

**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 October 1, 2019 to December 31, 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 has been no change in assessed risk this quarter.

This report highlights the progress made on resolving and closing non-conformance issues, with a 13% overall reduction since the beginning of 2019 and a 25% reduction since its 2015 peak. Recent challenges in completing required updates to OMS Manuals are documented, as are the corrective actions being taken to make near-term and more permanent improvements.

Interim Dam Safety Risk Management Plans have been put in place to manage isolation of the power tunnel at Spillimacheen through the winter, to bring the repaired Aberfeldie penstock back into service, and to address the gap that was identified in the most recent Alouette Dam Safety Review.


This report also describes the completion of capital works and in-service additions within several projects. These include new piezometers in the silt slope above Kootenay Canal Generating Station, a new reservoir debris boom at Seven Mile Dam, upgrades to the headworks gate and structure at Walter Hardman Dam, and ongoing, soon-to-be completed spillway gate hoist improvements at WAC Bennett Dam.

Descriptions for BC Hydro's dams were uploaded to the new Dam Safety "book" on Diligent following last quarter's Capital Projects Committee meeting, and now brief summaries of ongoing projects in the Dam Safety portfolio of capital projects have also been added. Similar summaries of Dam Safety Investigations will be added in the near future when resources are available.

**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.

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Risk	Severity	Likelihood	Speed of Onset	Ability to Mitigate	F20 Q3 Risk Priority	Change from Last Quarter
<b>Dam Safety</b> <i>Risk of a dam safety incident</i>	H	L	Fast	M		<ul style="list-style-type: none"> <li>For F20 Q3 the overall Dam Safety risk is stable.</li> </ul>

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.

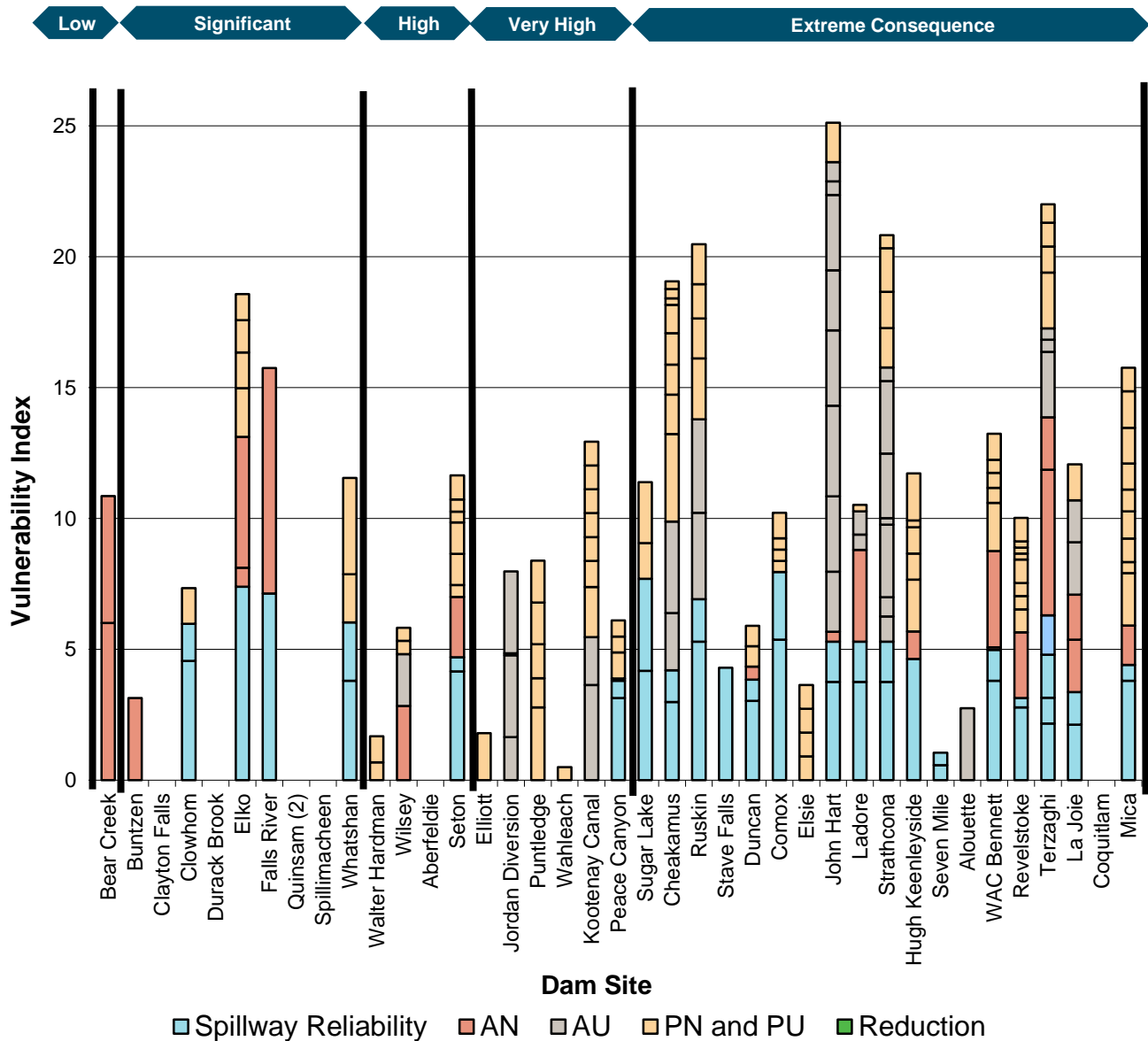
The Vulnerability Index for each currently identified issue at each dam site is shown in Figure 1. Dams are sequenced from left to right in order of increasing downstream consequences, per the BC Dam Safety Regulation. No Vulnerability Index changes relating to identified physical deficiencies were made in F2020 Q3.

With the new in-service assets and upgrades at Ruskin Dam, there are significant pending Vulnerability Index reductions at Ruskin. The sealed Engineering Design Conformance Records, on which Dam Safety bases its acceptance of the improvements, have yet to be completed and delivered, however. Dam Safety continues to anticipate that these documents will be received in F2020 so that the Vulnerability Index for Ruskin Dam can be reduced accordingly.

In Q3, Dam Safety implemented a new practice to align with the practice guidelines of the Engineers and Geoscientists of BC. All initial characterizations, ratings and updates of issues, including calculations of Vulnerability Indices, will henceforth be made under the seal of the relevant Dam Safety Engineer and undergo checking and reviewing per BC Hydro's Checking & Reviewing Practice.

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 over time. 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, BC Hydro's intent to not allow an overall increase in the dam safety risk profile continues to be realized.

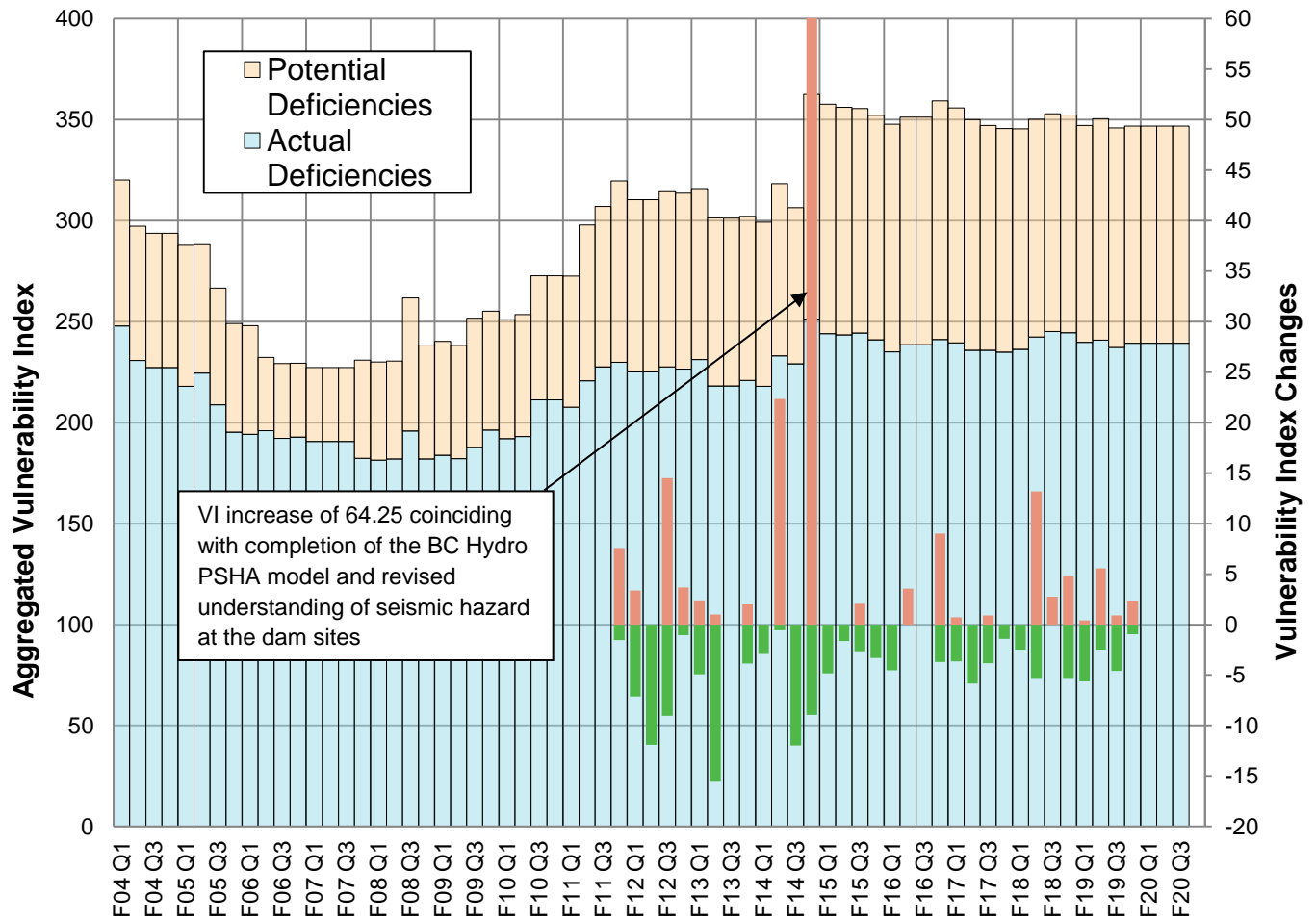
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**Figure 1** Dam Safety overall risk profile at the end of F2020 Q3, as represented by the Vulnerability Index. There were no changes in this quarter.

- 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

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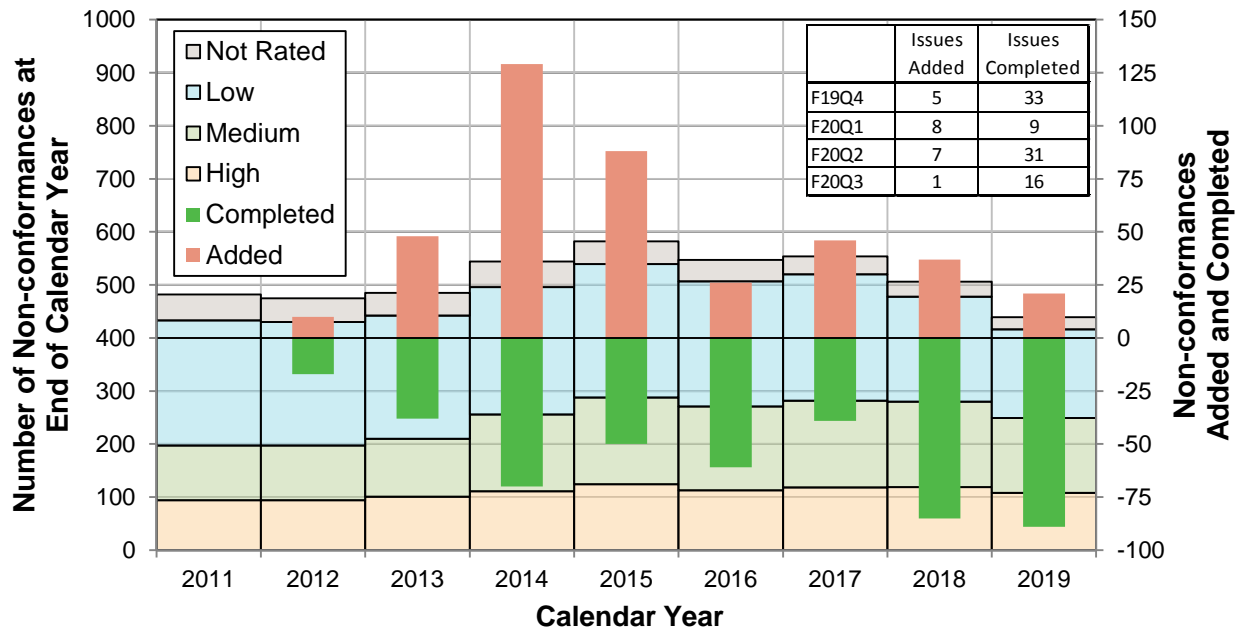


**Figure 2** Changes and trends in the Vulnerability Index aggregated across the BC Hydro system. Note: the bars are “stacked” such that total aggregated Vulnerability Index is given by the top of the Potential Deficiencies bar.

**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. Program non-conformances are identified and tracked in the Dam Safety Issues Database and rated as being of high, medium and low importance. The overall numbers of non-conformance issues by calendar year are plotted in Figure 3.

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**Figure 3** Changes and trends in the total number of non-conformances within the Dam Safety Program. Note: this data is plotted by *calendar year*.

Previous reports have identified the growth of non-conformance issues in the database through 2015 and the more recent efforts to reduce those numbers. Since the start of calendar year 2019, scheduled database reviews for individual dam sites have included rigorous reviews of the non-conformance issues, ensuring the status of completed issues is updated and duplicate issues are consolidated or closed. As a result, 89 issues have since been resolved while only 21 new issues have been added for a net reduction of 68 issues. The total number of non-conformances now sits at 439, as compared to 506 at the end of 2018, 554 at the end of 2017, and 582 when it peaked at the end of 2015. This represents a reduction of 13% over 2019 and of 25% since its 2015 peak.

This “cleanup” of non-conformance issues in the database is the first step. A broader strategy to reduce the number of non-conformances within the Dam Safety Program is under development as a component of Dam Safety’s F2020 Business Plan. For example, since gaps in information (“NCIs”) and maintenance non-conformances (“NCMs”) comprise the two largest components of the non-conformance issues count, that strategy will likely include:

- modifications to the way we fund, prioritize and schedule investigations, *i.e.*, use a portion of the investigations budget to fund smaller, issue-specific studies to close NCIs on a more timely basis, rather than bundle them up over time and then launch a more comprehensive investigation; and
- prioritizing identified NCMs for resolution in annual maintenance plans.

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Unusually high leakage flows of 3400 litres per minute were observed at Seton Canal Forebay on November 21, immediately after the forebay was refilled after a 17-day outage for scheduled cooling water upgrades and other miscellaneous maintenance work in the powerhouse.

Leakage from the canal forebay is measured through a weir and, in operation, typical leakage rates of about 250 litres per minute are measured. Higher rates of leakage—often 2000 to 3000 litres per minute—are often measured upon filling the forebay after an outage, particularly when the outage occurs in cooler weather and the canal's concrete liner slabs contract, opening up wider gaps at the joints where seals have failed.

Following a long outage during cold weather, the measured leakage flow of 3400 litres per minute on November 21 was the highest measured since 2002, when measurements from the weir were put onto the Automatic Data Acquisition System. A Dam Safety Technologist was dispatched to site to look for potential seepage or instability on the penstock slope. No unusual conditions were observed on the slope. On the afternoon of November 22, the leakage rates dropped by about 90% after the powerhouse was brought back on line, slightly reducing the forebay level.

This event has identified the need for a maintenance project to re-seal the joints, which is being worked into the Civil Maintenance Program for F2022. Studies of longer-term options to reduce the Seton Canal forebay leakage are also being considered for inclusion in the Dam Safety Investigations program.

**Update on Existing Issues****Spillimacheen**

The Spillimacheen Powerhouse has been out of service since March 2019, when a penstock inlet valve (PIV01/02) ruptured due to freezing and caused an uncontrolled release that flooded the powerhouse. Over the intervening months, it was decided that the powerhouse would not be returned to service, a blanking plate would be installed in place of failed PIV01/02, and the intake stoplogs would be left in place to isolate the tunnel and penstock from the forebay.

On further assessment, it was decided that additional risk mitigation measures should be put in place to protect the integrity of the water barrier over the winter. To protect the intake stoplogs from possible ice loading damage, heaters were installed in the vertical shaft immediately above the stoplogs to prevent ice build-up. As small amounts of water do leak through the stoplogs, heaters and additional insulation were also installed in the surge tower building to prevent freezing damage to the remaining Penstock Inlet Valve and the bypass in the installed blanking plate. Instruments were installed in both locations to monitor the operation of the heaters and the temperatures in those spaces to warn (at +5°C and +2.5°C) of any potential for freezing and resultant damage.

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An Interim Dam Safety Risk Management Plan that sets requirements for enhanced surveillance, monitoring and emergency response procedures through the winter months has been issued and is being implemented.

Quarterly reporting of this issue will now be discontinued.

**Aberfeldie Penstock Repair**

The Aberfeldie penstock was returned to service on January 6, 2020. The penstock had been out operation since it developed a significant leak in May 2019. Repairs to the high density polyethylene penstock were completed between May and October.

Following completion of the repairs and installation and commissioning of leak detection instrumentation, a “water up” test was conducted between November 18 and 22 to confirm the internal repairs to the penstock were successful. During the test the penstock was filled with water and the recently installed instrumentation was carefully monitored for any changes. The monitoring results indicated that the inner wall of the penstock was likely watertight except at Elbow PI09. A follow up inspection revealed a small leak at a survey marker installed near the elbow. The leak was patched on November 27 and the penstock was temporarily refilled on December 11. This second test provided a strong indication that the inner wall of the penstock is currently watertight.

Successful testing notwithstanding, it is clear that the manufacture of the penstock’s elbow joints was deficient and the risk of leaks developing in this penstock is higher than in other penstocks in our system. Accordingly, prior to returning the penstock to service, an Interim Dam Safety Risk Management Plan that identifies enhanced surveillance and monitoring of the penstock as well as response procedures in the event of a detected leak was issued.

Work to develop and evaluate options for more robust and permanent treatment of the penstock’s deficiencies will be initiated in F21.

Quarterly reporting of this issue will now be discontinued.

**Alouette Dam Interim Dam Safety Risk Management Plan**

The Interim Dam Safety Risk Management Plan (IDSRMP) to modify reservoir operations and make additional preparations for post-earthquake surveillance and response preparations has been issued. This IDSRMP will remain in place until the project to seismically upgrade the power tunnel between Alouette and Stave Lakes is complete.

Quarterly reporting of this issue will now be discontinued.

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### Compliance with Processes and Regulations

#### Regulatory Communications

Communications and submissions to the Comptroller of Water Rights and Dam Safety Section in Q3 included:

- Approval for extension of the John Hart Generating Station Replacement Project water licence deliverables, including the Operation, Maintenance and Surveillance Manual; and
- Notification of unusually high leakage flow from the Seton Canal Forebay.

In addition, the date for the annual meeting between BC Hydro Dam Safety and the Comptroller of Water Rights has been set for February 2020.

#### Operation, Maintenance and Surveillance Manuals

Each dam has an Operation, Maintenance and Surveillance (OMS) Manual for Dam Safety that identify responsibilities and expectations within BC Hydro for maintaining the safety of the dam. The OMS Manuals are a requirement under the Dam Safety Regulation and must be updated every seven to ten years, depending upon the dam’s failure consequences classification.

Updates to OMS Manuals continue to lag well behind the F2020 work plan, primarily due to an unexpected vacancy that arose in the department and remained in recruitment through Q3. As a consequence we will not meet our target for OMS Manual updates for the fiscal year, and we are currently forecasting completion of four updates on a target of eight.

	Year-To-Date			Year-End	
	Actual	Target	Indicator	Forecast	Target
OMS Manual updates completed	1	4	✘	4	8
Completion of F20 work plan	26%	77%	✘		

We have informed the Comptroller of Water Rights of our current resourcing challenges and proposed a revised schedule for updates to the OMS Manuals over the course of 2020. This schedule accounts for planned hiring in the Dam Safety department over the coming months.

A more comprehensive corrective action to prevent or at least mitigate future resourcing gaps of this nature is underway, and is described below, under “Changes to Delivery of Regulatory Compliance Documents.”

#### 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.



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Completion of Dam Safety Reviews relies to a great extent on the same personnel responsible for OMS Manuals. These staff perform up-front work to assemble information and organize and conduct site visits by the external Reviewers, but these tasks were mostly completed before the departure of the staff member described above. Consequently, F2020 work on Dam Safety Reviews is progressing closer to plan, though three Reviews are late due to missed delivery milestones by the external Reviewers.

	Year-To-Date			Year-End	
	Actual	Target	Indicator	Forecast	Target
Dam Safety Reviews completed	2	5	✘	7	8
Completion of F20 work plan	56%	77%	✘		

As of the end of Q3, the planned issue dates of three Dam Safety Reviews—for Hugh Keenleyside, Kootenay Canal and Mica—have been missed. All three of these Dam Safety Reviews are on track to be issued by the end of F2020, however, as are those for Ladore and Walter Hardman Dams. Completion of the Ruskin Dam Safety Review has been postponed into F2021, awaiting completion of required documentation from the Ruskin Dam and Powerhouse Upgrade project. Consequently, we are forecasting to complete seven of eight planned Dam Safety Reviews in F2020.

### Changes to Delivery of Regulatory Compliance Documents

The asset management and regulatory compliance groups within the Dam Safety Key Business Unit are being reorganized. There are several drivers for this reorganization, but one of its key perceived benefits will be to make our organization more resilient to personnel vacancies or absences

At present, responsibilities for different aspects of the Program—capital planning, investigations, OMS Manual updates, *etc.*—are siloed, with identified individuals being solely responsible for each specific aspect. Hence, if one person leaves the organization or is absent for an extended period, work on that aspect of the Program comes to a halt.

To address this vulnerability, current personnel and existing vacancies are being consolidated into a new team, Regulatory and Asset Planning. Members of this team will be responsible for the full cross-section of regulatory and asset management functions, but each team member will be focused on a specific geographic region. Where in the past there have been two persons tasked to regulatory activities such as OMS Manuals (only one at present with the vacancy), in the future there will be six. Where in the past a person being absent or having left meant that such work came to a halt or was significantly delayed, in the future other fully trained team members familiar with the work will be available to step in and temporarily take up the load until the vacancy or absence is filled. This reorganization is expected to take until the summer of 2020 until staff are reassigned and vacancies are filled. A new manager for this group is being recruited and expected to be in place before the end of Q4.

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### 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 third quarter of this year, 438 of 440 (99.5%) inspections were completed. Two inspections were missed in late December.

- One weekly inspection at Sugar Lake Dam was missed by Stations Field Operations due to temporarily unsafe road access conditions following a large snow storm, and was discussed with and agreed to by the Dam Safety Engineer.
- The other missed weekly inspection was at Mica Dam when, late on a Thursday afternoon, the Stations Field Operations crew notified the Dam Safety Engineer that the inspection would not be completed before the assigned and trained inspector left site. With poor road conditions between Revelstoke and Mica, Dam Safety staff were unable to travel to Mica on the Friday and complete the inspection themselves. The Upper Columbia Dam Safety Engineers have since reiterated the importance of the site inspections to the Stations Field Managers and discussed the need provide adequate notification to Dam Safety when they need support in completing the inspections.

Routine Inspections	F20 Year-to-date	F19	F18	F17	F16	F15
Completed	1260	1638	1595	1583	1594	1603
Missed	<b>2</b>	2	16	29	24	8

#### Instrumentation and Monitoring

The Regional 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. They are each tasked to perform three such checks per week. During the third quarter of F2020, 226 checks were completed, exceeding the target of 210.

#### Reservoir Slopes

Dam Safety's Slope Surveillance Program remained active through Q3, with all planned reservoir slope / landslide inspections being completed by mid-October. No significant changes to the behaviours of the slopes were observed.

Tom Stewart, Dam Safety's Specialist Slopes Surveillance Engineer, began serving on the panel of experts advising Norway's National Rock Slope Management Program. In December, Tom attended

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meetings in Oslo after which the panel submitted a summary report to the Norwegian Water Resources and Energy Directorate.

**Unusual Events or Observations**

The Dam Safety On Call Person (DSOP) responded to 109 calls this quarter. The calls included instrumentation alarms, operational inquiries, operations notifications during floods and earthquake notifications. Of note were a series of earthquakes that occurred off of the northwest coast of Vancouver Island between December 23 and 24, ranging in Magnitude from 4.3 to 6.0. None of these earthquakes were close enough to populated areas to have any impact on infrastructure.

**Maintenance****Civil Maintenance**

As of the end of Q3, the Civil Maintenance program had completed 25 of 31 projects, with a total spend year-to-date of \$3.64 million against a plan of \$3.73 million. Changes to the plan include:

- One-year deferrals of two projects (REV Bridge Repair; CMS Tunnel Shotcrete repair) due to outage changes and unfavourable reservoir elevations;
- Cancellation of one project that will instead be delivered in F2021 within the new Preventative Maintenance program;
- Addition of two projects (Jordan Diversion Penstock and Jordan Diversion Dam Inspections); and
- Reduction of \$130K resulting in a final forecast of \$3.87m for F2020

The remaining five projects are on schedule for completion in F2020.

**Spillway Gate Maintenance and Testing**

During Q3, all 58 scheduled gate tests at 23 sites were carried out. Three gate systems failed to operate on demand during testing. In six 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 December 2019, operational restrictions were in place on two out of 109 flood discharge gates due to known deficiencies (no change from the end of F2020 Q1).

A total of 30 corrective maintenance issues were identified through ongoing testing and maintenance from October to December 2019. A total of 26 new and previous issues were addressed in the same period, for an increase of 4 overall in this reporting period. There were 158 corrective maintenance issues outstanding at the end of December 2019.

**Board briefing – DAM SAFETY QUARTERLY REPORT****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.

**ShakeOut 2019**

Dam Safety participated in the emergency response exercise conducted on October 17 to coincide with the Great British Columbia ShakeOut. The exercise was designed to test emergency response procedures following a large earthquake affecting Vancouver Island.

Nearly all dam safety staff participated in the exercise, fulfilling roles in the Emergency Coordination Centre (ECC), Emergency Operations Centre (EOC) in Campbell River and on the Dam Safety emergency conference call. The Dam Safety Emergency Response Plan was followed and generally found to be effective. All staff followed established check-in procedures with the exception of individuals who were out of the province or on vacation. Dam Safety supported technical decisions in the ECC and EOC, gathered and assessed incoming information and secured resources to mobilize Dam Safety staff to the impacted facilities as required.

Identified items for improvement centered on information management; firstly to require one additional Dam Safety staff member in the ECC to assist in collection and dissemination of information from the field and secondly to begin work on developing a simple information management system that can be scaled to the technology that's available—ranging from manual tools to fully functioning network systems—after an earthquake.

**Capital Projects**

There were 38 Dam Safety initiated capital projects underway in Q3 of F2020. Summaries of these projects are available for reference in the Dam Safety “book” in Diligent. Updates regarding projects that were newly launched, where significant developments occurred or where milestones were achieved within the fiscal quarter are provided below.

**Alouette Dam – Headworks Tower and Surge Tower Seismic Upgrade**

The objective of this project is to ensure that the power tunnel discharge facilities at the Alouette Project can be relied upon after the Maximum Design Earthquake (MDE) to pass the reservoir inflows to Stave Lake.

During Feasibility Design, site inspections using a submersible remotely operated vehicle (ROV) identified an unplugged construction adit at the power tunnel intake that was previously reported to have been plugged. The project team had been working toward plugging of the adit as early implementation work in the summer of 2020, but worker safety and quality concerns were driving the project to require a lengthy deep drawdown of Alouette Lake during the busy recreational season. The project team is undertaking additional constructability reviews and evaluating alternative technologies

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and construction methods in efforts to reduce or eliminate the required drawdown, and the planned plugging of the adit has been deferred to a later date, as yet to be determined.

The scope of work that would rely upon sealing of the adit is not presently understood to be of immediate priority in meeting the project objective, in that it leads to improvements to the tunnel's headworks gate that facilitate long-term inspection and maintenance of the tunnel rather than to the immediate provision of controlled post-earthquake flows through the tunnel. In parallel to the reviews described above, therefore, options for uncoupling this scope from the remainder of the project will be considered.

**Bridge River 1 – BR1 Mitigate Surge Spill Hazard**

The objective of this project is to mitigate the hazards caused by overtopping of the surge shafts due to rapid closure of the Penstock Inlet Valves; namely downslope damage to BC Hydro facilities and potential loss of life. Completion of this project will enable the commissioning of a recently installed system that automatically closes the Penstock Inlet Valves upon detection of a penstock leak.

In Q3 of F2020, the Leading Alternative to construct separate concrete containment basins around each of the two surge shafts was confirmed as the Preferred Alternative and the project advanced into Definition Phase.

**Comox Dam and Puntledge Diversion Dam – CMC-PUN Flow Control Improvements**

The objective of this project is to improve control of water conveyance at Comox and Puntledge, with specific consideration to recreational areas and users of the river downstream of Puntledge Dam.

In Q3 the project completed Feasibility Design. The Preferred Alternative that was confirmed for advancement into Definition Phase includes upgrades to the Puntledge Generation conveyance control system, refurbishment and replacement of equipment and systems on the Comox Dam sluiceway gates, and improved support for operational decisions by way of updated local and generating operating orders and development of a real-time river simulation model.

**Hugh Keenleyside Dam – Upgrade Spillway and LLOs Concrete**

The objective of this project is to fully restore the operational function of the dam's reinforced concrete discharge structures, which have sustained significant damage ranging from minor abrasion to significant erosion of several cubic metres of concrete, since operations began in 1968.

The project is currently in the Needs Stage. A project gate review meeting was held in Q3, at which a single viable alternative consisting of underwater concrete placement and repair was endorsed.

**Kootenay Canal – KCL Install Intake Dam Foundation Uplift Instrumentation**

The objective of this project is to install standpipe piezometers at the Kootenay Canal Power Intake to better monitor the dam and to inform future assessment of the stability of the intake structure.

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In Q3, work to connect existing piezometers in the South Gravity Dam to the automatic data acquisition system was completed. Drawings and specifications were completed in December and a Request for Quotation was issued for the work

**Kootenay Canal – Replace Silt Slope Piezometers**

The objective of this project is to upgrade instrumentation of the silt slope above the penstocks and powerhouse at Kootenay Canal to replace failed piezometers that enable monitoring and assessment of the stability of the slope.

Drilling and installation of the instruments commenced in September and work was completed in November, including connection of the instruments to the site's Automatic Data Acquisition System in the South Gravity Dam. The new instruments were put into service in December.

**Peace Canyon Dam – Piezometers and Drains Upgrade**

The objectives of this project are to install new, additional piezometers to monitor the uplift pressures of the spillway blocks, to upgrade the drains to improve sliding stability of the spillway blocks, and to improve seismic monitoring.

Conceptual design was completed at the end of Q3 and comprised field investigations to assess response times of the existing piezometers, spillway sliding stability analyses, and assessment of the existing seismic monitoring system. The work led to the Leading Alternative that is being advanced into Feasibility Design Stage:

- Improve foundation pressure monitoring in the spillway blocks by remediating existing instruments and installing new piezometers at areas of suspected elevated pressure, as required;
- Clean existing spillway drains and install new foundation drains, as required;
- Improve seismic monitoring by installing one side-by-side broadband seismometer (BB) and strong motion accelerograph (SMA), replacing two SMAs, and installing a new SMA inside the spillway gallery.

**Seven Mile Dam – Replace Reservoir Boom**

The objective of this project was to replace the deteriorated two-span timber debris boom upstream of the Seven Mile Dam. Full implementation funding was received in October 2019. Construction Services mobilized to site in October 2019 and the assembled boom segments and associated components were delivered and installed between October and November 2019. The new boom went into service in December 2019.

**Spillimacheen – Bugaboo Diversion Dam Decommissioning**

The Bugaboo Creek Diversion Project is an abandoned development located on the Bugaboo Creek, a tributary to the Columbia River just south of the Spillimacheen River. The project was designed to divert water from Bugaboo Creek into the Spillimacheen River for additional power generation at the Spillimacheen Generating Station. The homogeneous earthfill dam is 9.1 m high and 44.2 m long and

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was constructed from 1955 to 1956 with an excavated spillway channel to the right of the dam. A rockfill timber crib spillway control structure was constructed at the head of the spillway channel.

During the 1957 spring freshet, a heavy load of gravel was deposited in front of the headpond and the spillway control structure was washed away. All Bugaboo Creek flow has since passed through the spillway channel, with no water being diverted to Spillimacheen.

The objective of this project is to decommission Bugaboo Diversion Dam, relinquish the water and crown licenses and minimize BC Hydro's long term commitments or obligations. The dam is to be lowered so that it falls within the criteria of a 'Minor Dam' under the Dam Safety Regulation. This will preserve the wetland features that have developed upstream and downstream of the dam and is of a lower cost than complete dam removal. It may result in the dam becoming fully exempt from the Dam Safety Regulation, though a more likely result will be that BC Hydro will be required to perform an annual inspection of the dam.

Tree and vegetation removal started following the bird nesting season in mid-September 2019 and was completed in October 2019. All components of the decommissioning work will be awarded directly to the Nupqu Development Corporation, which is a Business Partner of the Ktunaxa Nation Council. The Request for Proposal has been issued and their submittal is expected in Q4. The main decommissioning works are expected to start in June 2020 and to extend over two construction seasons due to the bird nesting window and the regional weather conditions.

**WAC Bennett Dam – GMS Spillway Gate Upgrade**

The objective of this project is to improve the reliability of the WAC Bennett Dam spillway gate system. The scope of the project was confined to at or above the hoist deck level focused on selected protection and control (P&C), electrical, and mechanical equipment and installation of an additional backup diesel generator. Broader scoped and longer term upgrades for post-seismic functionality have been deferred to future projects. This project addresses 14 of the 27 specific issues associated with the WAC Bennett Dam gates.

The project is in Implementation. As at the end of F2020 Q3, upgrades to Spillway Operating Gates 2 and 3 have been completed and commissioned. The upgrades to Spillway Operating Gate 1 have also been completed, but testing and commissioning will not take place until April 2020, after which the project will be fully in service.

**Wahleach – Unit 1 Tailrace Tunnel Upgrade**

The objective of this project is to refurbish the tailrace tunnel that runs under Highway 1 and the Canadian National Railway main line, specifically to correct deficiencies in the concrete-lined section of the tunnel and to recoat the steel section.

In January 2019, the contracted coating vendor, retained through public bid, abandoned the work immediately prior to start of construction. The reasons for this are unknown, but are understood to be related to problems originating within the contractor's organization and not the work itself. The contract has since be re-tendered and was awarded in Q3. Both the steel coating and concrete repairs are scheduled to be completed in close succession within the same twelve-week outage starting 27 January 2020.

**Board briefing – DAM SAFETY QUARTERLY REPORT****Walter Hardman Dam – Headworks Operating Gate Improvement**

The objective of this project is to upgrade the flow control (headworks operating gate and orifice control structure) to reduce inflows into the headpond and reduce the likelihood of spill from the spillway. This project is an interim risk control measure to reduce further damage to the spillway and to minimize environmental concerns associated with erosion of the downstream channel until this issue is addressed in a separate future project.

BC Hydro Construction Services initiated construction comprising invert slab remediation, abutment retrofit and new gate installation in September 2019 and completed the work in November 2019.

**Dam Safety Investigations**

There were eighteen Dam Safety Investigations and System-Wide Initiatives underway in Q2 of F2020. Summaries of these investigations and initiatives are being prepared for inclusion in the Dam Safety “book” in Diligent—similar to those for capital projects—but are not yet available for reference by the Committee. Updates regarding projects just launched, where significant developments occurred or where milestones were achieved within the fiscal quarter are provided below.

No new Dam Safety Investigation projects were initiated in Q3. It is anticipated that the following Dam Safety Investigations will be finalized by the end of F2020:

- GMS Spillway Seismic Performance Assessment
- Hydraulic (3D Computational Fluid Dynamic- CFD) Modelling for Revelstoke Spillway
- Wilsey Dam Stability Assessment – Stage 1
- Sugar Lake Abutments Seepage Assessment – Stage 1