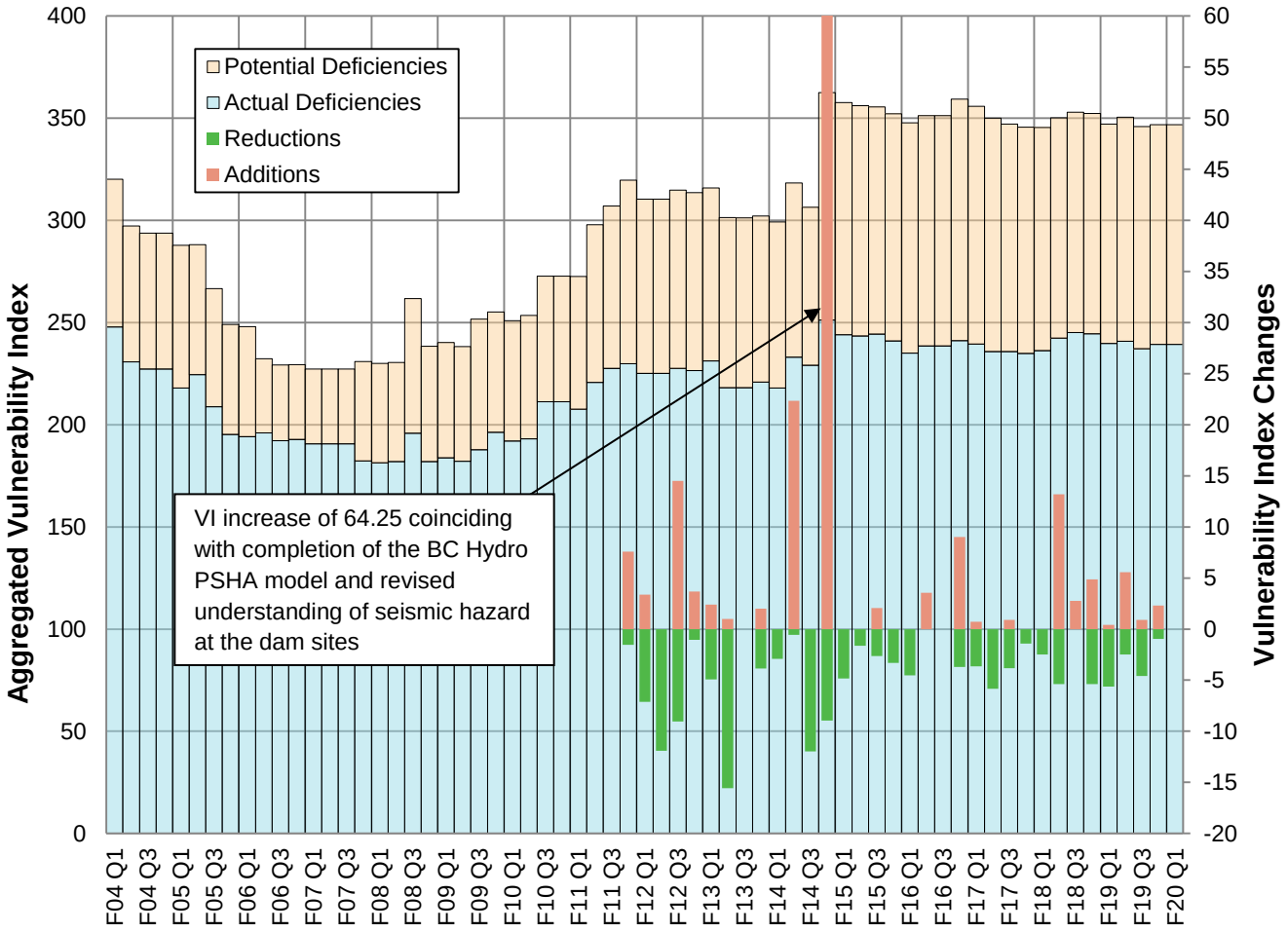

Figure 2 Changes and trends in the Vulnerability Index aggregated across the BC Hydro system. Note: the bars are "stacked" such that total aggregated Vulnerability Index is given by the top of the Potential Deficiencies bar.

The Vulnerability Index for each currently identified issue at each dam site is shown in Figure 1. Dams are sequenced from left to right in order of increasing downstream consequences, per the BC Dam Safety Regulation. No Vulnerability Index changes were made in F2020 Q1.

Changes in Vulnerability Index for actual and potential deficiencies—including those related to spillway reliability—aggregated across the entire fleet of dams, are tracked on a quarterly basis and shown in Figure 2. This is an indication of the changes in the understanding of BC Hydro's dam safety risk profile. Additions are due to the development or recognition of new issues. Reductions are due to risk remediation projects delivered through the Capital Plan, completed repairs and corrective maintenance, and resolution of issues via Dam Safety Investigations. Existing issues are re-examined on a regular basis and re-rated as required. As indicated by the uniformity of the height of the stacked blue and sand-coloured bars, the corporation's intent to not allow an overall increase in the dam safety risk profile continues to be realized.

Non-Conformances in the Dam Safety Program

The risk profile of BC Hydro's dams—and our understanding of it—is very much dependent upon the effectiveness of the operational, maintenance and surveillance procedures in place and being utilized within the Dam Safety Program. Effective and rigorously followed procedures are required to collect and interpret the observations and measurements necessary to verify the adequacy of the physical performance of the dams. Non-conformances are identified through a number of activities within the Program, including Dam Safety Reviews performed by external consultants that function as the Dam Safety Program's independent review.

Accumulation of non-conformances in the period leading up to and including calendar year 2015 had resulted in nearly 600 individual issues, as described in last quarter's report. Since that time, increased focus on these issues has resulted in a downward annual trend in the overall number of non-conformances, with a net decrease of just over 100 issues, or 18%, over that period.

In the first quarter of F2020 seven new non-conformance issues were identified and nine issues were resolved. Dam Safety is presently developing a plan to accelerate resolution and closure of non-conformances. We anticipate reporting the specifics of this plan in the next quarterly report.

New Issues

Aberfeldie Penstock Leak

The Aberfeldie Generating Station is located on the Bull River, approximately 45 kilometers east of Cranbrook. The 25 MW powerhouse and penstock leading from the dam to the powerhouse were constructed between 2006 and 2008 as part of a general facility redevelopment project. The penstock includes approximately 800 metres of buried, high density polyethylene (HDPE), double-walled pipe. The pipe was manufactured by winding a rectangular tube into a spiral and welding the inner and outer surfaces together. Straight sections and factory-fabricated elbow sections were installed in a trench at site and welded together to form the penstock, which was then buried. This is the only HDPE penstock in BC Hydro's system.

Figure 3 Manufacturing (at left) and installation (at right) of the HDPE penstock at Aberfeldie.

On the morning of April 30, a member of the public contacted BC Hydro to report water coming out of the bank near the road bridge over the Bull River. When the member of the public was contacted later to let them know the issue was being investigated, that person said that they thought that BC Hydro had turned something off because the water had disappeared suddenly. It was subsequently determined that this sudden reduction in flow was related to a coincidental closure of the intake gates at the dam and that the water coming out of the bank must therefore have come from the penstock. The penstock was left dewatered and, on inspection of the site, erosion of the slope above the road and adjacent to the buried penstock was observed (Figure 4). It was decided that the penstock would not be returned to service until the cause of the leakage had been investigated and repaired.

As there was no possibility that control or containment of the reservoir could be lost, a Dam Safety Incident was not declared. The province's Dam Safety Officer was informed.

Figure 4 Erosion of the penstock slope above the road. The penstock is buried under the fill to the left of this photo.

Figure 5 Weld failure at elbow joint observed after excavation.

On excavation of the fills around the pipe in the area of the leak, a split in one of the elbows was observed (Figure 5). The split measured 200 cm in length and was between 0.5 and 1 cm in width, extending upward from the bottom of the pipe. The factory welds on both the internal and external pipe walls were found to have failed due to poor adhesion of the weld, indicative of poor quality control during manufacturing.

A series of internal inspections have since been completed by BC Hydro Engineering. Two other splits and several other weld defects were found and since repaired.

Work is underway to return the penstock—and the Aberfeldie Generating Station—to service in October. Given that the failure of the welds is thought to be the result of poor quality control during manufacturing, there is potential for welds at other elbows to fail when the penstock is returned to service. A small capital project has been initiated by Dam Safety to install pressure taps in the annular

spaces between the inner and outer walls and standpipe piezometers in the fills at each elbow location to detect leakage. These instruments will be connected to Dam Safety's Automated Data Acquisition System (ADAS) for continuous monitoring. When returned to service, the penstock alignment will also be visually inspected on a frequent basis for signs of further leakage.

Update on Existing Issues

Spillimacheen

The failure of a penstock intake valve at Spillimacheen and the resulting Dam Safety Incident were reported in the previous quarter. In Q1, site cleanup and additional site assessments were performed. It has been confirmed that the valve failed when water inside the valve's bonnet froze. See Figure 6, below. Engineering's site inspection memo documenting this is to be issued prior to the end of August.

As the damage to the valve is irreparable, the valve is scheduled to be removed prior to the coming winter and replaced with a blocking flange.

Figure 6 Damaged (left) and intact (right) penstock intake valve bonnets.

Alouette Dam Interim Dam Safety Risk Management Plan

Engagement with First Nations and stakeholder groups regarding various issues relating to Alouette Dam is continuing. The variety and complexity of these issues has resulted in this engagement activity being extended for a longer period of time than had been initially anticipated. A public information session, wherein focus will be paid to the expected post-earthquake status of reservoir discharge, the projects underway to address the issues, and the required reservoir operations (including construction-related drawdowns) is scheduled for September. The Interim Dam Safety Risk Management Plan is complete and is expected to be issued to the Comptroller of Water Rights promptly after the public information session.

Compliance with Processes and Regulations

Regulatory Communications

Communications and submissions to the Comptroller of Water Rights and Dam Safety Section in Q1 included:

- Initial written notification of the penstock leakage at Aberfeldie (see New Issues) as well as verbal updates on the status of both the Spillimacheen and Aberfeldie penstocks;
- Peace Canyon and WAC Bennett Dam Safety Review reports; and
- Updates to the Duncan and Seven Mile Operation, Maintenance and Surveillance Manuals.

Operation, Maintenance and Surveillance Manuals

Each dam has an Operation, Maintenance and Surveillance (OMS) Manual for Dam Safety. The OMS Manuals are a requirement under the Dam Safety Regulation and must be updated every seven to ten years. The manuals identify responsibilities and expectations within BC Hydro for maintaining the safety of the dam. The update to the Jordan Diversion Dam OMS Manual was completed in Q1 and updates to other OMS Manuals progressed according to plan.

	Year-To-Date			Year-End	
	Actual	Target	Indicator	Forecast	Target
OMS Manual updates completed	1	1	✓	8	8
Completion of F20 work plan	7%	7%	✓		

Dam Safety Reviews

Dam Safety Reviews are a regulatory requirement carried out at minimum intervals of every five to ten years for High, Very High and Extreme consequence dams. The Peace Canyon and WAC Bennett Dam Safety Reviews were completed in Q1 in accordance with the plan for the quarter. Both dams were deemed to be “reasonably safe”. (A Dam Safety Review can only conclude that a dam is either “reasonably safe” or “not safe”).

The overall work progression lagged behind plan. The draft report for Hugh Keenleyside Dam was received but requires significant work and completion will be in Q2. The Kootenay Canal Dam draft report was due in Q1 but is behind schedule; completion will likely be delayed until Q2.

	Year-To-Date			Year-End	
	Actual	Target	Indicator	Forecast	Target
Dam Safety Reviews completed	2	2	✓	8	8
Completion of F19 work plan	9%	18%	✗		

Five new Dam Safety Reviews have been initiated for F2020: Ladore, Mica, Puntledge, Ruskin and Walter Hardman. Contracts are in the process of being signed with four different consulting firms and site visits have been scheduled to take place in Q2 and Q3.

Surveillance

Inspections

Routine weekly, monthly inspections are a regulatory requirement. These visual inspections are carried out by trained inspectors within Dam Safety or Stations Field Operations using checklists prepared by the Dam Safety Engineer. The purpose of these inspections is to identify changing conditions at a dam, reservoir or appurtenant structure that could threaten the safety of the dam. During the first quarter of this year all 411 (100%) scheduled inspections were completed.

Routine Inspections	F20		F19	F18	F17	F16	F15
	Q1	Total					
Completed	411	411	1638	1595	1583	1594	1603
Missed	0	0	2	16	29	24	8

Instrumentation and Monitoring

The Area Dam Safety Technologists continue to build on last fiscal's initiative to drive consistent, regular checking of instrumentation data plots at all dams to identify any unusual trends and to ensure continued accuracy of the data being collected. The Regional Dam Safety Technologists are each tasked to perform three such checks per week. Over the first quarter of F20, 221 checks were completed, exceeding the target of 195. Additionally, there were no weeks with less than 3 checks completed.

Reservoir Slopes

Dam Safety's Slope Surveillance Program remained active through Q1 and no significant changes to the behaviours of the slopes were observed. A more detailed update on this aspect of the Dam Safety Program will be provided in next quarter's report.

Unusual Events or Observations

The Dam Safety On Call Person (DSOP) responded to 114 calls this quarter. The calls included instrumentation alarms, operational inquiries, operations notifications during floods and earthquake notifications. One notable response is described below.

At approximately 2:00 am Saturday, June 8, the Dam Safety On-Call Person (DSOP) responded to an alarm from WAC Bennett Dam Weir T5, a device that measures seepage flows through the dam. Seepage flows are considered a Key Performance Indicator for earthfill dams and increasing flow rates can indicate a deteriorating condition within the dam. The apparent weir flow had increased from the

normal 40 litres per minute to more than 90 litres per minute, activating the alarm notification to DSOP. The flow rate continued to increase by about 3 to 5 litres per minute every 10 minutes. Upon reviewing the data, DSOP contacted the local Dam Safety Engineer and Dam Safety Technologist who drove up to site to investigate. Once on site they identified a problem with the sump pump, causing the water to back up in the weir and give the false indication of an increasing flow rate. The sump pump was repaired and flows returned to normal later in the day. Although this situation turned out to be a false alarm, it highlights the diligent manner in which Dam Safety responds to instrumentation alarms.

Maintenance

Civil Maintenance

In Q1 of F2020, the Civil Maintenance program completed 6 of 31 projects and spent $1.094M against a plan of $1.081M. One project was deferred to next year due to an outage cancellation at the Cheakamus Generating Station. The remaining 24 projects are on schedule for completion in F2020.

Key project highlights from Q1 include:

- Whatshan Generating Station tunnel repairs and rock trap clean out (Figure 7)
- La Joie Dam Face annual repairs

Raise chamber with bridge barrier wall and spider stage access that has been anchored to the ceiling

Figure 7 Whatshan Generating Station tunnel repairs and rock trap clean out set up (April 2019).

In Q1 F2020, the Civil Preventative Maintenance program continued to progress. An implementation review of the Package 1 rollout was conducted and the findings shared with the affected business units. The Package 2 and 3 assets are being finalized in F2020 with a partial rollout within the fiscal year and full rollout expected in F2021.

Spillway Gate Maintenance and Testing

During Q1, all 61 scheduled gate tests at 23 sites were carried out. No gate system failed to operate on demand during testing. In four other cases, while gates did operate on demand, certain individual components of the gate system malfunctioned or were found to be in unacceptable condition.

As of the end of June 2019, operational restrictions were in place on two out of 109 flood discharge gates due to known deficiencies (no change from the end of F19 Q4).

A total of 43 corrective maintenance issues were identified through ongoing testing and maintenance from April to June 2019. A total of 28 new and previous issues were addressed in the same period, for an increase of 15 overall in this reporting period. There were 152 corrective maintenance issues outstanding at the end of June 2019.

Dam Safety has been monitoring these issues, and is working with Generating Stations Maintenance Planning (Stations Asset Management) to expedite their resolution. All outstanding issues have been scheduled within the maintenance plan to be corrected in F2020 and F2021. In the meantime, Dam Safety fully expects additional issues to arise out of monthly testing and is working to develop an approach that would see safety-critical spillway gates equipment repaired on a more timely basis.

Emergency Preparedness and Public Safety

Emergency Preparedness is managed by Security & Emergency Management. Dam Safety reports on the updating of emergency plans for compliance with the BC Dam Safety Regulation as part of annual compliance reporting to the Comptroller of Water Rights. Public safety near dams and reservoirs is managed by the Public Safety team in Safety Engineering & Work Methods. Dam Safety reports on Public Safety activities related to dams during the Dam Safety Reviews. Please refer to other reports for quarterly updates on emergency preparedness and public safety around dams.

Emergency Planning Guide Meeting – Peace Region Dams

In June, the Dam Safety Engineer for the Peace region presented the Dam Safety risks for the WAC Bennett and Peace Canyon Dams at the Emergency Planning Guide meeting in Fort St. John. These meetings are scheduled by Security & Emergency Management and are attended by representatives from BC Hydro, the Comptroller of Water Rights, the Provincial Emergency Program, communities located downstream of the dam and emergency response agencies such as Fire and Police departments.

Capital Projects

There were 35 Dam Safety initiated capital projects underway in Q1 of F2020. A complete list of these projects is attached as Appendix B. Information regarding projects just launched, where significant developments occurred or where milestones were achieved within the fiscal quarter is provided below.

John Hart Dam Seismic Upgrade

In Q1 of F2020, the project came before the Capital Projects Committee and received approval for the Preferred Alternative, which comprises extensive seismic upgrades to all five dams on site, complete replacement of the spillway gates system for improved reliability and post-earthquake operability, and conversion of several concrete gravity blocks into a passive overflow spillway to mitigate the risk of overtopping the earthfill dams in the event of a flow imbalance between the John Hart and Ladore facilities. The project will now be proceeding into Preliminary Design within Definition Phase.

Strathcona Discharge Upgrade

Feasibility Design Reports for both the low level outlet and the free-crest spillway components of the project were completed in Q1 of F2020. The project team is working towards bringing its recommendations for the Preferred Alternative to the Capital Projects Committee in November. The recommendations comprise construction of a new low level outlet by excavating a deep channel through rock on the dam's right abutment and conversion of the existing gated spillway into a free crest overflow spillway.

WAC Bennett Dam Seal Low Level Outlets

In Q1 of F2020, this project obtained funding approval to progress to the Feasibility Design Stage, with the Leading Alternative being to permanently seal all nine sluiceways and decommission the slide gates and associated equipment. The sluiceways will be sealed downstream side of the slide gates, which will be left in place, and the gate bonnets in the gallery above will be permanently encased in reinforced concrete to seal all potential leakage paths.

Walter Hardman Dam – Headworks Operating Gate Improvement

Past spills—primarily one in 1996—from the Walter Hardman Dam's headpond through the spillway have led to structural damage and erosion of the downstream channel and consequent environmental impacts. Management of the headpond elevation so as to avoid spills relies heavily on discharges through the powerhouse turbines, which are aging and have diminishing reliability. This project's objective is to improve the control of flow into the headpond of Walter Hardman Dam from the diversion headworks structure at Cranberry Creek and, hence, improve control of the headpond elevation.

Feasibility Design was completed in Q1, and the Preferred Alternative was confirmed to comprise modifying the headworks by:

- Replacing the existing operating gate with a new, taller gate;
- Installing a new, more reliable hoist actuator and power supply; and
- Adding a headwall along the left and right banks of the structure to prevent overtopping of the abutments during flood inflow conditions.

Work on the project in Q1 further progressed into Definition and Partial Implementation Phases to carry through and complete Preliminary and Detailed Design. The project's planned In-Service Date is November 2020.

Dam Safety Investigations

There were 19 Dam Safety Investigations and System-Wide Initiatives underway in Q1 of F2020. A complete list of these investigations and initiatives is attached as Appendix C. Information regarding those just launched, where significant developments occurred or where milestones were achieved within the fiscal quarter is provided below.

Sugar Lake Dam – Assessment of Abutments Seepage

Sugar Lake Dam is a 13 metre high concrete buttress dam founded on bedrock. The two abutments consist of overburden soils overlying bedrock or dense till. On the left abutment, seepage has been occurring at various localized points downstream of the dam on the left river bank. There is concern that internal erosion of the left abutment material could lead to piping and hence an abutment failure if the seepage path/piping is eventually connected to the reservoir. On the right abutment, there is some evidence that the connection between the till cut-off trench and the concrete dam is ineffective due to insufficient excavation to the impermeable till prior to backfilling. Since only part of the downstream slope is protected by a filter, there is a risk that internal erosion is occurring which could lead to slope sloughing. The overall objective of this investigation is to better understand the seepage regimes in the abutments in order to assess if there are any dam safety implications and to devise viable upgrade measures (if warranted), to prevent internal erosion of the abutments. This investigation started in Q1 and will continue into Q2 with development of a work plan and a site inspection.

Update on Changes to the Report

This Quarterly Report further continues in the effort to streamline the report while also reporting on a larger breadth of the Dam Safety Program. One important component of this initiative is to make more detailed information regarding the dams, projects and investigations available to the Committee by way of summary documents to be accessed via hyperlinks in the appended tables or by some oter method amenable to the Board's "Diligent" software. These documents are not yet in place, but progress is being made. Dedicated resources have recently been assigned and are preparing the summary dam descriptions (Appendix A) and capital project summaries (Appendix B). A significant number of these summaries are expected to be in place and accessible for next quarter's report. Work in preparing summaries of the investigations and initiatives will follow thereafter. With these dam and project summaries in place, the reformatting of the Dam Safety Quarterly Report will be complete.

Appendix A – BC Hydro's Dams

With this report, the Quarterly Featured Dam Site segment has been discontinued. In future reports, summary information regarding each of BC Hydro's dams will be accessible via hyperlinks in the following table. This feature is not available in this quarter's report, however.

Dam Site	Consequence [1]	Dam Type [2]	# of Dams	Year [3]	Height (m)	Generating Station	Reservoir / Headpond
Aberfeldie	H	PG	1	1953	32	Aberfeldie	Aberfeldie Headpond
Alouette	EX	TE	1	1926 / 1983	21	Alouette	Alouette Lake Reservoir
Bear Creek	L	TE	1	1958	19	Jordan River	Bear Creek Reservoir
Buntzen	S	PG	1	1903	16.5	Buntzen 1 & 2	Buntzen Lake Reservoir
Cheakamus	EX	TE/PG	5	1957	29	Cheakamus	Daisy Lake Reservoir
Clayton Falls	S	PG	1	1961	7	Clayton Falls	Clayton Falls Headpond
Clowhom	S	PG	2	1958	22	Clowhom	Clowhom Lake Reservoir
Comox	EX	PG	1	1912	10.7	Puntledge	Comox Lake Reservoir
Coquitlam	EX	TE	1	1914 / 2008	30	-	Coquitlam Reservoir
Duncan	EX	TE	1	1967	38.7	-	Duncan Reservoir
Durack Brook	S	TE	1	1963	4.5	-	Durack Brook Reservoir
Elko	S	PG	1	1924	16	Elko	Elko Headpond
Elliott	VH	PG	1	1971	27.4	Jordan River	Elliott Headpond
Elsie	EX	TE	6	1958 / 2001	31	Ash River	Elsie Lake Reservoir
Falls River	S	PG	1	1930	13	Falls River	Bigs Falls Headpond
Hugh Keenleyside	EX	TE/PG	2	1968	58	-	Arrow Lakes Reservoir
John Hart	EX	TE/PG	5	1947	34	John Hart	John Hart Reservoir
Jordan Diversion	VH	CB	1	1913	39.9	Jordan River	Jordan Diversion Reservoir
Kootenay Canal	VH	PG/ER	8	1975	38	Kootenay Canal	Kootenay Canal Headpond
La Joie	EX	ER	1	1948	87	La Joie	Downton Reservoir
Ladore	EX	PG	3	1949	37.5	Ladore	Lower Campbell Lake Reservoir
Mica	EX	TE	1	1972	244	Mica	Kinbasket Reservoir
Peace Canyon	VH	PG	2	1979	61	Peace Canyon	Dinosaur Reservoir
Puntledge Diversion	VH	PG	1	1912	5.5	Puntledge	Puntledge Headpond
Quinsam Diversion	S	PG	1	1957	15	Ladore	Quinsam Diversion

Dam Site	Consequence [1]	Dam Type [2]	# of Dams	Year [3]	Height (m)	Generating Station	Reservoir / Headpond
							Headpond
Quinsam Storage	S	PG	1	1957	9	Ladore	Upper Quinsam Lake Reservoir
Revelstoke	EX	TE/PG	4	1984	175	Revelstoke	Revelstoke Reservoir
Ruskin	EX	PG	1	1930	59.4	Ruskin	Hayward Lake Reservoir
Seton	H	PG	3	1956	13.7	Seton	Seton Lake Reservoir
Seven Mile	EX	PG	1	1980	80	Seven Mile	Seven Mile Reservoir
Spillimacheen	S	PG	2	1955	14.5	Spillimacheen	Spillimacheen Headpond
Stave Falls	EX	PG	2	1911	26	Stave Falls	Stave Lake Reservoir
Strathcona	EX	TE	2	1958	53	Strathcona	Upper Campbell Lake, Buttle Lake Reservoir
Sugar Lake	EX	CB	1	1942	13.4	Shuswap Falls	Sugar Lake Reservoir
Terzaghi	EX	TE	1	1960	60	Bridge River 1 & 2	Carpenter Reservoir
W.A.C. Bennett	EX	TE	1	1968	183	GM Shrum	Williston Reservoir
Wahleach	VH	TE	1	1953	21	Wahleach	Jones Lake Reservoir
Walter Hardman	S	TE	6	1960	12	Walter Hardman	Walter Hardman Headpond
Whatshan	S	PG	2	1951	12	Whatshan	Whatshan Lake Reservoir
Wilsey	H	VA	2	1929	30	Shuswap Falls	Wilsey Headpond

[1] Consequence Categories: EX extreme, VH very high, H high, S significant, L low

[2] Main dam at site: PG concrete gravity, CB concrete buttress, VA concrete arch, TE earthfill, ER rockfill, ER/T rockfill timber crib.

[3] Where two years are indicated, the dam has been substantially or completely rebuilt; the first is the year of original construction and the second is the year of the rebuild.

Appendix B – Dam Safety Capital Projects

All Dam Safety capital projects that are currently underway are listed in the following table. In coming quarterly reports, each project listing will contain a hyperlink that will direct the reader to a detailed project description and status summary. This feature is not available in this quarter's report, however.

Dam / Facility	Project Description	Current Phase	Forecasted Completion Date for current phase	Update Available
Alouette Dam	Headworks and Surge Tower Seismic Upgrade	Identification – Feasibility	February 2020	*This column not yet functional*
Alouette Dam	Environmental Flow Discharge Upgrade and LLO Sealing	Needs	September 2019	
Bridge River 1	Slope Drainage Improvements	Identification	December 2021	
Bridge River 1	Mitigate Surge Spill Hazard	Identification – Feasibility	November 2019	
Bugaboo Diversion Dam	Decommissioning	Definition	July 2019	
Clowhom Dam	Gate Control Improvement	Identification	April 2020	
Comox – Puntledge	Flow Control Improvements	Identification – Feasibility	September 2019	
Duncan Dam	Spillway Gates Replacement	Identification	TBD	
Hugh Keenleyside and Revelstoke	Debris Boom Replacement	Definition & Implementation (Combined)	September 2019	
John Hart Dam	Seismic Upgrade	Definition - Feasibility	October 2022	
Kootenay Canal	Power Intake Piezometers Installation	Definition	April 2020	
Kootenay Canal	Replace Silt Slope Piezometers Project	Definition	September 2019	
Kootenay Canal	Reservoir Boom Replacement	Implementation	September 2019	
Ladore Dam	Spillway Seismic Upgrade	Identification – Feasibility	March 2020	
La Joie Dam	Dam Improvements	Identification - Conceptual	October 2020	
Mica Dam	Discharge Facilities Seismic and Reliability Upgrades	Needs	August 2019	
Mica and Revelstoke	Rehabilitate Vertical Movement Gauges	Definition	May 2020	

Dam / Facility	Project Description	Current Phase	Forecasted Completion Date for current phase	Update Available
Peace Canyon Dam	Instrumentation Upgrades	Identification-Conceptual	October 2019	*This column not yet functional*
Revelstoke Dam	731 Block Stability Improvements	Identification – Feasibility	February 2019	
Revelstoke Dam	Replace Downie Slide Instrumentation	Identification – Feasibility	August 2019	
Ruskin Dam	Seismic Upgrade	Implementation-In Service Project Completion	November 2019	
Salmon River Diversion	Decommissioning	Implementation – Project Completion	August 2020	
Seven Mile Dam	Reservoir Boom Replacement	Feasibility	TBD	
Strathcona	Upgrade Discharge	Identification – Feasibility	September 2019	
Terzaghi Dam	Spillway Chute Access Upgrade	Identification – Conceptual	November 2019	
WAC Bennett Dam	Riprap upgrade	Implementation – Project Completion	August 2019	
WAC Bennett Dam	Spillway Concrete Upgrade	Needs	October 2019	
WAC Bennett Dam	Spillway Gate Reliability	Implementation	May 2020	
WAC Bennett Dam	Instrumentation Embankment Dam	Identification – Conceptual	October 2019	
WAC Bennett Dam	Seal Low Level Outlets	Identification – Feasibility	November 2020	
WAC Bennett Dam	Recommission/Seal Sluice Gates	Identification – Feasibility	July 2020	
Wahleach Dam	Tailrace Upgrade	Implementation	September 2022	
Wahleach Dam	Replace Intake Over-Velocity System	Implementation	March 2021	
Walter Hardman Dam	Headworks Operating Gate Improvement	Definition	August 2019	

Appendix C – Dam Safety Investigations

All Dam Safety Investigations and system-wide initiatives that are currently underway are listed in the following tables. In coming quarterly reports, each Investigation listing will contain a hyperlink that will direct the reader to a detailed description and status summary. This feature is not available in this quarter's report, however.

Investigations:

Dam / Facility	Description	Update Available
Alouette Dam	Seismic Assessment of Spillway	*This column not yet functional*
Coquitlam Dam	Data Compilation, 3-D stability model	
Hugh Keenleyside Dam	Low Level Outlets – Operations Concerns	
Mica Dam	Performance Assessment of the Earthfill Dam	
Revelstoke Dam	Computational Fluid Dynamic Modelling of Spillway	
Strathcona Dam	Seismic Performance Assessment	
Sugar Lake Dam	Assessment of Abutments Seepage	
WAC Bennett Dam	Embankment Dam Project; Long-term Performance	
WAC Bennett Dam	Spillway Seismic Performance Assessment	
Walter Hardman Dam	Performance Assessment Investigations	
Wilsey Dam	Static and Seismic Performance Assessment	

System-wide Initiatives:

Description	Update Available
Constitutive Model to Analyse Internal Erosion in Embankment Dams	*This column not yet functional*
Dam Safety Information System development	
Flood Dashboard- Inflow Design Floods Information Compilation	
FloodSiMM-Hydraulic Models Update	
Hydrofracturing Hazard	
Remote Sensing, LiDAR Surveys and InSAR Analysis and Information Database for Landslides	
Stochastic Modelling of Extreme Floods – Columbia River System	
Systems Engineering Analysis of Dam and Reservoir Systems	