BC Hydro
Power smart

June 29, 2021

Mr. David M. Morton
Chair and CEO
British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Morton:

RE: British Columbia Utilities Commission (BCUC or Commission)
British Columbia Hydro and Power Authority (BC Hydro)
Site C Clean Energy Project PUBLIC Quarterly Progress Report No. 21

Today, we are filing Site C Quarterly Progress Report No. 21 that covers the period of January 1 to March 31, 2021.

During this reporting period, the Government of British Columbia announced the Site C Project would continue based on a cost estimate of $16 billion, which included a new expected in-service date of 2025. Earlier this month, Treasury Board approved this cost estimate, and this is now the approved budget for Site C. This information is being disclosed consistent with the requirements under section 14 of the *Budget Transparency and Accountability Act*.

As the cost estimate was approved by government subsequent to the reporting period, the project's overall health for this quarter remains "red." Our next progress report to the Commission in the fall of 2021, will reassess the project health based on the newly approved budget and revised project schedule.

As I acknowledged in my previous letter to the Commission of March 18, 2021, we continue to manage significant risks on the Site C Project. These risks include the ongoing COVID-19 pandemic and the associated impacts to on-site construction activities; the continuation of commercial negotiations with contractors; design finalization, procurement and execution of the foundation enhancements; and the ability to attract and retain skilled workers. We continue to work with Peter Milburn, EY Canada, the Technical Advisory Board, the external independent dam experts, and the Project Assurance Board to manage these risks.

Despite these risks, our objective is to complete Site C within the approved budget and we're managing the Project to that cost.

The ongoing COVID-19 pandemic continued to impact dam-site construction activities during the first quarter of 2021. On December 29, 2020, the Provincial Health Officer posted the Industrial Projects Restart Order, which required a slow and controlled return of workers at five industrial camps in Northern B.C., including Site C, following the holiday season. BC Hydro worked closely with Northern Health to implement all

components of the order and gradually increase worker numbers safely over the reporting period. The Order did have impacts on our construction activities, primarily the generating station and spillways works, which we further detail in this progress report.

Recently, we have seen significant improvements with the number of COVID-19 cases associated with the Project declining and we continue to make progress with onsite vaccinations with support from Northern Health. In addition, the outbreak at Site C that was announced by Northern Health in late April was officially declared over on June 23, 2021.

While we managed a number of challenges during the quarter, we also achieved some important construction milestones, including the completion of both the upstream and downstream cofferdams. This work, which needed to be in place before spring freshet, was completed ahead of schedule. The cofferdams create a dry construction area to continue construction activities with the earthfill dam. The team also made progress on the second 500 kV 75-kilometre-long transmission line and the first two turbine runners (out of six) have arrived at site from Brazil.

Finally, I wanted to update the Commission on the status of implementing the Milburn recommendations. Mr. Milburn's review of the project included 17 recommendations aimed at improving oversight, governance, risk management and construction and claims management on the project.

Most of the recommendations from the Milburn review have been implemented. The Province announced last month a restructured Site C Project Assurance Board to strengthen its independence and increase its expertise. Other recommendations that have been implemented include enhancing the project's risk management processes and creating a dedicated commercial management team.

BC Hydro continues to work with government to complete the implementation of the remaining recommendations by the end of the summer.

The next progress report, covering the period April 1 to June 30, 2021, will be filed in the fall of 2021.

A confidential version of the Report is being filed with the BCUC only under separate cover.

Yours sincerely,

Chris O'Riley
President and Chief Executive Officer
BC Hydro

Enclosure

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Site C Clean Energy Project

Quarterly Progress Report No. 21

F2021 Fourth Quarter

January 1 to March 31, 2021

PUBLIC

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1 Executive Summary

1.1 Overview and General Project Status

The Site C Project (**Project**) continues to face significant challenges that have materially impacted Project cost and schedule, as previously discussed in Annual Report No. 5 (January to December 2020).

The most significant challenge continues to be the impacts of the global COVID-19 pandemic, which, during the quarter, included the implementation of health orders to gradually re-start work after the winter holidays in January 2021, managing COVID-19 cases at site, and incremental costs to complete work.

The second significant challenge relates to geotechnical issues on the right bank. By early 2020, BC Hydro had determined that significant foundation enhancements were required to increase the stability under the structures on the right bank, including the powerhouse, spillways and future dam core area. During the quarter, independent dam experts confirmed BC Hydro's proposed foundation enhancements solution is appropriate and sound, and will make the right bank structures safe and serviceable over the long operating life of Site C.

The final significant challenge relates to cost pressures facing the Project. Prior to the onset of the COVID-19 pandemic, the Project was already managing significant financial pressures; the pandemic-related costs and delays and the need for foundation enhancements have added to these cost and schedule pressures.

However, despite the COVID-19 pandemic, the Project achieved significant construction milestones during the quarter, including the completion of the upstream and downstream cofferdams, significant progress on the second 500 kV 75-kilometre-long transmission line, and the first two (of six) turbine runners arrived at site from São Paulo, Brazil.

During the reporting period, the Government of British Columbia (**B.C.**) announced a revised cost estimate to complete the Project of $16 billion, along with a new expected in-service date of 2025, as a result of the delays and impacts of the pandemic. Subsequent to March 31, 2021, Treasury Board approved the new budget of $16 billion and the new in-service date of 2025, subject to the risks summarized in this report.

Also, in February, the Government of B.C. also released the Site C Project Review, led by Peter Milburn (**Milburn Review**), which included 17 recommendations aimed at improving oversight, governance, risk management, and construction and claims management.

The sections below discuss the major challenges and successes of the quarter in further detail.

1.2 The COVID-19 Pandemic Continues to be a Significant Challenge

The COVID-19 pandemic continues to impact on-site work activities. To reduce the risk of increased post-winter holiday transmission of COVID-19 at major projects and local communities in the north, B.C.'s Provincial Health Officer issued several public health orders in late December 2020 and early January 2021.

Starting from a reduced number of onsite workers in January 2021, BC Hydro was able to ramp up gradually throughout the first few months of the year. During the reporting period, COVID-19 cases on the Site C Project started to increase, mirroring what was occurring across the province during the pandemic's third wave. Subsequent to the reporting period, on April 28, 2021, Northern Health declared a COVID-19 outbreak at Site C because of an increase of cases at site. This step was taken to ensure the health and safety of employees, contractor workers and members of the public. Work continued on-site and BC Hydro was not directed to shut down the site or stop any work due to the COVID-19 protocols in place.

Throughout the pandemic, BC Hydro has continued to prioritize employee health and safety by implementing measures across site to minimize the risk of transmission at the worker accommodation, all work fronts, and all construction offices by offering vaccination clinics to on-site Site C workers and employees; and working closely with local government, First Nations and health authority stakeholders. Through regular communication, these stakeholders were kept informed about pandemic-related updates on the Project.

1.3 Geotechnical Review from Independent Dam Experts Confirmed Foundation Enhancements Proposed Solution

By early 2020, BC Hydro had determined that significant foundation enhancements were required to increase the stability under the structures on the right bank, including the powerhouse, spillways and future dam core area.

In February 2021, the Government of B.C. released the geotechnical review from two independent, world-leading dam experts. Their review confirmed the foundation enhancements developed to address geotechnical issues on the Project's right bank indicate the Project design continues to meet the highest safety standards and international best practices. The independent dam experts have been retained to provide oversight to BC Hydro while construction of the foundation enhancements is completed.

1.4 Revised Cost Estimate and New Expected In-Service Date

As announced by the Government of B.C. on February 26, 2021, the revised cost estimate to complete Site C is $16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the COVID-19 pandemic. COVID-19 is the single largest contributor to the cost increase, followed by the additional costs for foundation enhancement measures, and other cost pressures.

Prior to the onset of the COVID-19 pandemic, and since the $10.7 billion Project budget was approved in February 2018, BC Hydro was managing significant financial pressures due to:

- Amendments to the main civil works contract;
- Additional labour resource requirements;
- First Nations treaty infringement claims and an injunction application;
- Increased costs associated with reservoir clearing, transmission line construction and highway re-alignment work; and
- Additional significant scope and design enhancements to the foundations of the structures on the right bank.

However, prior to the COVID-19 pandemic, the Project remained on schedule for the first generating unit to go into service in late 2023 and a final in-service date in 2024.

The COVID-19 pandemic, along with the need for foundation enhancements on the right bank to deal with unanticipated geotechnical conditions, significantly added to the cost pressures. BC Hydro continues to review the revised cost estimate and key Project risks, further to the recommended actions in the Milburn Review.

The key Project risks that remain and continue to be assessed include the continuation of the COVID-19 pandemic and the potential impacts to on-site construction activities; commercial negotiations with contractors; design finalization for the foundation enhancements and related procurements; the procurements for the balance of plant contracts; and the ability of the Project to attract and retain sufficient skilled workers.

1.5 BC Hydro Received and Started to Implement the Milburn Review Recommendations

In February 2021, the Government of B.C. also released the independent review of the Project by special advisor Peter Milburn. His report included 17 recommendations aimed at improving oversight and governance and strengthening Site C risk reporting and management. The Government of B.C. and BC Hydro have accepted all the recommendations and implementation of all recommendations has started. Mr. Milburn has been retained to provide oversight on the implementation of the recommendations, which include enhancing the independence, mandate and expertise of the Site C Project Assurance Board and strengthening BC Hydro's risk management processes.

1.6 Upholding Commitments to the Environment, Indigenous Groups and Local Communities

During the reporting period, BC Hydro continued to uphold its commitments to the environment, Indigenous groups and local communities.

BC Hydro continued to secure the appropriate permits, authorizations and leaves to commence construction required for the Project. BC Hydro estimates that approximately 600 permits will be required throughout the life of the Project and of these permits, 481 have been received to March 31, 2021, and are actively being managed. The remaining authorizations are anticipated to be received as required to meet the overall Project schedule needs.

In March 2021, BC Hydro submitted a draft Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area. Prior to submitting the final submission in June 2021, BC Hydro engaged with local governments, First Nations and local residents on the proposed activity and responded to concerns. A decision on the amendment is expected in the fall of 2021.

Work advanced in the areas of environmental monitoring and assessment as well as in the Project's fish, wildlife, habitat, vegetation management and heritage programs. During the reporting period, environmental activities focused on responding to and assessing noise, light and air quality concerns within the Hudson's Hope area as well as re-opening the temporary fish passage and establishing contingency trap and haul programs to augment the fish passage.

Throughout the quarter, BC Hydro worked to engage, build relationships and find solutions together on topics that are most important to the First Nations communities affected by Site C.

1.7 Despite COVID-19 Pandemic, Construction Progress Continued Over the Winter Season

Despite the challenges COVID-19 pandemic, the Project achieved significant construction milestones during the quarter, including the completion of the upstream and downstream cofferdams, which needed to be in place in advance of the spring freshet. Completed ahead of schedule, the cofferdams create a dry construction area to continue construction activities with the earthfill dam. Construction on the earthfill dam progressed with excavations in the core trench areas.

Significant progress was also made on the second 500 kV 75-kilometre-long transmission line, with the completion of all foundations, and all towers assembled and installed on the foundations by the end of the quarter.

The first two (out of six) turbine runners arrived at site from São Paulo, Brazil, during the quarter.

1.8 Project Status Dashboard for the Quarter

BC Hydro, with direction from the Project Assurance Board, is committed to delivering the Site C Project without compromising on safety, scope, and quality. To report on Project status, BC Hydro uses a dashboard system where key Site C

Project areas are classified as red (at risk), amber (moderate issues) or green (on target).

The Project Status Dashboard is provided in Table 1 below. Overall Project health as of March 31, 2021, remained “red” due to significant schedule and cost pressures that had not then been reflected in the budget and schedule that was approved by Treasury Board subsequent to the end of the reporting period. In February 2021, the Government of B.C. announced that the Project will continue with a revised cost estimate of $16 billion and a new expected in service date of 2025. Project health will be reassessed in the next Quarterly Progress Report based on the newly approved budget and revised project schedule.

Table 1 Project Status Dashboard

● On Target ● Moderate Issues ● At Risk

Status as of:		March 2021
Overall Project Health	●	Overall Project health remained "red" due to significant schedule and cost pressures. In February 2021, the Government of B.C. announced that the project will continue with a revised cost estimate of $16 billion and a new expected in service date of 2025. The revised cost estimate was approved by Treasury Board subsequent to the end of the reporting period. The scope status changed from "red" to "amber" as independent experts confirmed the foundation enhancements developed to address geotechnical issues on the Project's right bank will work and will ensure the Project meets the highest safety standards. Further to the recommended actions in the Milburn Report, BC Hydro continued to review the revised cost estimate, along with Project risks, which are very significant.
Safety	●	Safety remained "amber" during the quarter. Management of COVID-19 transmission for Site C workers and local communities continued to be a priority in the reporting period. To reduce the risk of increased post-winter holiday transmission of COVID-19 at major projects and local communities in the north, B.C.'s Provincial Health Officer issued several public health orders in late December 2020 and early January 2021. One of these orders was the *Industrial Projects Restart Order*, which required a slow and controlled return of workers to the five major projects in the region, including Site C. BC Hydro worked closely with Northern Health to implement the order and gradually increase worker numbers over the reporting period. From January to March 2021, there were 34 confirmed positive cases of COVID-19 on the Project, with 25 cases linked to five controlled, onsite clusters. Subsequent to the reporting period, on April 28, 2021, Northern Health declared a COVID-19 outbreak at Site C because of an increase in cases at Site. During the reporting period, there were five serious safety incidents consisting of four near misses that had the potential to be a serious injury and one serious injury that required medical attention. To encourage active learning from safety incidents across all work fronts and contractors, the Project held 22 Safety Incident Reviews in this quarter.
Scope	●	Scope changed from "red" to "amber" during the quarter as independent experts confirmed BC Hydro's proposed foundation enhancements solution is appropriate and sound, and will make the right bank structures safe and serviceable over the long operating life of Site C. The independent dam experts have been retained to provide oversight to BC Hydro while construction of the foundation enhancements is completed. Scope remains "amber" as certain designs are still being finalized.
Schedule	●	Schedule remained "red" during the quarter. The revised cost estimate and schedule include a one-year delay to 2025 for the project in-service date, as a result of the delays and impacts of the COVID-19 pandemic. BC Hydro continues to refine its updated schedule. The revised cost estimate and schedule were not yet approved by Government during the reporting period. The schedule status will be updated when the revised cost estimate and schedule are approved.

Status as of:		March 2021
Cost	🔴	Cost remained "red" during the quarter. The Government of B.C. announced the project will continue with a revised cost estimate of $16 billion. Prior to the onset of the COVID-19 pandemic, BC Hydro had identified in previous progress reports dating back to 2019 that the Project was already managing significant cost pressures, and these were being assessed, monitored and managed to the best extent possible. The COVID-19 pandemic, along with the need for foundation enhancements on the right bank to deal with unanticipated geotechnical conditions, significantly added to those cost pressures. The revised cost estimate based on an in service date of 2025 was not yet approved by Government during the reporting period. The cost status will be updated when the revised cost estimate is approved. Significant cost risks remain, including the continuation of the COVID-19 pandemic, the continuation of commercial negotiations with contractors, procurements for the remaining work fronts and equipment, and the availability of skilled workers. BC Hydro continues to review the revised cost estimate, along with risks, further to recommendations provided by Peter Milburn.
Quality	🟢	The overall quality rating for the Project continued to be good during the reporting period, indicating that the work generally conforms to the requirements of the drawings and specifications. For the main civil works, BC Hydro focused its quality assurance efforts on the foundation drilling and grouting for the main dam. For the generating station and spillways civil works, BC Hydro focused its quality assurance efforts on the wet curing, thermal control and strength of concrete for the generation station, spillways and intake structures. For offsite manufacturing, BC Hydro continues to meet weekly with the quality management teams of key suppliers in COVID-19 affected areas to discuss impacts, plan upcoming inspections and to coordinate with our local quality assurance representatives to ensure quality requirements are satisfied prior to components being shipped.
Regulatory, Permits and Tenures	🟢	As at March 31, 2021, BC Hydro estimates that approximately 600 permits will be required throughout the life of the Project. Of these permits, 481 have been received to March 31, 2021, and are actively being managed. The remaining authorizations are anticipated to be received as required to meet the overall Project schedule needs. In March 2021, BC Hydro submitted a draft Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area.
Environment	🟢	During the reporting period, the focus of the environmental work was responding to and assessing noise, light and air quality concerns within the Hudson's Hope area as well as re-opening the temporary fish passage and establishing contingency trap and haul programs to augment the fish passage. Environment Canada initiated an investigation on October 10, 2018, with regards to a rainfall event in September 2018. BC Hydro has subsequently increased the system capacity along with other actions to reduce the potential of future similar events. This investigation is still ongoing. Focus remains on minimizing sediment and erosion across the dam site, care of water, hydrocarbon management, wildlife attractant management and invasive weed control.
Procurement	🟢	The balance of plant contract has been split into six packages and will be procured in 2021. The balance of plant mechanical request for proposals was posted on January 22, 2021 and closed on April 21, 2021. The closing date of the balance of plant electrical request for proposals is scheduled to close in June 2021.

Status as of:		March 2021
Indigenous Relations	🟡	Seven of 10 agreements are fully executed and in implementation. West Moberly First Nations withdrew from confidential discussions to seek alternatives to litigation related to Site C in August 2019 and filed an amended Notice of Civil Claim in September 2019. British Columbia and BC Hydro concluded an agreement with Prophet River First Nation in 2020.
Litigation	🟡	The treaty infringement claim filed by West Moberly First Nations in January 2018 remains active. An amended Notice of Civil Claim filed by West Moberly First Nations in September 2019, among other things, expanded their original treaty infringement action, shifting the focus to all three Peace River facilities, not just Site C, and their alleged cumulative impacts. BC Hydro is preparing for the trial, which is scheduled to commence in March 2022.
Stakeholder Engagement	🟢	BC Hydro continues to work with the communities, regional district and stakeholder groups on the implementation of various community agreements. Throughout the reporting period, BC Hydro continued sharing recurring COVID-19 updates (through calls and emails) with local community representatives and Northern Health, as well as engaged with stakeholders and residents about the Environmental Assessment Certificate amendment regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area. Additionally, BC Hydro continues to receive, respond to and resolve Project-related complaints.

1.9 Significant Project Updates for the Quarter

Significant Project updates that occurred between January 1 and March 31, 2021 include the following:

- On December 29, 2020 the Provincial Health Officer posted the *Industrial Projects Restart Order* limiting the number of workers at five industrial camps in Northern B.C., including Site C. BC Hydro complied with the *Industrial Projects Restart Order* issued by the Provincial Health Officer throughout the reporting period. Refer to section 3.1.1 and section 11.2 for more information.
- Two turbine runners were shipped from São Paulo, Brazil, and arrived at the Port of Prince Rupert in late 2020. One turbine runner was shipped to site in January 2021 and the second turbine runner was shipped to site in early February 2021. Refer to section 2.1.5 for more information.
- The upstream cofferdam was completed to full height (elevation 433.9 metres) in February 2021, two months ahead of schedule. The downstream cofferdam

interlocking steel pile wall was completed in January 2021 followed by the completion of the downstream cofferdam to full height (elevation 414 metres) in March 2021. Refer to section 2.1.1 for more information.

- The area between the upstream and downstream cofferdams was dewatered to allow for commencement of the excavation of the centre section of the earthfill dam core trench. The dewatering was completed in February 2021. Refer to section 2.1.1 for more information.
- On February 26, 2021, the Government of B.C. announced the revised cost estimate to complete Site C is $16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the COVID-19 pandemic. Refer to section 5.2 for more information.
- The Government of B.C. released the geotechnical review from two independent, world-leading dam experts. Their review confirmed the foundation enhancements developed to address geotechnical issues on the Project's right bank indicate the Project design continues to meet the highest safety standards and international best practices. Refer to section 2.2.2, section 2.2.6 and Appendix E for more information.
- Preparation of in-river infrastructure began in February 2021 to manage water-borne wood debris for the 2021 season. Refer to section 2.1.2 for more information.
- On March 16, 2021, BC Hydro submitted an Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area. Prior to submitting the request, BC Hydro engaged with local governments, First Nations and local residents on the proposed activity and responded to concerns in the final amendment submission. Refer to section 9.4 for further information.

- By the end of March 2021, crews installed the last of the 205 transmission tower foundations for the second, 75-kilometre-long, 500 kV transmission line that connects Site C to the Peace Canyon Generating Station. All the towers for the second transmission line were also assembled and installed on the foundations. The tower foundations are constructed using helical piles and anchors. Refer to section 2.2.4 for more information.
- Powerhouse construction continued throughout the reporting period, including concrete placements at the powerhouse, intakes and spillways; installation of penstock segments; and construction of the steel super-structure for the powerhouse. Refer to section 2.1.3 for more information.
- In March 2021, there were 4,321 total workers on the Site C Project. Of the total workers, 3,134 (73 per cent) were from British Columbia, and there were 900 workers on site from the Peace River Regional District (25 per cent of the construction and non-construction contractors' workforce). Refer to section 11.3 for further information.
- During the reporting period, BC Hydro was notified of 34 positive cases of COVID-19 related to people working on the project. Refer to section 3.1.1 for further information.

Refer to Appendix A for site construction photos for the quarter and refer to Appendix B for a list of work completed since the project commenced in 2015.

2 Construction and Engineering Major Accomplishments, Challenges and Work Completed,

2.1 Construction

The COVID-19 pandemic continued to have a significant impact on dam-site construction activities in the first quarter of 2021. On December 29, 2020, the Provincial Health Officer posted the *Industrial Projects Restart Order*, limiting the number of workers at five industrial camps in northern B.C., including Site C. Refer to section 3.1.1 and section 11.2 for further information. The Order primarily impacted the generating station and spillways civil contractor, discussed further in section 2.1.3 below.

BC Hydro continues to work closely with contractors to understand the costs and schedule impacts due to COVID-19.

2.1.1 Main Civil Works

The scope of the main civil works contract includes the construction of the following major components:

- Diversion works, including two concrete-lined, 10.8-metre-diameter tunnels. Tunnel No. 1 is 700 metres in length and Tunnel No. 2 is 790 metres in length;
- Diversion tunnel inlet and outlet portals, and approach channels;
- Excavation and bank stabilization;
- Relocation of surplus excavated materials (including management of discharges);
- Dams and cofferdams (including a zoned earth embankment dam 1,050 metres long and 60 metres above the present riverbed, and stage 1 and 2 cofferdams);

- Roller-compacted concrete (including a powerhouse, spillways and dam buttress approximately 800 metres long made up of approximately 1.7 million cubic metres of concrete); and
- Haul roads.

An update on construction activities currently underway or completed during the reporting period are described below under four main areas: (1) left bank, (2) right bank, (3) river diversion, and (4) earthfill dam. Refer to the Earthfill Dam section for updates on the right and left bank earthfill dam core trench excavation.

Left Bank

The significant work activities on the left bank for the quarter were focused on the left bank drainage adit. During the quarter, the 454-metre-long left bank drainage adit tunnel was completed and approximately 50 per cent of the finishing concrete work, which includes the placement of slabs, was completed.

Right Bank

The right bank scope of work includes the excavation of the powerhouse, spillways and dam, and placing roller-compacted concrete for the foundations to support the powerhouse, dam and spillway structures.

The activities currently underway or completed for the quarter ending March 31, 2021 on the right bank include:

Right Bank Drainage Tunnel

Remediation work is continuing in the right bank drainage tunnel. In 2019, some shotcrete on the wall of the tunnel was damaged, which limited access into the tunnel. Work has continued to advance in the first quarter of 2021. As of March 31, 2021, 84 per cent of the tunnel was remediated and had been completed to its final state. The contractor is continuing to progress the work to remediate the tunnel.

Spillway Roller-Compacted Concrete (Dam/Core Buttress)

Roller-compacted concrete for the dam/core buttress was expected to be complete in fall 2020. Due to the necessary reduction in the number of workers in the worker accommodation lodge because of the COVID-19 pandemic, only 30 per cent of the original planned placements of roller-compacted concrete for the dam/core buttress was achieved in 2020. The remainder of the roller-compacted concrete placements are planned to occur during the summer construction season of 2021. No roller-compacted concrete was placed in the first quarter of 2021 as the construction season had not yet begun due to low winter temperatures.

River Diversion

After years of preparations, the Peace River was diverted on October 3, 2020.

Activities to support diversion of the Peace River will continue until reservoir filling is complete, at which time the diversion facilities will be permanently de-commissioned.

Upstream and downstream Cofferdam Construction[1]

Construction on the upstream and downstream cofferdams commenced in the summer of 2020 as part of the river diversion process and were completed in the first quarter of 2021. The upstream cofferdam was completed to full height (elevation 433.9 metres) in February 2021, two months ahead of schedule. The downstream cofferdam interlocking steel pile wall was completed in January 2021 followed by the completion of the downstream cofferdam to full height (elevation 414 metres) in March 2021. The completion of both the upstream and downstream cofferdams allows for the creation of a dry area to continue construction activities with the earthfill dam.

[1] This section was previously referred to as “In River Work”.

Earthfill Dam

Work to resume material placements for the earthfill dam was planned in spring 2020, when temperatures are conducive to earthfill dam material placements; however, due to the necessary reduction in the number of workers in the worker accommodation lodge because of the COVID-19 pandemic, the start date was impacted, as the work areas associated with the earthfill dam construction were scaled down. Due to the ramp down, placements of the material in the 2020 season did not occur and first placements of materials took place one year later, in April 2021.

Core Trench Excavation

The area between the upstream and downstream cofferdams was dewatered to allow for commencement of the excavation of the centre section of the earthfill dam core trench. The dewatering was completed in February 2021.

Excavation of the earthfill dam core trench continued and, as of March 31, 2021, the class 1 (soil) excavation of the entire core trench (left, right, and centre sections) was 78 per cent complete, and the class 2 excavation (bedrock) was 74 per cent complete.

Grouting on the left bank core trench floor is complete. The remaining grouting on the left slope of the core trench will recommence once the dam material placements has reached elevation of 410 metres and above to provide access to the remaining sections of the slope.

Grouting on the right bank core trench floor was completed prior to March 31, 2021, allowing for the dam core material to progress once the summer construction season begins. As of March 31, 2021, the contractor had completed 64 out of 76 grouting holes on the slope. Subsequent to the reporting period, the remaining holes were completed to allow for the roller-compacted concrete program to begin with the construction season.

Conveyor Belt System

Upgrades to the conveyor system were completed by March 31, 2021 and works to complete tests on the system in advance of the production season were completed during the reporting period.

2.1.2 Infrastructure and Site Operations

The infrastructure and site operations include construction and operations updates for the quarter for the worker accommodation, debris management on the rivers, and temporary fish passage operations.

Worker Accommodation

The total capacity of the worker accommodation, including camp operations staff, is 2,350.

Since January 2020, BC Hydro and the camp operator have implemented numerous measures to protect employees, contractors and facilities as a result of the COVID-19 pandemic. The changes made at the worker accommodation lodge to increase cleaning and physical distancing continued through the quarter.

Prior to workers boarding flights, all workers continue to be required to complete the B.C. Ministry of Health self-assessment and confirm their results with their employer.

Additionally, every person accessing the site is screened and their temperature is scanned daily at the gate before entering the work site. BC Hydro and its contractors also set up thermal scanners at various exit and entry points in the worker accommodation lodge that are used before workers board crew buses or leave camp to go to other Project work sites. This supports the employers and employees with the required daily self-assessment before reporting to work each day.

BC Hydro continues to implement the protocols mandated by the Provincial Health Authority and the British Columbia Centre for Disease Control for the worker accommodation lodge. The on-site health clinic remained well stocked during the

reporting period with the supplies needed to protect workers in the event of an outbreak.

On December 29, 2020, the Provincial Health Officer posted the *Industrial Projects Restart Order*, limiting the number of workers at five industrial camps in northern B.C., including Site C. Refer to section 3.1.1 and section 11.2 for further information. BC Hydro prioritized the available camp bed nights while maintaining the operation of the worker accommodation facility to the extent possible, in compliance with the Order.

Debris Management

There are four debris retention structures on the Moberly and Peace Rivers that provide coverage for all head pond elevations to capture and prevent debris from entering the diversion tunnels. Debris management is seasonal with activities from approximately April to November each year and no activities over the winter season (approximately December to March).

During the quarter, there was no active debris management given the winter season. The debris management contractor returned to site at the end of March 2021 to begin debris management. The contractor performed maintenance on the BC Hydro Peace River boom prior to returning it to service for the season, and subsequent to the reporting period in early April 2021, strung the boom across the Peace River.

Temporary Fish Passage

The temporary fish passage facility is a trap-and-haul facility located on the right bank of the Peace River diversion tunnel outlet channel and provides safe and efficient fish passage from the outlet channel to upstream release locations during the construction of the Project. The operational season for the temporary fish passage is approximately April to October each year and the facility is winterized for the period of October to March. The facility is re-commissioned annually following spring freshet for the duration of the diversion of the Peace River. After reservoir

inundation, fish passage operations will be transferred to the permanent fish passage facility that will be constructed.

In February 2021, work commenced to re-commission and start-up the facility for operations in April 2021.

2.1.3 Generating Station and Spillways

The generating station and spillways scope of work includes the construction of the following major components:

- Generating station and spillways civil works, including:
  - Powerhouse: Concrete placements, installation of structural steel, and installing hydraulic gates;
  - Inlet headworks: Concrete placements, construction of the penstocks, and installing hydraulic gates; and
  - Spillways: Concrete placements and installing hydraulic gates.
- Cranes, which includes the supply and commissioning of the powerhouse cranes, tailrace gantry crane, and headworks gantry crane; and
- Hydromechanical equipment, including the supply of all gates.

Construction progress is taking place in the generating station and spillways civil works, cranes and hydromechanical equipment as described below.

Generating Station and Spillways Civil Works

The generating station and spillways civil works contract include the delivery of civil works associated with the powerhouse, intakes, penstocks, and spillways. During the quarter, the contractor was impacted by the *Industrial Projects Restart Order*, issued in late December 2020, which required a slow and controlled return of workers to work projects and communities in the north after the holiday period. Refer to section 3.1.1 and section 11.2 for further information. The contractor has

proposed a schedule to recover the most significant contract milestones. Despite the challenges posed by the COVID-19 pandemic, the contractor started to recover the schedule and exceeded production targets in March 2021. Concrete for the generating station and spillways civil works project is 40 per cent complete.

Powerhouse

Powerhouse concrete is 75 per cent complete. The first stage concrete (the formed concrete foundation of the powerhouse), will be largely complete by May 2021. The second stage concrete (concrete that embeds the turbines and forms the floors) is advancing at a pace to match the turbine and generators contractor's schedule. In May 2021, the contractor will start to remove its infrastructure from the downstream adjacent area (the tail race) to enable the foundation work to procced on schedule.

Intakes Headworks

Intakes concrete is 50 per cent complete. Intakes 1 and 3 are largely complete. Construction of intakes 2 and 6 are proceeding. Construction of intake 5 will start in April 2021. During the winter, production of the intakes was falling behind plan, but production in April and May 2021 is expected to increase with increased staffing and warmer weather. There is some float in the schedule for the intakes.

Penstocks

As of March 31, 2021, the generating station and spillways contractor has completed 58 per cent of the penstock steel. The steel for penstocks 1 and 2 is complete. penstocks 3 and 6 are proceeding on schedule.

Spillways

The contractor has completed 24 per cent of the spillways concrete and has met the planned production rates through the winter. The concrete work in the spillways stilling basins has been postponed until the foundation enhancement work is

complete in late 2021. The spillway headworks is on the critical path for the generating station and spillways civil works project.

Cranes

Powerhouse bridge cranes were initially commissioned in August 2020. The cranes continue to be commissioned over the length of the powerhouse as the work progresses.

Hydromechanical Equipment

Draft tube gates, intake operating gates, and intake maintenance gates started shipping from Italy in 2020. All of the gates are expected to be at the site by summer of 2021.

2.1.4 Balance of Plant

The balance of plant procurement has been split into six contract packages and the schedule for the balance of plant work is being aligned with the turbine and generators schedule. The six contract packages include: mechanical, electrical, architectural, heating, ventilation, and air conditioning (**HVAC**) and fire protection. The sixth package is a general contract for the other buildings on the site including the fishway. The mechanical request for proposals was posted to BC Bid on January 22, 2021 and the electrical request for proposals was posted on BC bid on March 19, 2021. Subsequent to the reporting period, BC Hydro received four proposals for the mechanical contract on April 21, 2021. Proposals for the electrical package are expected to be received in June 2021. The remaining four requests for proposals will be posted through 2021.

2.1.5 Turbines and Generators

The scope of work for turbines and generators includes the complete design, supply, installation, testing and commissioning of six turbines, generators, governors and

exciters. Overall, the design, procurement and manufacturing for the turbines and generators are on schedule.

During the quarter, the contractor's work to assemble and weld embedded turbine components in its temporary manufacturing facility continued and was completed subsequent to the period in April 2021.

The contractor's São Paulo, Brazil, factory will supply most of the turbine and generator components. There are some impacts due to the COVID-19 pandemic, but work is continuing. Meetings regarding manufacturing progress of the turbine and generator components in the São Paulo, Brazil factory are continuing and have been held concurrently with visits by BC Hydro's subcontracted inspection agencies to many of the contractor's subcontractors in the São Paulo area and Europe.

Two turbine runners were shipped from São Paulo, Brazil, and arrived at the Port of Prince Rupert in late 2020. One turbine runner was shipped to site in January 2021 and the second turbine runner was shipped to site in early February 2021.

2.1.6 Transmission and Substation

The transmission sub-project connects the Site C Project to the BC Hydro transmission system. The scope of work includes the following major components:

- Two 75-kilometre-long, 500 kV transmission lines from the Site C substation to the Peace Canyon generating station;
- Three one-kilometre-long, 500 kV transmission lines from the Site C generating station to the Site C substation;
- A new 500 kV Site C substation; and
- Expansion of the existing Peace Canyon 500 kV Gas Insulated Switchgear to incorporate the two new 500 kV transmission line terminals.

Progress continued on the transmission lines during this reporting period.

The COVID-19 pandemic impacted the transmission and substation activities but work generally continued as planned during this reporting period. The following reflects progress to March 31, 2021.

Transmission Towers and Lines

Transmission Lines

Construction of the second 500 kV transmission line continues and as of the end of March 2021, all 205 of 205 foundations had been completed, 205 of 205 towers had been assembled, and 205 of 205 towers had been installed on foundations. Stringing of conductors is expected to begin in the summer of 2021.

In total, 405 towers will support the two new 500 kV transmission lines that will connect the Site C substation to the Peace Canyon generating station, over a distance of 75 kilometres.

2.1.7 Highway 29 and Hudson's Hope Shoreline Protection Berm

The creation of the Site C reservoir requires realignment of six segments of Highway 29 totalling approximately 32 kilometres. The scope of the highway realignment includes relocation of existing 25 kV distribution lines adjacent to the highway and the decommissioning of the existing highway. BC Hydro is working with the Ministry of Transportation and Infrastructure on Highway 29 construction. The Highway 29 sub-project also includes the construction of a shoreline protection berm within the District of Hudson's Hope to protect against bank erosion due to reservoir wind waves and water table rise, and the development and operation of the Portage Mountain Quarry, which will supply riprap and filter materials for highway and berm construction. The permanent highway realignment is planned to be completed by spring 2023 to ensure the highway remains accessible once the reservoir is inundated and the dam is operational.

The Highway 29 sub-project is divided into the following components:

- Cache Creek highway realignment and bridge;
- Halfway River highway realignment and bridge;
- Farrell Creek East highway realignment;
- Farrell Creek highway realignment and bridge;
- Dry Creek highway realignment and bridge;
- Lynx Creek highway realignment and bridge;
- Portage Mountain Quarry development and operation; and
- Hudson's Hope shoreline protection berm.

The following reflects progress to March 31, 2021.

Cache Creek

Construction continued on the Cache Creek East segment during the reporting period. Activities included the site preparation for bridge foundations, clearing and stripping of the highway alignment, the diversion of Cache Creek around the future bridge piers, construction of a temporary detour bridge in the event that the existing bridge is impacted by the diversion head pond, and the installation of piles for the bridge foundations.

Halfway River

The Halfway River segment includes the realignment of 3.7 kilometres of highway and the construction of a new one-kilometre long bridge crossing the Halfway River, approximately 500 metres north of the current structure.

The construction of the 1,042-metre-long bridge at Halfway River started in January 2020 and includes the operation of a concrete batch plant, aggregate plant, aggregate pit development, construction of bridge abutments and hauling and stockpiling of materials.

At the end of the reporting period, the contractor had completed the highway grading to 85 per cent, the bridge substructure to 99 per cent and the bridge superstructure to 63 per cent. This included the installation of all 81 bridge steel girders and 264 of 638 pre-cast concrete deck panels.

Farrell Creek East

The Farrell Creek East segment includes the realignment of 8.4 kilometres of highway. Geotechnical studies in 2019 concluded that 5.7 kilometres of this segment could be removed from the scope of work and monitored following the creation of the Site C reservoir, reducing the length of Farrell Creek East realignment work to 2.7 kilometres.

The contractor mobilized clearing equipment to site and completed the clearing of trees and vegetation from the highway right-of-way. Temporary fencing was also installed.

Farrell Creek

The Farrell Creek segment includes the realignment of 1.9 kilometres of highway, including the construction of a new 411-metre-long bridge.

At the end of the reporting period the contractor had cleared the site, including reservoir clearing in the Farrell Creek drainage, established borrow and disposal sites for grading works, installed bridge berms for the bridge foundations, diverted the Farrell Creek around the future bridge piers, and installed 89 per cent of the foundation piles.

Dry Creek

The Dry Creek segment includes the realignment of 1.4 kilometres of highway, including the construction of a new 192-metre-long bridge.

There was no work completed during the reporting period.

Lynx Creek

The Lynx Creek segment includes the realignment of 9.1 kilometres of highway and the construction of a 169-metre-long bridge.

At the end of the reporting period the Lynx Creek contractor had completed all clearing works and had substantially completed the pre-load structure for the bridge causeway. Stripping of the east and west bridge approaches was completed as well as a significant portion of the new highway alignment. Gravel extraction, hauling and placement along the highway alignment was approximately 10 per cent complete.

Portage Mountain Quarry

Portage Mountain Quarry supplies riprap and berm filter materials for various segments of the Highway 29 realignment and construction of the shoreline protection berm in the District of Hudson's Hope.

The quarry contractor completed the construction of a new stockpile area just outside the quarry, which will be used to store material that does not meet specifications.

Blasting operations will resume on May 16, 2021.

Hudson’s Hope shoreline protection berm

The Hudson’s Hope berm is a 2.6-kilometre shoreline protection berm that will protect the slopes adjacent to the reservoir from erosion.

As of the end of the reporting period, the contractor had completed 55 per cent of the construction of the toe berm, which forms the base of the berm. Activities on site also included stripping and vegetation clearing as well as the crushing and stockpiling of berm fill material.

2.1.8 Reservoir[2]

The following reflects progress to March 31, 2021.

Reservoir Clearing

The reservoir clearing scope of work is divided into two main regions:

- Lower reservoir, Moberly River drainage and eastern reservoir including Cache Creek drainage; and
- Middle reservoir, Halfway River drainage and western reservoir.

Clearing in the lower reservoir, Moberly River drainage, eastern reservoir and middle reservoir up to Halfway River was required to support river diversion. All other clearing is scheduled for completion prior to reservoir inundation.

Lower Reservoir, Moberly River Drainage and Eastern Reservoir including Cache Creek Drainage

Clearing activities including waste wood disposal occurred in the Moberly River drainage, north and south banks of the eastern reservoir and Cache Creek area over the winter. All clearing and burning activities are now substantially complete for these areas except for some road deactivation works on the south bank of the eastern reservoir and some waste disposal in the Moberly River drainage.

Middle Reservoir, Halfway River Drainage and Western Reservoir

Clearing activities include burning of waste wood continued between Cache Creek and Halfway River drainage over the fall and winter. By March 31, 2021, clearing was substantially complete though some tree removal, waste wood disposal and road deactivation activities remained on the south bank of the middle reservoir. Some burn piles also remain at the Halfway and Peace rivers confluence. These activities are planned to be completed next winter.

[2] This section was previously referred to as “Reservoir Clearing”.

All clearing activities were completed in the middle and western reservoirs, Halfway River drainage, and an area between Halfway River and Farrell Creek by the end of the reporting period except for some trees that were left for wildlife buffers and on an island near Farrell Creek that had restricted access due to high water flows. Clearing activities will resume in summer 2021 to clear the remaining areas as well as further westward when road conditions are suitable.

Other Reservoir Work

The scope of other reservoir work includes infrastructure relocations and reinforcements as well as environmental mitigation and enhancements works, which are required as part of reservoir filling.

BC Hydro's existing 1L364 transmission line crossing of the Halfway River drainage needs to be relocated prior to inundation. Detailed design work continued over the winter and procurement was initiated for the supply of the steel poles. The procurement for the foundation installation will occur in summer 2021 with construction works planned for next winter.

Preferred locations for fisheries enhancements sites were identified in the eastern and western reservoirs and design work advanced during this reporting period.

Existing oil and gas wells may be impacted by reservoir filling. Assessment on individual well sites continued over the winter and this work is anticipated to continue in the coming months. Consultation with regulatory bodies is occurring.

2.2 Engineering

The Engineering team provides technical support to all aspects of the Project. Through the reporting period, substantial effort was given to support the achievement of the contractor's schedule for both the main civil works and the generating station and spillways civil works contracts, as well as advancing the

selection and design of required foundation enhancements to the structures on the right bank.

2.2.1 Main Civil Works

Support for the main civil works contract continued during the reporting period supporting excavations, grouting and instrumentation of the main dam foundations in preparation for the placement of dam fills in 2021.

Detailed geological mapping of the excavations and instrumentation monitoring continues during construction. This information is used to update the design parameters for the site geology and foundations.

2.2.2 Foundation Enhancements

During the reporting period, value engineering activities continued in support of advancing the design of the foundation enhancement measures required to increase the stability below the powerhouse and spillways.

Value engineering, coupled with cost and schedule optimization analysis, resulted in finalizing the total number of piles required to be installed within the foundation of the spillways and powerhouse. A total of 96 piles are required, which corresponds to 48 piles within the foundation of each structure. The vertical steel and concrete piles are 2.4 metres in diameter and vary in length ranging from 30 to 40 metres.

The piles will extend the function of the spillways and powerhouse buttress roller-compacted concrete shear key a further 15 to 25 metres into the bedrock, to an elevation below the deepest bedding plane where movements have been measured. The depth of the piles assures adequate stability even if weaker planes exist below the level identified; and the fixed nature of the piles will provide added resistance to both the spillways and the powerhouse in the event of a low probability, extreme or unusual event.

Value engineering work continued on the enhancements to improve the water-tightness of the approach channel. Work included optimizing the approach channel's shape, the location and design of the channel's grout curtain and the design of the approach channel's liner. In addition, advancements in value engineering continued for the design of the drainage enhancements required below the approach channel's foundation.

BC Hydro continued to engage the independent dam experts, Technical Advisory Board and other subject matter experts to provide oversight of value engineering activities associated with the design of the foundation enhancements. Refer to section 2.2.6 for a summary of Technical Advisory Board meetings and Appendix E for the reports issued by the independent dam experts and Technical Advisory Board during the first quarter.

2.2.3 Large Cranes, Hydromechanical and Turbines and Generators

Engineering support to construction and manufacturing, as well as vendor submittal review and integration, continued throughout the reporting period for the large cranes, hydromechanical equipment and turbines and generators contracts.

Generating Station and Spillways, Balance of Plant and Equipment Supply

During the reporting period, work focused on the production of record drawings for the powerhouse, along with supporting construction with review of submittals for the powerhouse, intakes, penstocks, and spillways.

For the balance of plant scope of work, engineering focused on preparation and issuance of the technical specifications and issued for proposal drawings for the balance of plant mechanical and electrical request for proposals packages which were both issued to BC Bid in early 2021. The team continues to support the procurement process for the mechanical and electrical request for proposal packages through responding to requests for information, reviewing proposals and other BC Hydro requests. Work also continued on preparation of the technical

specifications and issued for proposal drawings for the four-remaining balance of plant request for proposals packages. The balance of plant team also continued to support the review of the technical submittals and design drawings, factory acceptance testing, and virtual factory visits for the nine equipment supply contracts including the generator terminal equipment, generator circuit breakers, generator step-up transformers, AC station service, DC station service, 500 kV motor operated disconnects, diesel generators, large valves and compressed air receivers contracts.

Engineering design continued to be advanced on the protection and control systems and is on schedule with various protection and control panels now under construction.

Overall, the detailed engineering on the generating station and spillways is complete. This excludes the foundation enhancements design, for which the detailed engineering is approximately 50 per cent complete.

2.2.4 Transmission and Substation

During the reporting period, engineering support was provided to complete construction of the second 500 kV transmission line foundations and tower installations.

2.2.5 Highway 29

The 100 per cent detailed design was completed for the Farrell Creek East segment B. The design will be provided to the Ministry of Transportation and Infrastructure for use in the event that impacts are caused by the future Site C reservoir. Engineering support is being provided to the various highway segments and the Hudson’s Hope berm as required to progress construction activities.

Design was initiated for the construction of an intersection for a boat launch at Halfway River.

2.2.6 Technical Advisory Board

A series of video conferences occurred from January to March 2021 to review the design and construction of the earthfill dam and foundation enhancements. A report was issued from the Technical Advisory Board in January 2021 on the overall status of the design and provides context for the foundation enhancements. In addition, three reports were issued by the independent experts.

Refer to Appendix E for the reports issued by the Technical Advisory Board and the independent experts during the reporting period.

2.3 Quality Management

The Project has a quality management plan that outlines activities to ensure materials, equipment and the constructed works meet contract quality requirements. The plan identifies resources and procedures necessary for achieving the quality objectives, roles and responsibilities, and is the framework document for the quality management program.

During the reporting period, the Project team continued its activities to support the Project quality plan, including:

1. Ongoing meetings with the quality management teams of key manufacturers in countries affected by COVID-19;
2. Ongoing meetings with the quality management teams of the site contractors to address quality issues; and
3. Continuing with monthly quality performance indicator assessments for the engineering, manufacturing and construction activities across each sub-project.

The Project team continues to track and manage quality nonconformances. Table 2 summarizes quality nonconformity instances during the reporting period.

Table 2 Quality Management Nonconformity Report (NCRs) Metrics Reporting Period – January 2021 to March 2021

Contract	NCRs Reported January 1, 2021 to March 31, 2021	NCRs Closed January 1, 2021 to March 31, 2021	NCRs Reported to Date	NCRs Closed to Date	NCRs Open as of March 31, 2021
Main Civil Works	17	37	1,826	1,810	16
Turbines and Generators	69 (52+17)	38 (22+16)	442 (406+36)	324 (307+17)	118 (99+19)
Generating Station and Spillways Civil Works	76	73	640	575	65
Large Cranes	3	5	26	26	0
Hydromechanical Equipment	12	12	30	30	0
Transmission	0	0	115	114	1

BC Hydro's ability to travel to participate in equipment inspections and final acceptance tests continues to be restricted due to the COVID-19 pandemic. In order to mitigate the quality risks associated with these restrictions, BC Hydro continues to meet virtually with contractors in affected areas, including the turbines and generators contractor (Brazil) and the hydromechanical equipment contractor (Italy) on a weekly basis to plan upcoming inspections and to coordinate with local quality assurance representatives. For critical components, BC Hydro's local inspectors maintain a full-time equivalent presence in order to monitor the progress and quality of the manufacturing. For selected factory acceptance tests, for example the exciter transformer, BC Hydro participated remotely via video conferencing and data file sharing with the equipment manufacturer. With the implementation of these measures, BC Hydro continues to ensure that quality requirements are satisfied prior to components being shipped.

During the reporting period, the main civil works contractor continued drilling and grouting the main dam foundation. The contractor focussed its efforts on heating and hoarding the foundation in order to maintain the specified ground-temperature parameters for the grouting. BC Hydro and the contractor continue to meet weekly to discuss and resolve open nonconformity reports as well as discuss broader topics related to the contractor's quality performance. BC Hydro continues to work with the contractor to ensure the operational readiness of its on-site materials testing laboratory in advance of the resumption of roller-compacted concrete placement and commencement of materials processing for the main dam.

The quality of the constructed works in the generating station and spillways and intake structures continues to be good. During the reporting period, the contractor focussed its efforts on adjusting the concrete mix design to ensure that the 56-day requirement for compressive strength is achieved, as well as maintaining the heating and hoarding structures over the concrete placements to ensure that the thermal control and wet-curing requirements are achieved during winter conditions.

For the turbines and generators contract, the quality of the components manufactured to date continues to be good. BC Hydro continues to meet with the contractor on a weekly basis to discuss upcoming inspections, quality issues and the overall quality assurance program.

3 Safety and Security

Managing COVID-19 issues in ways that allowed construction activities to continue safely remained a primary focus during this reporting period.

3.1.1 Industrial Projects Restart Order and COVID-19 at Site

To reduce the risk of increased post-winter holiday transmission of COVID-19 at major projects and local communities in the north, B.C. Provincial Health Officer issued several public health orders in late December 2020 and early January 2021.

one of these orders was the *Industrial Projects Restart Order*, which required a slow and controlled return of workers, and specifically applied to the five major projects in the region, including Site C.

Starting from a reduced baseline number of onsite workers, BC Hydro was asked to submit a Restart Plan that set out how the project would increase worker numbers while managing the risk of COVID-19 transmission. The Site C Restart Plan was submitted in late January 2021 and BC Hydro was able to ramp up gradually throughout late winter and into early spring.

From January to March 2021, the medical clinic saw 453 initial clinic visits for respiratory and gastrointestinal symptoms, and 313 (69 per cent) resulted in the workers being isolated. A total of 221 COVID-19 tests were administered by the onsite clinic. There were 34 confirmed positive cases of COVID-19 on the Project with 25 cases linked to five controlled, onsite clusters.

Subsequent to the reporting period, on April 28, 2021, Northern Health declared an outbreak of COVID-19 at Site C because of an increase in cases at site. This step was taken to ensure the health and safety of employees, contractor workers and members of the public. Work continued on-site and BC Hydro was not directed to shut down the site or stop any work due to the COVID-19 protocols in place.

3.1.2 Site C COVID-19 Vaccinations

In early March 2021, Northern Health launched an industrial projects vaccination initiative and provided the major projects with AstraZeneca / Covishield vaccines. Working with the onsite medical clinic, Site C launched a mass vaccination program on March 19, 2021 and vaccinated 1,430 workers in 10 days before the vaccination program was temporary halted due to federal reviews of the AstraZeneca / Covishield vaccines.

Subsequent to the reporting period, in late May 2021, Northern Health authorized the Site C vaccination program to restart.

3.1.3 Security

Gate C is now fully automated and operational. Permanent security fencing has been installed along with an automated sliding gate. Pedestals with proximity access readers have been installed and control access to workers with a valid site access card. The original security office now houses automated COVID-19 screening equipment and security technologies to enable 24/7 monitoring and alerting.

Working collaboratively with the Site C security services contractor, BC Hydro introduced a new set of service expectations and key performance indicators for the security on the Project. These key performance indicators are relevant and achievable, designed to improve security outcomes and better utilize the security workforce.

3.1.4 Summary of Safety and Regulatory Performance Metrics

From July 2015 through March 2021, all work fronts across the Project had completed almost 32 million work hours, with no fatalities and one permanent partial disabling injury in 2017. In this reporting period, there were five serious safety incidents consisting of four near misses that had the potential to be a serious injury and one serious injury that required medical attention. There were 194 non-serious incidents reported including 48 near misses and 146 low grade injuries that may have required first aid and/or medical attention treatment. A near miss is defined as an incident that could have resulted in an injury but did not because of effective hazard barriers or the person was out of harm's way/missed. BC Hydro considers near miss reporting as indicative of a strong and improving safety culture and is strongly encouraging all Site C contractors and employees to report near misses.

To encourage active learning from safety incidents across all work fronts and contractors, the Project held 22 Safety Incident Reviews in this quarter. Two of the more serious safety incident investigations and corrective actions were reviewed by BC Hydro and contractor senior leaders. Site C construction management and

safety teams reviewed another 20 less-serious incidents as well as safety trends observed in the incidents (e.g., working at heights).

Table 3 below reflects safety and regulatory performance results for the Project, including all contractors and all sub-projects.

Table 3 Summary of Site C Safety and Regulatory Metrics

	Reported January 1, 2021 to March 31, 2021[3]	Reported Since Inception (July 27, 2015 to March 31, 2021)[3]
Fatality[4]**Error! Bookmark not defined.**	0	0
Permanently Disabling Injury[5]	0	1[6]
Serious Incidents[7]	5	80
Lost Time Injuries[8]	1	34
All-Injury Incidents[9] (Lost Time Injuries[8] and Medical Attention requiring Treatment[10])	12	216

3 Numbers are subject to change due to timing of when data is retrieved and when injury is categorized.

4 Excludes any non-occupational incidents.

5 A permanently disabling injury is one in which someone suffers a probable permanent disability.

6 In June 2018, an injured worker received a permanent partial disability award from WorkSafeBC due to a lost time injury incident in August 2017. The worker was attempting to unload a light plant (tower) from a flatbed truck. The worker stepped on the light plant (tower) outrigger to gain enough height to reach the lifting attachment when the worker lost balance and fell approximately 7.5 feet to the ground. BC Hydro reclassified this incident as a permanent disabling injury after receiving an update on the WorkSafeBC award in June 2018. The incident is identified as a serious injury in the BC Hydro Incident Management System.

7 Serious incidents are any injury or near miss with a potential for a fatality or serious injury.

8 Lost time injuries are those where a worker (employee or contractor) misses their next shift (or any subsequent shift) due to a work-related injury / illness. If a worker only misses work on the day of the injury, it is not considered a lost time injury.

9 All-Injury incidents are work-related medical attention requiring treatment, lost time injuries, and fatalities.

10 Medical attention requiring treatment is where a medical practitioner has rendered services beyond the level defined as “diagnostic or first aid” and the worker (employee or contractor) was not absent from work after the day of the injury. Services beyond diagnostic / first aid include (but are not limited to) receiving stitches, a prescription, or any treatment plan such as physiotherapy or chiropractic.

There was one lost time injury between January and March 2021, which occurred in poor winter conditions when a worker slipped on ice and injured their foot. This is down from five lost time injuries from the same quarter last year (quarter ending March 31, 2020). There was also a 48 per cent decline of all-injury incidents compared to the same quarter last year. These declines are due in part to a reduction in the workforce due to the *Industrial Projects Restart Order*.

3.1.5 Safety Verifications

In this reporting period, the Site C safety team completed a total of 183 formal, planned safety verifications for the Project (on dam-site and off dam-site) – an average of 61 per month. The closure rate for these 2020 verifications (indicating the number of identified nonconformances addressed) was 94.9 per cent; a continued strong collaboration between the BC Hydro construction and safety teams. Of these 183 safety verifications, 27 per cent were clean sheet verifications, where no nonconformances were found during the verification. Further, 87 per cent of all the safety verifications conducted during the reporting period identified good safety practices even if there were some nonconformances.

3.1.6 Regulatory Inspections and Orders

WorkSafeBC, under the authority of the *Worker's Compensation Act*, is the primary regulator with jurisdiction over safety for the Project. WorkSafeBC oversees all worker safety (employee and contractor) for the Project, both on the dam site and off the dam site. The Ministry of Energy, Mines and Low Carbon Innovation is the regulatory authority for worker safety on any work fronts subject to the *Mines Act*, specifically West Pine Quarry, Portage Mountain Quarry, and Wuthrich Quarry.

From January to March 2021, WorkSafeBC issued 10 regulatory inspection reports and four regulatory orders. The Ministry of Energy, Mines and Low Carbon Innovation did not conduct any regulatory inspections during this period.

Of the 10 inspection reports, seven were 'clean sheets' with no orders. Two of the clean sheets were related to COVID-19. This is a slight improvement from the quarter ended March 31, 2020. Refer to Appendix B, for a list of safety regulatory inspections and orders received from January to March 2021.

In March 2021, the generating station and spillways contractor received an administrative penalty from WorkSafeBC, for the maximum allowed under regulation. This penalty was in response to an incident where a worker was injured after falling about 12.2 metres (40 feet) from a formwork shoring deck in November 2020. Holes had been cut out of the deck to accommodate the installation of future shoring tower components, which had not yet been covered. The worker, who was wearing a fall protection harness but was not connected to a lifeline, was returning from lunch and stepped through one of the unguarded holes. WorkSafeBC observed a number of worker safety high risk violations.

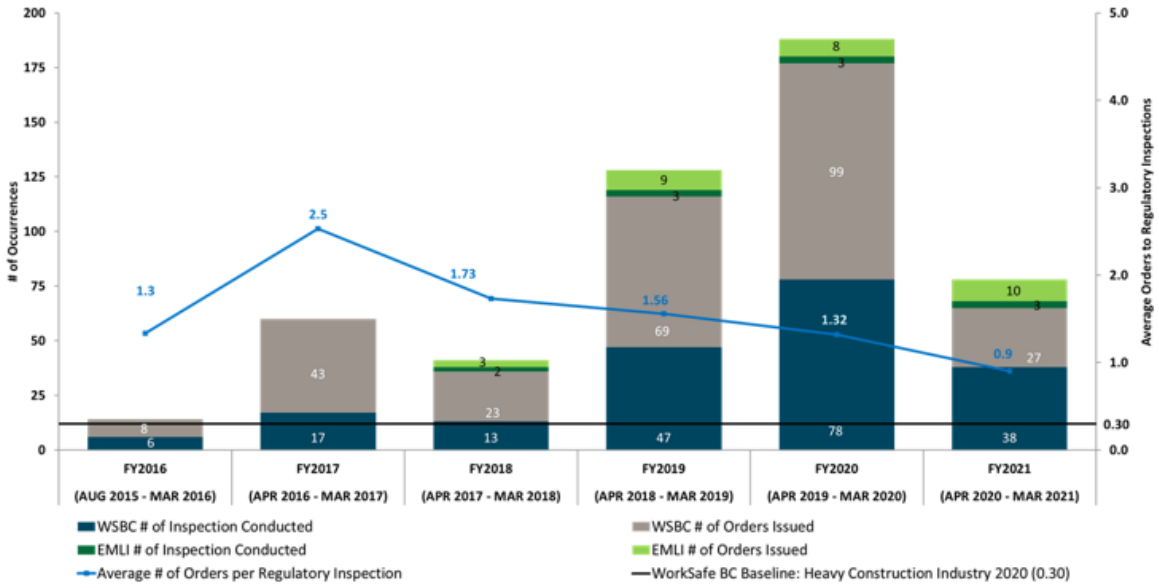
The Project monitors an additional metric – average number of orders per regulatory inspection. Between April 2020 and March 2021, the average number of orders per inspection is 0.90, an improvement from 1.32 orders per inspection in the previous year.

Table 4 Safety Regulatory Inspection and Orders

	Reported January 1, 2021 to March 31, 2021[11]	**Reported Since Inception (July 27, 2015 to March 31, 2021)**
Regulatory Inspections	10	211
Regulatory Orders	4	299

[11] Numbers are subject to change due to timing of when data is retrieved and when injury is categorized.

Figure 1 Number of Orders to Regulatory Inspections, August 2015 to March 2021



4 Project Schedule

4.1 Project In-Service Dates

Work to re-baseline the Project began in July 2020. As announced by the Government of B.C. on February 26, 2021, the revised cost estimate to complete Site C is $16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the COVID-19 pandemic. BC Hydro continues to review the schedule, work closely with contractors to understand the costs and schedule impacts due to COVID-19, and review risks as part of the recommended actions in the Milburn Review. During the quarter, BC Hydro and Site C contractors continued to explore ways in which the work delayed by the COVID-19 pandemic could potentially be accelerated, which, if successful, could result in an earlier in-service date.

Table 5 shows the status of key Project milestones in relation to the new expected in-service date of 2025.The Project schedule continued to be reviewed during the reporting period.

Table 5 In-Service Dates

Description	In-Service Dates based on Announcement from Government of B.C.[12]	Status
5L5 500 kV Transmission Line	October 2020	Complete
Site C substation	November 2020	Complete
5L6 500 kV transmission line	July 2023	On track
Unit 1 (first power)	December 2024	On track
Unit 2	February 2025	On track
Unit 3	May 2025	On track
Unit 4	July 2025	On track
Unit 5	September 2025	On track
Unit 6	November 2025	On track

5 Project Governance, Costs and Financing, and Risk

5.1 Project Governance

On February 26, 2021, the Government of B.C. announced that construction on Site C will continue at a revised estimated cost of $16 billion and a new expected in-service date of 2025. At the same time, the Government of B.C. released the independent review of the Project by Mr. Milburn resulting in seven recommendations related to Project governance. Measures to improve Project governance during the reporting period include:

- Significant progress has been made on all of Mr. Milburn's recommendations and BC Hydro is working closely with Government to complete their implementation

[12] In-service dates based on Government of British Columbia announcement on February 26, 2021.

including the seven recommendations related to the Project Assurance Board (**PAB**) in areas of composition, skills matrix, meeting structure and time commitments, orientation process and terms of reference;

- EY Canada continues to provide independent oversight for the Project including budget oversight, schedule and commercial management evaluation and risk assessment analysis. BC Hydro and EY Canada are working collaboratively on implementing identified opportunities for improvement;
- BC Hydro completed a cost risk analysis and schedule risk analysis in the first quarter of 2021. During these analyses, BC Hydro worked collaboratively with EY Canada and continues to implement enhancements identified by both EY Canada and Mr. Milburn;
- An Independent Construction Advisor retained by the Project Assurance Board continued to provide advice and opinions on construction planning by major contractors at the dam site;
- The two independent dam experts commissioned by the Site C Project Assurance Board completed their initial assessment of the right bank foundation enhancements and earthfill dam during the quarter, and concluded the right bank foundation enhancements solutions are appropriate and sound, will make the right bank structures safe and serviceable over the long operating life of Site C, and that the earthfill dam can be built safely and meet all Canadian Dam Association dam safety and reliability guidelines. The independent dam safety experts, along with the Technical Advisory Board, will continue to monitor the design and construction of the right bank foundation enhancements and earthfill dam as the work evolves; and
- BC Hydro continued to increase the number of on-site representatives to effectively manage the construction contracts.

5.2 Project Budget Summary

In January 2018, the Government of B.C. approved a revised total Project budget of $10.7 billion, comprised of a $9.992 billion base budget and $708 million in Project reserve.

Prior to the COVID-19 pandemic, and since the $10.7 billion Project budget was approved in February 2018, the Project was managing significant financial pressures due to:

- Amendments to the main civil works contract;
- Additional labour resource requirements;
- First Nations treaty infringement claims and an injunction application;
- Increased costs associated with reservoir clearing, transmission line construction and highway re-alignment work; and
- Additional significant scope and design enhancements to the foundations of the structures on the right bank.

In addition to the above noted financial pressures, an identified Project geological risk materialized on the right bank. BC Hydro identified by early 2020 that significant foundation enhancements were required to increase the stability under the structures on the right bank, including the powerhouse, spillways and future dam core area.

However, prior to the COVID-19 pandemic, the Project remained on schedule for the first generating unit to go into service in late 2023 and a final in-service date in 2024.

The COVID-19 pandemic has created significant pressures on the Project budget and schedule. This is primarily due to the Project not being able to restart and accelerate certain work that was restricted due to the pandemic. In response to the increasing escalation of provincial measures to manage the COVID-19 pandemic, in

March 2020, BC Hydro substantially reduced the number of workers in the worker accommodation lodge, which resulted in fewer workers travelling to and from Fort St. John and the Peace Region. This impacted construction activities on Site C as the work on the construction site was scaled back to only those activities that were critical to achieve river diversion and essential services, such as site safety and security and environmental protection. This decision resulted in a reduction of the work force staying at site by about 50 per cent. In May 2020, BC Hydro began safely increasing camp capacity and consequent construction activities at Site C in a gradual phased approach. In December 2020 and January 2021, several public health orders were issued to limit the number of onsite workers in January 2021 to reduce the risk of increased post-winter holiday transmission of COVID-19.

BC Hydro commenced work to re-baseline the Project budget starting in July 2020. This process included completing a detailed review of base budgets, remaining work and risks and included the review and input from the independent oversight advisor, EY Canada.

As announced on February 26, 2021 by the Government of B.C., the revised Project cost estimate is $16 billion. BC Hydro continues to review the revised cost estimate, along with risks, further to the recommended actions in the Milburn Review. The revised project cost estimate was not yet approved by Government during the reporting period.

Table 6 below provides a comparison between the previous Project budget to the revised cost estimate of $16 billion.

Table 6 Previous Project Budget compared to Revised Project Cost Estimate ($ million)

Description	Previous Budget	Revised Project Cost Estimate	Change
Dam, Power Facilities and Associated Structures and Transmission (Note 1)	4,548	8,258	3,710
Offsite Works, Direct Construction Supervision and Site Services (Note 2)	1,845	2,895	1,050
Total Direct Construction Cost	**6,393**	**11,153**	**4,760**
Indirect Costs (Note 3)	1,456	2,082	626
Total Construction and Indirect Costs	**7,849**	**13,235**	**5,386**
Interest During Construction	1,285	2,028	743
Contingency / Reserve	1,566	737	(829)
Total	**10,700**	**16,000**	**5,300**

Note 1: Key items included are river diversion infrastructure, earthfill dam and related works, spillways, powerhouse, generation equipment and transmission and substation work.

Note 2: Key items included are highway re-alignment and reservoir related work, direct construction supervision, and site services such as workers accommodation.

Note 3: Key items included are mitigation and compensation programs, development and regulatory costs, project management, engineering and other support services such as project controls, contracts management, environmental, and Indigenous relations.

The one-year delay due to the COVID-19 pandemic and other costs associated with COVID-19 are the single largest driver to the increase in the cost estimate followed by the additional costs for the foundation enhancement measures. In addition, prior to COVID-19, the Project was managing significant financial pressures due to amendments to the main civil works contract; additional labour resource requirements; increased costs associated with reservoir clearing, transmission line construction and highway re-alignment work.

The key project risks that remain and continue to be assessed include the continuation of the COVID-19 pandemic and the potential impacts to on-site construction activities; commercial negotiations with contractors; design finalization for the foundation enhancements and related procurements; the procurement for the

balance of plant contracts; and the ability of the Project to attract and retain sufficient skilled workers.

5.3 Project Expenditure Summary

As of March 31, 2021, the life-to-date expenditures on the Project was $6.867 billion. Table 7 below provides a summary of the 2020/21 to 2022/23 Service Plan Project expenditures for Fiscal 2021, the actual Project expenditures for Fiscal 2021 and the related variance.

Table 7 Actual Fiscal 2021 Project Expenditures Compared to 2021/22 to 2023/24 Service Plan ($ million Nominal)

Description	2021/22 to 2023/24 Service Plan March 2021 YTD	Actual Expenditures March 2021 YTD	Variance
Total Project	1,646	1,740	(94)

Details of the variances between actual and plan are in Appendix H.

5.4 Internal Project Financing versus External Borrowings to Date

To date, all Project funding has been from internal borrowings and there has been no Site C Project-specific debt issued. As part of BC Hydro's debt management strategy, BC Hydro's exposure to variable debt is managed within a board approved range of 5 per cent to 25 per cent and a target of 15 per cent.

5.5 Material Project Risks

Material Project risks are identified and reviewed on an ongoing basis. As the Project progresses through implementation phase, the material Project risks will evolve to reflect the current risks facing the Project.

During the reporting period and in response to recommendations from the Milburn Review, the criteria for selecting those risks for inclusion in internal and external reporting were updated. The criteria include both objective and subjective measures, and these criteria have been utilized to select the risks included in the list below.

Refer to Table 8 below for a list of the material Project risks as of March 31, 2021.

Table 8 Material Project Risks

Risk Description	Impact and Response Plan Summary
Risk that COVID-19 event impacts continuation of construction activities at site or in Vancouver.	**Impact**: BC Hydro and contractors do not have access to the required labour for daily construction and project management activities. BC Hydro and contractor costs increase to respond to COVID-19 and schedule delay impacts; camp capacity reduction and/or shutdown due to COVID-19 outbreaks. **Response:** Minimize non-essential travel to site. Screen workers before they travel to site and at site before entry; implement camp mitigation measures (additional cleaning, closed cafeteria self serve stations, establish isolation wings); put in place BC Hydro and contractor worker protection exposure protocols and plans.
Risk that union raiding, organizing, or other union conflicts impact site work.	**Impact**: Schedule delay, low productivity and morale, and increased legal fees. **Reponses**: Implement labour stability terms in commercial contracts; execute security plans if on site disruption occurs
Risk that the Project cannot attract and retain sufficient skilled workers.	**Impact:** Contractors may not be able to adequately source, supply, attract, and retain sufficient project labour due to workforce demographics, increased competition for labour from other major projects, the requirement for specialized workers, and the effects of COVID-19. This may result in potential impacts to schedule, safety, productivity and cost. **Response**: Contractors provide labour sourcing and supply plans, provide advance notice of foreign workers, and participate in local job fairs. BC Hydro encourages and facilitates capacity building initiatives and monitors employee turnover rates and labour conditions on other projects.

Risk Description	Impact and Response Plan Summary
Risk that increased interest rates and changes in expenditure timing increases borrowing costs.	**Impact**: Rising interest rates and changes in expenditure timing result in an increase to the Project's interest costs above the amount budgeted. **Response**: Implement interest rate hedging program for future debt placements to reduce the potential impact of rising interest rates. Monitor changes to expenditure timing.
Risk of contractor claims.	**Impact**: Increased construction management and contract management effort required to respond and investigate claims; settlement of claims may result in increased costs. **Response**: Ensure sufficient commercial management resources in place, proactively resolve claims as received, and ensure commercial management procedures are in place.
Risk of a safety incident resulting in a fatality or disabling injury.	**Impact:** Serious worker injury or fatality; project delays and associated costs. **Response**: Continue with BC Hydro and contractor safety steering committee to address shared safety issues and opportunities; BC Hydro and contractors have implemented safety cultural leadership training; increase BC Hydro executive involvement and engagement with site safety leadership; regularly hold on site safety conferences; continue to include safety in BC Hydro and contractor on boarding orientations; and continue to promote a strong safety culture.
Risk of earthfill dam construction delays due to instrumentation installations.	**Impact**: Earthfill dam construction is delayed awaiting the installation of instruments; Instruments are non-functional and/or damaged. **Response**: Close oversight of the main civil works contractor's current effort to self perform work; main civil works contractor refining/training personnel and drilling techniques/equipment; communicating to main civil works contractor the importance of instrumentation and scheduling to mitigate delays.
Risk of a slope failure on transmission right-of-way above the Site C substation.	**Impact**: Slope failure on the transmission line right-of-way above the substation. Costs to repair transmission lines and substation. **Response**: Conduct geotechnical investigations, install additional instrumentation, and implement recommended slope failure mitigation measures.
Risk of erosion of the outlet riprap material.	**Impact**: Cost of remediation; schedule delay and potential generation flow restriction on G.M. Shrum and Peace Canyon generation stations. **Response**: Complete both temporary and permanent solutions to prevent erosion. Monitor outlet area for any signs of erosion.
Risk of procurement uncertainty for the right bank foundation enhancement work.	**Impact**: Existing contractors' scope of work and schedule impacted by potential new right bank foundation enhancement contractor interfaces. **Response:** Rely on change schedule terms of existing contracts to proceed with change orders for the right bank foundation enhancement work scope, and if agreement can’t be reached, proceed with an open procurement process.

Risk Description	Impact and Response Plan Summary
Risk of lack of access to intake deck impacts transmission lines from generating station to substation.	**Impact**: Delays to transmission lines in-service date and turbine-generator unit 1 in-service date **Response**: Work with interface management and construction management to update the schedule to ensure the transmission lines are available when required. Develop plan to complete the work and resolve any potential lack of access to the intake deck.

5.5.1 Safety Performance Frequency Metrics

To assess safety performance over time, the Project considers key safety metrics in the context of the total amount of hours worked (frequency) which corrects for the volume of work. Table 9 below summarizes these key safety frequencies by quarter for a rolling 12-month average.

Table 9 Summary of Safety Performance Frequency Metrics

	Fiscal 2020 April 2019 – March 2020 (Rolling 12-Month Average)				Fiscal 2021 April 2020 – March 2021 (Rolling 12-Month Average)			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Serious Incident Frequency	0.43	0.39	0.53	0.53	0.55	0.62	0.48	0.48
Lost Time Injury Frequency	0.23	0.18	0.14	0.22	0.23	0.21	0.21	0.12
All Injury Frequency	1.03	1.44	1.68	1.93	1.92	1.46	1.33	1.14

Fiscal 2021 Q4 will be updated when information is available.

Comparing results from the quarter ended March 31, 2020 to the quarter ended March 31, 2021, indicates all safety performance frequencies (serious incident, lost time injury and all-injury) have decreased. These declines are due in part to a reduction in the workforce due to the *Industrial Projects Restart Order* (reduced workforce during this reporting period).

The serious incident frequency for January to March 2021 is 0.48, a slight but not significant decrease compared to 0.53 for the same period in 2020. Lost time injury

frequency this quarter is 0.12, a significant decrease compared to 0.22 from the same quarter last year. Finally, all-injury frequency is at 1.14 this quarter, a 41 per cent decrease compared to 1.92 for the same quarter last year; the decrease was in medical attention injuries.

6 Key Procurement and Contract Developments

6.1 Key Procurement

The procurement approach was approved by the board of directors in June 2012 for the construction of the Project. The procurement approach defined the scope of the major contracts and their delivery models. The remaining procurements on the Project are summarized in Table 10 below.

Table 10 Remaining Major Project Contracts and Delivery Models

Component	Contract	Procurement Model	Anticipated Timing
Reservoir/ Transmission Clearing	Multiple reservoir clearing contracts to be awarded over seven to eight years	Design-Bid-Build	Fifteen contracts completed (reservoir 13, transmission two). Three reservoir access and clearing contract packages remain to be procured; the final number will depend on the scope of each package.
Generating Station and Spillways	Balance of Plant – Mechanical contract	Design-Bid-Build	Request for proposals closed in April 2021
	Balance of Plant – Electrical contract	Design-Bid-Build	Request for proposals was posted in March 2021
	Balance of Plant – Architectural contract	Design-Bid-Build	Request for proposals scheduled to be posted in June 2021
	Balance of Plant – Permanent upstream fishway and other out structures	Design-Bid-Build	Request for proposals scheduled to be posted in July 2021
	Balance of Plant – Fire detection and protection contract	Design-Build	Request for proposals scheduled to be posted in August 2021

Component	Contract	Procurement Model	Anticipated Timing
	Balance of Plant – Heating, ventilation and air conditioning contract	Design-Build	Request for proposals scheduled to be posted in September 2021

6.2 Major Construction Contracts Exceeding $50 million

Since inception of the Project, 10 major construction contracts have been awarded that exceed $50 million in value, as shown in Table 11.

All of the construction contracts have been procured and awarded as per BC Hydro procurement policies.

Table 11 Major Project Contracts Awarded

Work Package	Contract Value at March 31, 2021[13] ($ million)	Contract Execution Date
Site Preparation: North Bank	60	July 2015
Worker Accommodation	551	September 2015
Main Civil Works	2,671	December 2015
Turbines and Generators	464	March 2016
Transmission and Clearing	80	October 2016
Quarry and Clearing	101	February 2017
Generating Station and Spillways Civil Works	1,809	March 2018
Hydromechanical Equipment	70	April 2018
Transmission Line Construction	137	May 2018
Highway 29	377	October 2019

6.3 Contracts Exceeding $10 million

For open contracts procured and awarded in excess of $10 million, refer to Appendix F.

[13] Contract value reflects the current value including executed change orders to the end of the reporting period.

6.4 Contract Management

6.4.1 Material Changes to the Major Contracts

The main civil works contract is a unit price contract and as such variations in quantities and design are expected over the term of the contract. Since contract award in December 2015, the main civil works contract value has increased by $924 million to reflect approved changes to March 31, 2021. This increase in contract value is primarily the result of a number of contract amendments since contract award in 2015 including two larger contract amendments, one in 2018 and the second in March 2020.

The generating station and spillways contract is also a unit price contract and as such variations in quantities and design are expected over the term of the contract. Since contract award in March 2018, the generating station and spillways contract value has increased by $205 million to reflect approved changes to March 31, 2021.

7 First Nations Consultation

Pursuant to the Environmental Assessment Certificate and Federal Decision Statement, BC Hydro is required to consult with 13 Indigenous groups with respect to the construction stage of the Project. This consultation includes provision of information on construction activities, support for the permit review process, and review and implementation of mitigation, monitoring and management plans, and permit conditions.

Accommodation offers were originally extended to 10 First Nations communities. Seven agreements have been fully executed and are in various stages of implementation. In February 2019, the Government of B.C., BC Hydro, West Moberly First Nations and Prophet River First Nation agreed to enter into confidential discussions to seek alternatives to litigation related to the Site C Project. West Moberly First Nations withdrew from the discussions in August 2019 and filed an amended Notice of Civil Claim in September 2019. The Government of B.C. and

BC Hydro have since negotiated an agreement with Prophet River First Nation to settle this litigation, which was publicly announced in August 2020. To date, Impact Benefits Agreements with McLeod Lake Indian Band, Doig River, Halfway River, Prophet River, and Saulteau First Nations, and Project Agreements with Dene Tha' and Duncan's First Nations have been publicly announced.

Diversion readiness, headpond, Highway 29, mitigation, and monitoring engagement activities were adapted in light of the COVID-19 pandemic, including continuation of the Environment Forum and the Culture and Heritage Resources Committee, primarily by video conference. Modified community engagement events were organized for several Nations. Most of the Nations have also participated in COVID-19 modified site tours. Additional communication materials, including videos and social media, have also been developed to support ongoing information sharing. Consultation is ongoing with impacted First Nations regarding options and site-specific plans for identified burial and cultural sites impacted by reservoir inundation, in particular in the Halfway River and Cache Creek Bear Flats areas. The cultural monitoring program continues with First Nations monitors observing Project construction at Highway 29 locations as well as environmental enhancement and mitigation programs. Due to the B.C.'s Provincial Health Officer public health order restricting numbers at the dam site, the cultural monitors will not be on the dam site until further notice.

In October 2020, in collaboration with the Project's Cultural and Heritage Resources Committee, BC Hydro launched a new interactive travelling exhibit that tells the story of Indigenous peoples in the Peace Region. During the reporting period, the exhibit was set up at the Fort St. John museum and the Site C camp and will resume travel to communities once COVID-19 health orders are lifted.

The exhibit describes past use of the Peace Valley area, tells stories from various communities, and commemorates sites that will be lost to inundation from the future

Site C reservoir. It includes important archaeological evidence uncovered from the Site C construction area, which spans from 12,500 years ago until the recent past.

8 Litigation

The details of open proceedings as of March 31, 2021 are summarized in Table 12 below.

Table 12 Litigation Status Summary

Description		Date
B.C. Supreme Court: Treaty Infringement Claim		
West Moberly First Nations	Civil claim filed Injunction application filed Injunction hearing date Injunction denied (no appeal filed) Amended civil claim filed Scheduled trial date	January 15, 2018 January 31, 2018 July 23 to August 3, 2018 and September 4 to 7, 2018 October 24, 2018 September 25, 2019 March 2022
B.C. Supreme Court: Civil Claims		
Building and Construction Trades Council	Civil claim filed Response to claim filed No steps have been taken in litigation that require a response from BC Hydro.	March 2, 2015 April 10, 2015
Michael Acko, etal (residents of Old Fort community)	Civil claim filed Claim is being reviewed by legal counsel and a response will be filed in due course.	January 18, 2021
Allianz Global Risks US Insurance Company, etal	Civil claim filed Claim was filed by BC Hydro to preserve BC Hydro's rights to claim under the Site C property insurance policy.	February 5, 2021

Description		Date
B.C. Supreme Court: Civil Claims – Expropriation Act		
Joy Ross	Notices of claim filed to keep open plaintiffs' rights to claim further compensation under the *Expropriation Act*. Further appraisal and other reports are required prior to commencing settlement negotiations in all but one claim, where a further appraisal has been completed and settlement negotiations commenced. No requirement for BC Hydro to file responses at this time.	July 22, 2019
Chipmunk Holding Ltd., *et al*		July 22, 2019
Sam and Judy Mahood		July 22, 2019
Gordon and Heather Kelly		May 13, 2020
Derrek Beam		September 22, 2020
Ken and Arlene Boon		January 15, 2021
Caroline Bentley		January 15, 2021
Dale and Clara London		January 15, 2021
Carla Salmond		January 15, 2021
Lloyd Bentley, *et al*		January 15, 2021
Hudson's Hope Historical Society		March 18, 2021
Hudson's Hope Holdings Ltd.		March 26, 2021
Beverley and Bob Bach		March 26, 2021

9 Permits and Government Agency Approvals

9.1 Background

Before the Site C Project could start construction, an extensive environmental assessment process was undertaken which resulted in the issuance of the Provincial Environmental Assessment Certificate and the Federal Decision Statement in support of the Project. In addition, the Project is required to apply for multiple provincial permits, water licences, leaves to commence construction and federal authorizations. Timing of the application for these permits and authorizations is staged and aligned with the construction schedule, availability of detailed design information, and by Project component. Permitting approaches and requirements are also determined through regular meetings with regulatory agencies and are subject to change throughout the Project. As at March 31, 2021, BC Hydro estimates that approximately 600 permits will be required throughout the life of the Project. Of these permits, 481 have been received and are actively being managed.

Multiple conditions are attached to each permit or authorization, which cover subjects such as air quality, water quality, fish and aquatics, wildlife, heritage, health and safety, construction environmental management and First Nations consultation. As of March 31, 2021, all required conditions and submissions have been met in accordance with the schedule and requirements of the conditions.

9.2 Federal Authorizations

Federal authorizations are required under the *Fisheries Act* (Fisheries and Oceans Canada) and the *Navigation Protection Act* (Transport Canada). All major federal authorizations for construction and operation of the Site C dam and reservoir were received in July 2016. As of March 31, 2021, one additional *Fisheries Act* authorizations is anticipated for the temporary placement of fill material immediately downstream of the downstream cofferdam. Additional *Canadian Navigable Waters Act* (formerly *Navigation Protection Act)* approvals for discrete works in the reservoir

(e.g., shoreline works, debris booms and Highway 29 bridges) are anticipated to be issued at the regional level. As of March 31, 2021, a total of 95 federal approvals have been received and are actively being managed. Thirty future approvals are planned.

9.3 Provincial Permits

Site C requires provincial permits primarily under the *Land Act, Water Sustainability Act, Forest Act, Wildlife Act, Heritage Conservation Act,* and *Mines Act*. These permits include investigative permits, licences to occupy land, water licence approvals, leaves to commence construction and leaves to construct, and licences to cut vegetation, among others.

Approximately 475 provincial permits and approvals will be required throughout the life of the Project. As of March 31, 2021, 386 permits have been obtained and are actively being managed. These include permits for the dam site, worker accommodation, Highway 29 realignment, transmission line and eastern and middle reservoir clearing. Future provincial permits are being planned for western reservoir clearing and the remainder of the generating station construction, reservoir filling and operations. All future permits are anticipated to be issued in accordance with the Project construction schedule.

9.4 Environmental Assessment Certificate

Compliance with the Project conditions in the Environmental Assessment Certificate is regularly monitored, and evidence is collected by various federal and provincial regulatory agencies, the Independent Environmental Monitor, BC Hydro and contractors.

On March 16, 2021, BC Hydro submitted a draft Environmental Assessment Certificate amendment request to the Environmental Assessment Office regarding the use of haul trucks on a contingency basis to transport till material from 85th Avenue Industrial Lands to the dam site area. Prior to submitting the final

submission in June 2021, BC Hydro engaged with local governments, First Nations and local residents on the proposed activity and responded to concerns. A decision is expected in the fall of 2021. Hauling will comply with all requirements for the use of public roadways.

All amendments and amendment requests are posted on the Environmental Assessment Office website.

As with any large construction project, refinements to the design are expected. There are no material impacts to the cost of the Project as a result of the proposed amendment requests.

9.5 Permitting Improvement

To efficiently and effectively manage the large volume of permits required for the Project, BC Hydro continues to engage with regulators, Indigenous groups, and contractors to share information, seek feedback, and identify process improvements. Process improvements implemented in the quarter ending March 31, 2021 include the following:

- BC Hydro continues to facilitate meetings with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, the Comptroller of Water Rights, the Department of Fisheries and Oceans and contractors to ensure permit applications are coordinated, timely and sufficient;
- BC Hydro has implemented a coordinated Indigenous groups consultation process with the Ministry of Forest, Lands, Natural Resource Operations and Rural Development to assist with the government permit workload; and
- Regular permitting forums are being held with Indigenous groups to share information on upcoming permit applications and to seek feedback before applications are submitted to regulators. Given progress on provincial permit applications, smaller bundles of permits may also be reviewed with Indigenous

groups at Environmental Forums. Permits were discussed at two environmental forums held during this quarter: January 18, 2021 and March 9, 2021.

10 Environment

10.1 Mitigation, Monitoring and Management Plans

The Environmental Assessment Certificate and Federal Decision Statement conditions require the development of environmental management, mitigation and monitoring plans, as well as the submission of annual reports on some of these plans.

Focus remains on minimizing sediment and erosion across the dam site, care of water, hydrocarbon management and invasive weed control. Given the size of the Project and the length of construction, wildlife is becoming less wary of the site. As such, wildlife attractant management continues to be a focus.

On the left bank, all care-of-water systems performed well during spring melt, re-vegetation is established in many areas of the site, and the temporary fish passage facility was opened for the season as well as a contingency “trap and haul” program established.

On the right bank, the water treatment plant and holding ponds to treat potentially acid generating rock contact water were fully operational throughout the reporting period.

Throughout the winter, wildlife installations were paused and will resume this coming season. Wildlife sweeps of the area for any potential project interactions with burn piles and active construction continue regularly and appropriate mitigation or avoidance practices established. Burn piles with wildlife denning established are not ignited and will be addressed in the next burn season. A beaver radio telemetry study to track beavers affected by the winter 2020/21 head pond was completed with reporting of results expected in the next reporting period.

The Wildlife and Vegetation and Technical Committee has agreed that BC Hydro can use rehabilitation of aging wetlands as part of the overall wetland compensation program.

Air quality, water, noise and light monitoring were undertaken within the Hudson's Hope area related to works within the berm and along the truck haul route. Air quality overall for the region was observed to be problematic at times. However, point monitoring at the roadways and along the berm did not identify air quality exceedances coming from the Site C works. Additionally, noise monitoring along the roadways determined that Project related traffic noise was similar to ambient traffic noise. Environmental staff continue to monitor the area and work with inspectors from the Environmental Assessment Office.

Care-of-water systems within the till conveyor performed well over the reporting period.

10.2 Environmental Compliance Inspections and Enforcement

During the reporting period, the Project was inspected by the Independent Environmental Monitor and provincial regulators from the B.C. Environmental Assessment Office, who performed more than 430 hours of inspections.

Throughout the course of the onsite inspections, environmental compliance was focused on the following areas:

- Equipment spill/leak monitoring. BC Hydro continues to promptly identify the presence of leaks and spills on equipment and report the findings in daily logs. Further actions to address issues include continuing to utilize spill pads and drip trays, and monitoring of equipment with appropriate storage and disposal;
- Erosion prevention and sediment control along the River Road ditch line and a former main civil works contractor access road. Repairs have been completed along the River Road ditch line and temporary measures are being put in place

for the access road. BC Hydro continues to monitor and apply appropriate erosion and sediment control measures;

- Dust control and prevention within the Hudson Hope berm and Portage Mountain Quarry areas. BC Hydro continues to work with contractors regarding dust mitigation/monitoring and assessment of dust-generating activities. Such measures, currently in place, include usage of ‘skeleton’ buckets, water trucks, and the dispatch of a consulting occupational health and safety inspector to use a handheld device to measure dust; and
- Noise monitoring and control within the Hudson Hope berm area. BC Hydro has continued to work with the surrounding community regarding site specific details and have addressed any related issues.

BC Hydro completed over 9,000 environmental compliance inspections in the reporting period, with a compliant or partial compliant result of 99 per cent across all contractors and works areas.

Site C Project staff continues to meet with provincial regulators to ensure ongoing focus and attention to the areas of most importance and concern for the regulators, and to proactively address any environmental or regulatory issues that may arise.

Additionally, the Project has engaged both an Independent Environmental Monitor and an Independent Engineer that report directly to provincial regulators. The Independent Environmental Monitor provides weekly reports that have also demonstrated substantial compliance across the Project while continuing to identify areas of focus for sediment and erosion control, water management and spill prevention. The Independent Engineer works directly with site staff to proactively identify design issues that may impact the environment and develop mitigation plans to avoid or minimize impacts.

10.3 Heritage

In accordance with Environmental Assessment Certificate and Federal Decision Statement conditions, the Site C Heritage Resources Management Plan addresses the measures that will be used to mitigate the adverse effects of the Project on heritage resources.

In the period January to March 2021, the heritage program focused on reporting associated with the past year's activities, including field work that met regulatory requirements for pre-construction archaeological impact assessments and systematic data recovery at selected archaeological sites, as well as providing Project construction support.

Heritage reporting included the submittal of 10 archaeological interim reports and two archaeological annual reports for 2020 work to the B.C. Archaeology Branch and Indigenous groups in accordance with *Heritage Conservation Act* permit terms and conditions. One palaeontological chance find report for 2020 was submitted to the B.C. Archaeology Branch and the B.C. Heritage Branch. In addition, the Heritage Resources Management Plan 2020 Annual Report was submitted to regulators in accordance with Environmental Assessment Certificate and Federal Decision Statement conditions.

Heritage reviews of contract documents, contractor environmental plans and construction readiness plans, as well as construction-related field inspections at archaeological sites were performed to ensure compliance. Additionally, two heritage chance finds with significance were reported.

10.4 Agricultural Mitigation and Compensation Plan Framework

As part of the Site C Agricultural Mitigation and Compensation Plan, BC Hydro has established a $20 million BC Hydro Peace Agricultural Compensation Fund to support agricultural production and related economic activity in the Peace Region. The fund is governed by a regional decision-making board made up of

representatives from five regional agricultural organizations, the Peace River Regional District, three agricultural producer members-at-large and one Peace River Valley agricultural producer. Northern Development Initiative Trust is the fund administrator and manages the investment of the funds.

As of March 2021, $771,319 in funding has been approved for 33 projects. The Board established a grant budget of $750,000 for 2021. A second grant intake is planned for early fall.

11 Employment and Training Initiatives and Building Capacity Initiatives

11.1 Labour

To date, unions that have participated in the construction of Site C are listed in Table 13 below.

Table 13 Participating Unions

Union
Construction Maintenance and Allied Workers (CMAW)
Christian Labour Association of Canada (CLAC), local 68
Canada West Construction Union (CWU)
Construction and Specialized workers Union (CSWU), local 1611
International Union of Operating Engineers (IUOE), local 115
Millwrights Union local 2736
Ironworkers, local 97
International Brotherhood of Electrical Workers (IBEW)
MoveUP, local 378
Pile Drivers 2402
Boilermakers, lodge 359
United Association of Journeymen & Apprentices of the Plumbing & Pipefitting Industry of the U.S. & Canada, local 170
Teamsters, local 213

In addition, unions affiliated with the BC Building Trades will be working on the installation of the turbines and generators.

The labour approach for the Site C balance of plant contracts will be for the contractors to retain the Construction Labour Relations Association to enter into an agreement, with the Bargaining Council of B.C. Building Trades Unions or another consortium of Building Trades Unions that covers an agreed set of labour requirements.

11.2 Labour Update on Scaled Back Activities at Dam Site due to COVID-19 Pandemic

BC Hydro continues to provide updates to key project unions on site regarding information that is being shared with workers, the latest number of people in camp in isolation, and the status of COVID-19 testing results.

In late December 2020, the Provincial Health Officer posted the *Industrial Projects Restart Order* for several large-scale industrial camps to help slow down the number of workers returning to work following the holiday season.

For Site C, the maximum number of people that could be physically working at site in late January 2021 (both at camp and locally) was approximately 1,500 people.

In early January 2021, the Provincial Health Officer updated the *Industrial Projects Restart Order* to include the requirement for camp workers to remain in camp during their shift rotation. BC Hydro and its contractors are working with the workforce to implement this order. Exemptions are granted for work-related reasons, medical emergencies and critical appointments.

11.3 Employment

Contractors submit monthly workforce data electronically to BC Hydro. Table 14 presents the monthly number of construction contractors, non-construction contractors, engineers, and Project team workers for this period. As with any

construction project, the number of workers – and the proportion from any particular location – will vary month-to-month and also reflects the seasonal nature of construction work.

Table 14 Site C Jobs Snapshot Reporting Period – January 2021 to March 2021

Month	Number of B.C. Primary Residents[14]	Total Number of Workers[15]
January 2021	2,862	3,852
February 2021	2,840	3,877
March 2021	3,134	4,321

In March 2021, there were 4,321 total workers on the Site C project. Seventy-three per cent (3,134 workers) of the workforce was made up of residents of British Columbia, while 25 per cent (900 workers) of the workforce lived in the Peace River Regional District. The on-site contractor workforce number also includes 13 per cent women (474 workers) and 143 workers who are working for various contractors as apprentice carpenters, electricians, millwrights, ironworkers, mechanics, boilermakers and heavy equipment operators.

Figure 2 below shows the monthly Site C workforce over the period March 2020 to March 2021 and illustrates the impact of the COVID-19 pandemic on the workforce. The initial reduction of the workforce at site occurred in mid-March 2020 and the slow ramp up of the workforce started at the end of May 2020. The *Industrial Projects Restart Order*, which limited workers returning to site in January and

14 Employment numbers provided by Site C contractors and consultants are subject to revision. Data not received by the Project deadline may not be included in the above numbers. Employment numbers are direct only and do not capture indirect or induced employment.

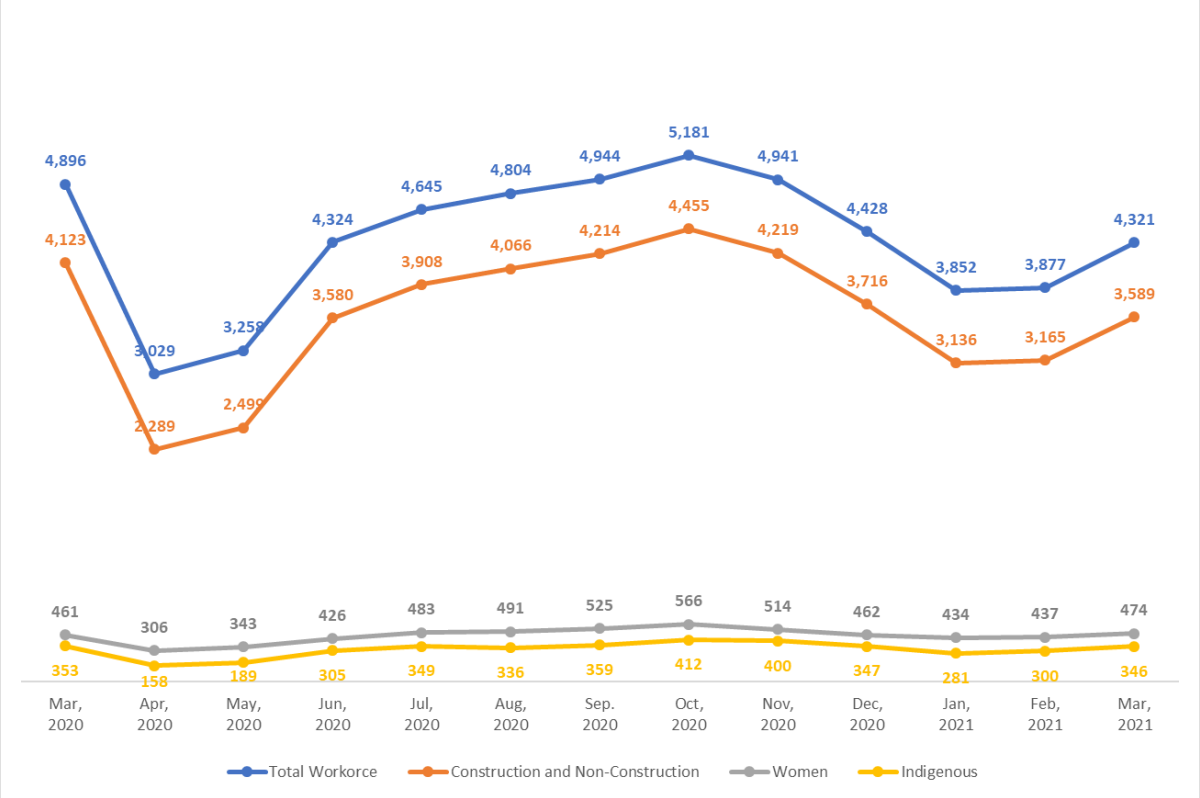
15 Total workers include:

- Construction and non-construction contractors performing work on Site C dam site, transmission corridor, reservoir clearing area, public roadwork, worker accommodation and services.
- Engineers and Project team that is comprised of both on-site and off-site workers.
- The Project team, which includes, BC Hydro construction management and other offsite Site C Project staff. An estimate is provided where possible if primary residence is not given.

February 2021, impacted the construction and non-construction workforce during the reporting period (January to March 2021).

Prior to COVID-19, BC Hydro had anticipated that 2020 would be one of the Project's peak workforce years. For the most important work months for the project (April to October), BC Hydro projected a total workforce of about 5,000 people for each of those months.

Figure 2 Site C Workforce March 2020 to March 2021



Note 1: The Indigenous and women numbers are a subset of the construction and non-construction contractors workforce number.

In October 2020, the total workforce peaked at 5,181, the highest number to date since the start of construction. With reduced occupancy in the worker accommodation due to COVID-19, Project contractors continue to maximize the

local workforce. In October 2020, there were 1,144 workers reported from the Peace River Regional District (26 per cent of the workforce), which is a peak number for the Project.

11.4 Training and Capacity Building Initiatives

In September 2017, the Contractors Labour Committee agreed to establish an Indigenous labour subcommittee. The purpose of the subcommittee is to support Indigenous training, labour and employment on Site C through communication, consultation, coordination and cooperation among contractors on the Project.

The committee meets quarterly, or on an as-needed basis. All major Site C construction contractors currently attend this meeting.

BC Hydro has included apprentice targets in the generating station and spillways civil works contract, the transmission lines and the substation contracts, the balance of plant contracts and the Highway 29 work to be procured by BC Hydro, as appropriate.

In August 2013, Northern Lights College Foundation started distributing the BC Hydro Trades and Skilled Training Bursary Awards. As of March 2021, a total of 274 students had received bursaries, including 122 Indigenous students who have benefitted from the bursary in programs such as electrical, welding, millwright, cooking, social work, and many others. BC Hydro has worked with the Northern Lights College Foundation to extend the bursary timeline and reserve a portion of bursary amounts for trades programs directly needed for Project work. Part of this agreement was to set aside funds for the BC Hydro and Northern Lights College pre-carpentry skills pilot program for Site C as well as other joint pre-skills programs. In March 2021, BC Hydro provided funds to the Northern Lights College Foundation to continue the bursary for an additional year.

BC Hydro continues to work with local employment agencies to ensure that as job opportunities become available, they are posted on the WorkBC website as well as on the Fort St. John Employment Connections website.

In February 2021, BC Hydro and key Site C contractors signed the BC Construction Association's Builders Code Pledge for an acceptable worksite. Signing this pledge jointly demonstrates the Project's commitment and belief that everyone has a right to be safe and protected at the worksite. This initiative between BC Hydro and Site C contractors demonstrates that inclusion, diversity and respectful workplace behavior is jointly valued on the Project.

Contractor Indigenous Employment and Training information Session

In February 2021, BC Hydro facilitated the sixth bi-annual Indigenous Employment and Information session with Site C contractors and employment and training representatives from the Treaty 8 First Nations (the session was held virtually due to COVID-19). In attendance were six site contractors, and representatives from seven different nations, as well as the North East Native Advancing Society and BC Hydro. The purpose of these meetings is to assist in building relationships between employment and training professionals from the Indigenous communities and key Site C contractors, as well as to share employment and training opportunities. Representatives from the Indigenous communities, BC Hydro and Site C contractors wanted to proceed with this forum even though they could not meet in person this year due to COVID-19.

Site C contractors have noted that certain trades will continue to be in high demand during peak Project construction periods. As such, in early 2020, major on-site contractors started exploring opportunities for apprentice and other training to take place on-site. Further in 2020, BC Hydro worked with Northern Lights College and Site C contractors to develop three on-site pilot programs. The programs included a new program with Northern Lights College designed for local Indigenous candidates

interested in becoming heavy equipment operators on the Site C Project, a re-launch of the Pre-Carpentry Skills Program with Northern Lights College, and a Fish Monitoring Program.

Both the pre-heavy equipment operator skills program and pre-carpentry skills program were postponed due to COVID-19. BC Hydro continues to monitor the situation for an appropriate time to proceed with these programs as well as looking at restructured options for smaller groups and online options. The BC Hydro and Northern Lights College Fish Monitoring Program was restructured and delivered off-site with additional COVID-19 safety protocols, was launched in August 2020, and is planned to be delivered again in 2021.

- **Fish Monitoring Program**

  This pilot program was scheduled to commence in late spring 2020 but was restructured to an off-site program and with additional training offered online. This was successfully delivery in August 2020, with eight participants completing the program. The program included workforce training certifications in preparation for employment opportunities on the Project.

- **Pre-Carpentry Skills Pilot Program at Site C**

  This pilot program was successfully delivered in April 2019 by BC Hydro and Northern Lights College. In 2019, seven Indigenous students from this program were hired for Project work by contractors on the Project, with two students entering an apprentice program to become journeyperson carpenters. Funding for this program was also provided through the North East Native Advancing Society and donations from the Construction Maintenance and Allied Workers. The intent of this program is to provide an overview of the skills required for the carpentry trade (essential skills training), general employment knowledge (employment readiness), overview of job requirements for carpenters,

knowledge of B.C.'s apprenticeship system, and Site C Project-specific knowledge.

- **Pre-Heavy Equipment Operator Skills Pilot Program at Site C**

  This course focuses on preparing individuals who have prior heavy equipment operator training for employment opportunities on BC Hydro's Site C Project with its contractors. Funding for this program was to be provided through the North East Native Advancing Society and donations from the Christian Labour Association of Canada (**CLAC**), local 68. Both the carpentry and the pre-heavy equipment operator programs were designed as 14-day programs for local new workers or workers new to the trade with preference given to local Indigenous candidates. The courses were to be partly run at the worker accommodation lodge and the 14 days were intended to reflect a typical Site C schedule.

12 Community Engagement and Communication

12.1 Local Government Liaison

There are a number of Environmental Assessment Certificate conditions that are relevant to local communities in the vicinity of the Project. BC Hydro is implementing some of these conditions through community agreements offered to five local governments. Through these agreements and discussions, BC Hydro has, in some instances, agreed to additional measures to address concerns about local community impacts from construction and operation of the Project. BC Hydro provided update emails at a frequency agreed upon with the Regional Community Liaison Committee regarding actions taken to respond to the pandemic and, in 2020, launched a Site C COVID-19 website for public information. Biweekly calls continued through the reporting period with the Regional Community Liaison Committee to continue to engage with local governments and Indigenous groups in partnership with Northern Health and Emergency Management B.C.

BC Hydro has concluded four community agreements with respect to the Project: The District of Taylor (2013), the District of Chetwynd (2013), the City of Fort St. John (2016) and the District of Hudson's Hope (2017). BC Hydro and the City of Fort St. John established a Community Agreement Monitoring Committee to jointly oversee implementation of the community agreement. BC Hydro and the Peace River Regional District advanced negotiations through exchanging supporting information during this period and staff have worked to implement some of the mitigation measures for the Charlie Lake Wastewater outfall. Subsequent to the reporting period, BC Hydro provided a comprehensive response to the Peace River Regional District on April 9, 2021, addressing all the issues raised by the Peace River Regional District in 2020 and early 2021. There is a significant gap between the payments proposed by the Peace River Regional District and what BC Hydro has offered based on an analysis of direct specific impacts due to Site C and the existing environmental assessment certificate conditions.

The Regional Community Liaison Committee, which is comprised of local elected officials and local First Nations communities, most recently met virtually on March 17, 2021. Eight local governments and four local First Nations communities (McLeod Lake Indian Band, Doig River First Nations, Saulteau First Nations and Blueberry River First Nations) as well as the two MLAs for Peace River North and Peace River South, are invited to participate as committee members. Representatives from the Project's major contractors may also attend the meetings as invited guests.

As part of the Site C Project, BC Hydro is working with communities to provide lasting benefits for residents of the Peace Region. In 2016, BC Hydro launched the GO Fund, an $800,000 fund to support Peace Region non-profit organizations. The GO Fund is being distributed over an eight-year period to organizations that provide services to vulnerable populations including children, families and seniors.

The GO Fund is administered by Northern Development Initiative Trust on behalf of BC Hydro. During this reporting period, BC Hydro distributed $10,000 to one non-profit organization in the Peace Region and as of March 31, 2021, nearly $505,000 had been distributed to 57 projects since the fund was launched in 2016.

12.2 Business Liaison and Outreach

BC Hydro continued to implement its Site C Business Participation Plan, which supports local and regional business participation in the project. The Project team sent out four procurement notifications to the Site C business directory in the first quarter of the year.

12.2.1 Community Relations and Construction Communications

Throughout the reporting period, BC Hydro continued to implement its construction communications program. The program includes updating and maintaining the Project website (www.sitecproject.com) with current information, and photos and

videos of construction activities, as well as providing information to local and regional stakeholders as required.

Due to COVID-19 restrictions, the Site C community relations team has not hosted any external site tours since before the beginning of the pandemic.

Construction Bulletins

Bi-weekly construction bulletins continued to be issued throughout the reporting period. These bulletins are posted on the Project website and sent by email to the web-subscriber list. There were six construction bulletins and one quarterly construction notification letters issued in the first quarter of 2021.

Public Enquiries

In total, BC Hydro received 236 public enquiries between January 1 and March 31, 2021. The majority of these enquiries continued to be about business and job opportunities, with limited construction impact concerns from local residents. Table 15 shows the breakdown of some of the most common enquiry types.

In total, BC Hydro has received more than 12,700 enquiries since August 2015.

Table 15 Public Enquiries Breakdown

Enquiry Type[16]	January 1 to March 31, 2021
Job Opportunities	75
Business Opportunities	41
General Information	53
Construction Impacts[17]	32
Other[18]	35
Total	**236**

16 This table is a sample of enquiry types and does not include all enquiry types received.

17 The nature of the construction impact inquiries is primarily air quality, noise and traffic conditions.

18 "Other" accounts for enquiries related to a variety of other topics, such recreation access near construction sites, property owner correspondence, or requests for site tours.

12.2.2 Communications Activities

Based on a search using the media database Infomart, there were 370 stories about the Site C Project in B.C. news media between January 1 and March 31, 2021.

12.3 Labour and Training Plan

In accordance with an Environmental Assessment Certificate condition, a Labour and Training Plan was developed and submitted to the Environmental Assessment Office on June 5, 2015. This plan, as well as Environmental Assessment Certificate Condition 45, includes reporting requirements to support educational institutions in planning their training programs to support potential workers in obtaining Project jobs in the future. This report was issued to the appropriate training institutions in the northeast region of B.C. in July 2016, July 2017, July 2018, July 2019 and September 2020. The next report will be issued in summer/fall 2021.

12.4 Human Health

12.4.1 Health Care Services Plan and Emergency Service Plan

The Project health clinic is contracted by BC Hydro with Halfway River International SOS Medical Ltd., a partnership between Halfway River First Nation and International SOS. The clinic continues to operate in its permanent location within the Two Rivers Lodge and based on camp occupancy was staffed 24/7 during this period with a nurse practitioner and advanced care paramedics. BC Hydro and the clinic operator continue to liaise with the local health care community.

The clinic provides workers with access to primary and preventative health care and work-related injury evaluation and treatment services and is currently open seven days a week, 24 hours a day. Since opening the health clinic, there have been a total of 23,541 patient interactions. During the first quarter of 2021, there were 1,938 patient interactions, of which 225 were occupational and 1,713 non-occupational. Several preventive health themes were promoted to workers including smoking awareness; influenza, cancer, the stress and

transmission of the COVID-19 virus, COVID-19 variants and vaccination and aftercare.

12.5 Property Acquisitions

In spring of 2021, BC Hydro secured the last of the remaining land rights required for the remaining highway re-alignment segments (Lynx Creek and Farrell Creek East). BC Hydro also successfully negotiated several land acquisitions for other Project components to enable reservoir clearing and inundation.

13 Plans During Next Six Months

As announced by the Government of B.C. on February 26, 2021, the revised cost estimate to complete Site C is $16 billion and includes a new expected in-service date of 2025, as a result of the delays and impacts of the pandemic. BC Hydro continues to review the schedule, work closely with contractors to understand the costs and schedule impacts due to COVID-19, and review risks consistent with the recommended actions in the Milburn Review. Based on the current expected schedule, Table 16 below shows the key milestones for activities planned during the next six months, April 2021 to September 2021.

Table 16 Key Milestones for Activities Planned During the Next Six Months (April 2021 to September 2021)

Milestone	Current Expected Schedule[19]
Generating Station and Spillways	
Unit 4 – Unit bay superstructure complete and powerhouse bridge crane ready	April 2021 (complete)
Unit 5 – Unit bay superstructure complete and powerhouse bridge crane ready	June 2021
Contract Award – Balance of plant mechanical	July 2021
Unit 6 – Unit bay superstructure complete and powerhouse bridge crane ready	August 2021
Contract Award – Balance of plant electrical	September 2021
Main Civil Works	
Complete all the work for the closure section of the upstream cofferdam to elevation 433.9 m	April 2021 (complete in March 2021)
Roller-compacted concrete buttress complete	September 2021
Turbines and Generators	
Unit 1 – Stay ring and spiral case assembled and handover of generator embedded parts	June 2021
Unit 2 – Stay ring and spiral case assembled and handover of generator embedded parts	September 2021
Right Bank Foundation Enhancements	
Commence pile installation at the spillway	August 2021

14 Impacts on Other BC Hydro Operations

During the reporting period, the operation of system storage at Williston Reservoir (including GM Shrum and Peace Canyon powerplants) was planned to meet flow releases necessary for Site C construction, and this operation continues. Water releases from Peace Canyon Generating Station were maintained at or below the levels necessary for Project construction. BC Hydro maintained adequate vacant

[19] Once the current expected schedule is finalized and approved, BC Hydro will report on the performance measurement baseline, control budget, forecast and current status.

storage in Williston Reservoir to protect Site C construction works from flows that could otherwise exceed the capacity of the diversion works.

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Appendix A

Site Photographs

Figure A-1 **An aerial view of the Site C penstocks and intakes under construction (January 2021)**

Figure A-2 **Halfway River bridge construction where the final girders will connect pier 12 to the eastern bridge abutment (January 2021)**

Figure A-3 **Unit 1 turbine runner arrives at Site C after travelling from Sao Paulo, Brazil, by ship to Prince Rupert, and transported on a customized truck to the project site (January 2021)**

Figure A-4 **Construction of the shoreline protection at Hudson's Hope (January 2021)**

Figure A-5 **Powerhouse steel superstructure construction. The powerhouse construction also includes concrete placements at the powerhouse, intakes and spillways, and the installation of penstock segments. (February 2021)**

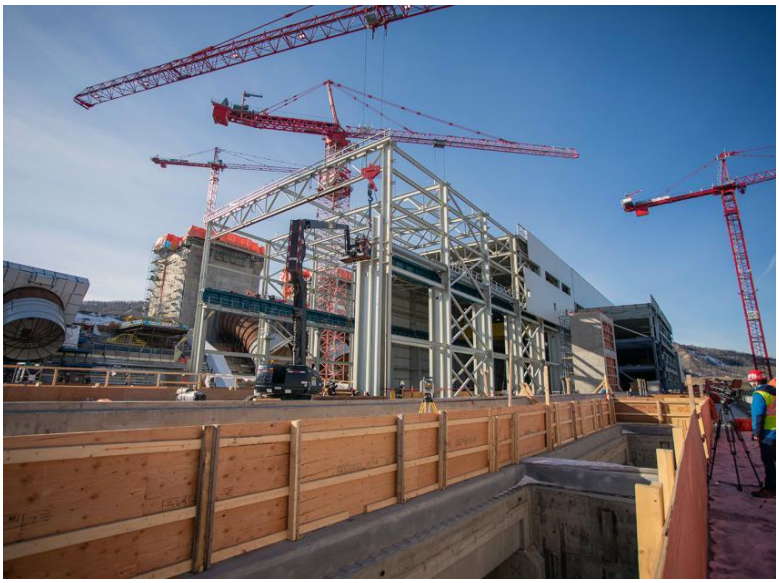

Figure A-6 **Crews have commenced installation of the turbine-embedded components for Units 1 and 2 inside the powerhouse. The Unit 1 draft tube cone and thrust ring are being prepared for installation (February 2021)**

Figure A-7 **The upstream and downstream cofferdams, which divert the Peace River through the two diversion tunnels (February 2021)**

Figure A-8 **Intake Units 1 and 3 are nearing completion as part of the ongoing powerhouse construction (February 2021)**

Figure A-9 Crews install the Unit 2 turbine pit elbow liner (March 2021)

Figure A-10 Girder installation is complete, and workers remove scaffolding from the Halfway River bridge (March 2021)

Figure A-11 **Main service bay and operations building (March 2021)**

Figure A-12 **The last of 205 transmission towers on the second transmission line was completed at the end of March – eight months ahead of schedule (March 2021)**

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Appendix B

Work Completed Since Project Commencement in 2015

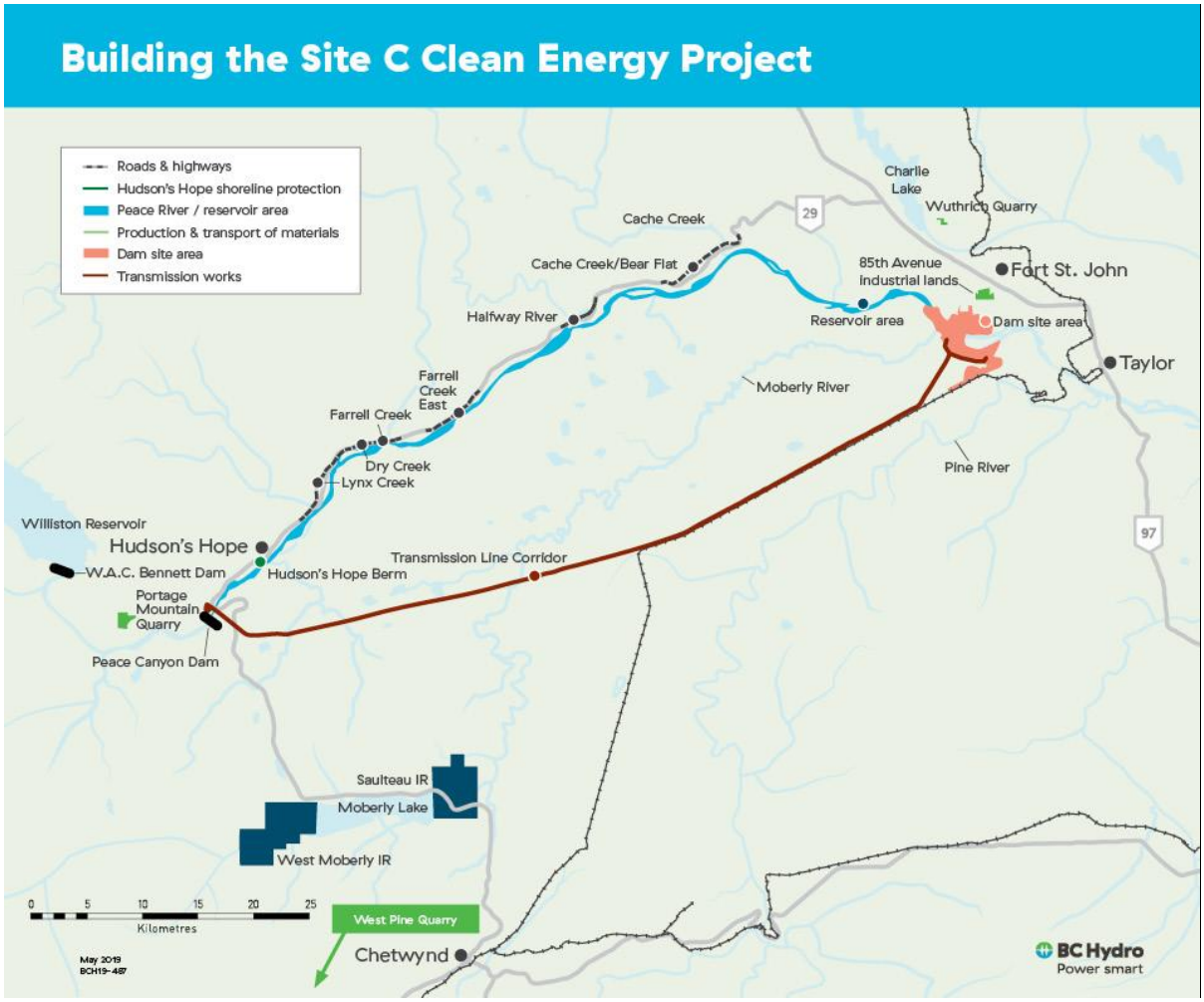
Appendix B: Work Completed Since Project Commencement in 2015

Construction began on July 27, 2015 and is ongoing. Since the commencement of construction, the following work has been completed:

- Site preparation, including on-site access roads;
- Clearing of the left and right banks at the dam site and clearing of the lower reservoir area;
- Construction of the worker accommodation lodge and Peace River construction bridge;
- Powerhouse excavation, and placement of 414,000 cubic metres of roller-compacted concrete in the powerhouse buttress;
- Spillways excavation, and the placement of 586,000 cubic metres of roller-compacted concrete in the spillways buttress;
- Construction of dam site access public roads;
- Construction of the Site C viewpoint;
- Excavation of the diversion tunnel inlet (upstream) and outlet (downstream) portals, allowing for the commencement of diversion tunnel excavations;
- Excavation of the right bank drainage tunnel, which will be used to monitor and drain the water from within the foundation under the powerhouse, spillways and dam buttresses and will eventually be connected to services within the powerhouse;
- Completion of two river diversion tunnels, which are used to reroute a short section of the Peace River to allow for the construction of the main earthfill dam;

- Completion of the upstream and downstream cofferdams;
- Construction and commissioning of the temporary fish passage facility;
- Diversion of the Peace River around the Site C construction site;
- Completion of the Peace Canyon 500 kV gas-insulated switchgear expansion to enable connection of Site C to the BC Hydro electrical system;
- The completion of the Site C substation and first of two new 500 kV transmission lines;
- Clearing activities in the lower reservoir;
- Fish habitat enhancements downstream of the dam site; and
- The completion of 50 affordable housing units in Fort St. John.

Figure B-1 Site C Project Components



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Appendix C

Safety and Security

The following safety incidents occurred during the quarter from January 1, 2021 to March 31, 2021:

Serious Safety Incidents

The five serious incidents that occurred during this reporting period include:

1. Cord reel fell from the overhead door in the main service bay area;
2. A worker was observed standing inside an operating conveyor hopper;
3. A worker slipped, fell and fractured their tibia, resulting in a lost time incident due to the need for surgery;
4. While a guyed transmission tower was being lifted, a 7.7 kg wedge block fell within the work area zone from 18 metres above; and
5. A ventilation system failure within the left bank drainage adit, resulted in silica exposure to exceed occupational exposure limits. Workers who may have exposed to higher levels of silica were encouraged to record the incident with WorkSafeBC for possible future claims.

All Injury Incidents

The 12 injury incidents that occurred during this reporting period include one lost-time injury and 11 medical attention requiring treatment injuries. Note that serious incidents resulting in an injury will be listed in both the list of serious incidents and the list of All Injury Incidents.

Lost time injury:

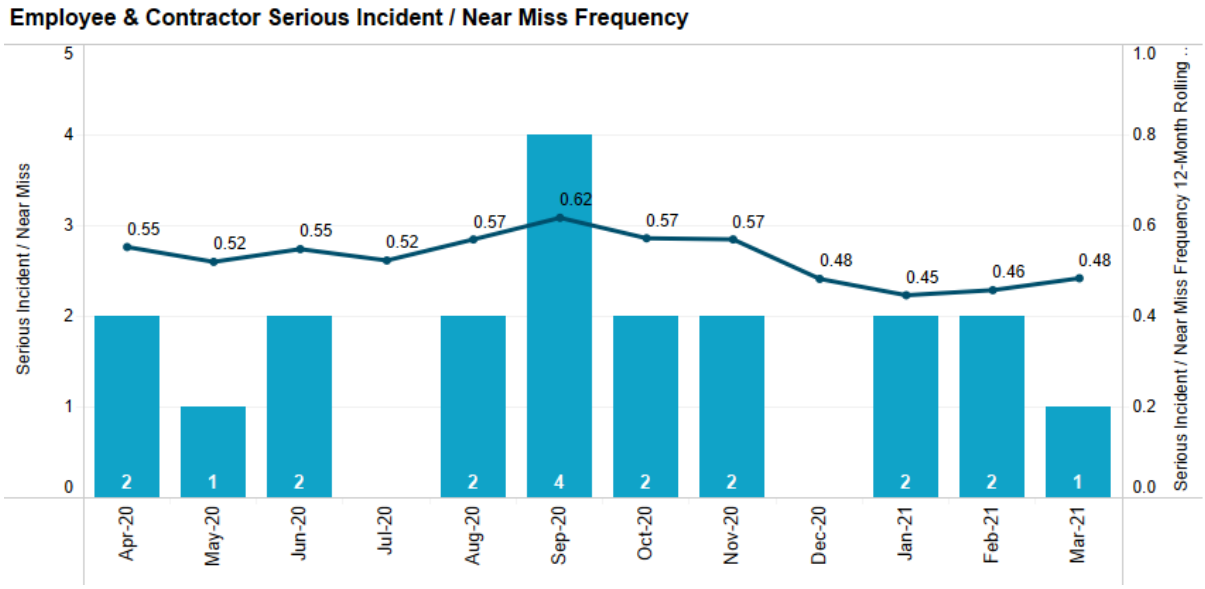
1. A worker slipped, fell and fractured their tibia resulting in lost time due to required surgery.

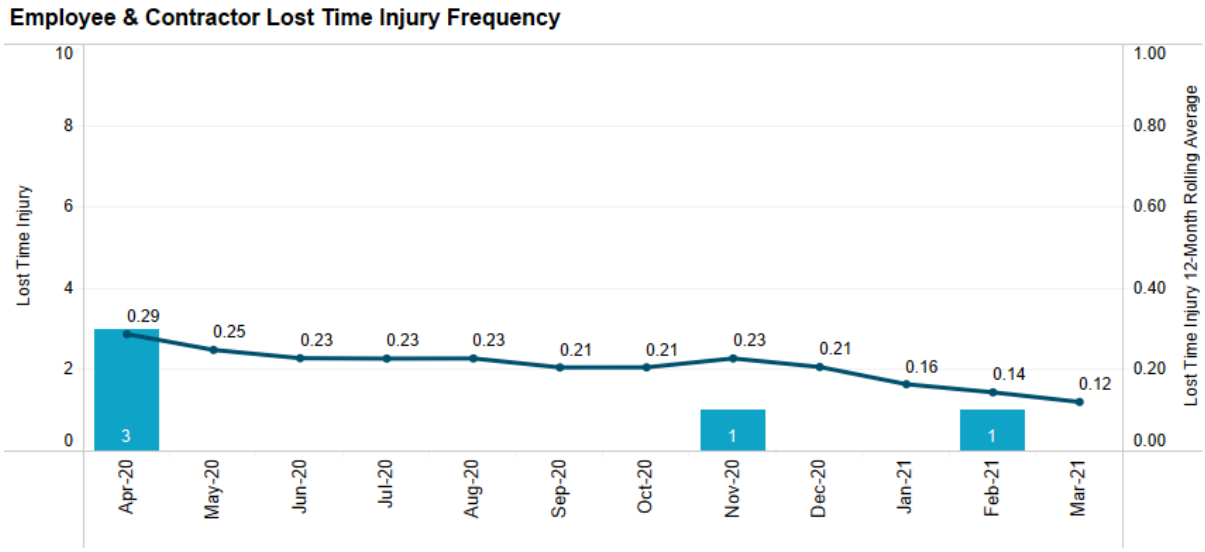
Medical attention requiring treatment injuries:

1. A worker pinched their finger when a tool slipped. The worker suffered a laceration;
2. A worker pinched their finger when a tool slipped. The worker suffered a laceration;
3. A worker slipped and their head contacted the blade of a grader. The worker suffered a laceration;
4. A worker accidently triggered the pressure water hose and suffered a laceration to their shin;
5. A worker lost their footing on rebar then fell and suffered a laceration to their hand;
6. A worker slipped on ice and their knee contacted the running board of a light duty truck. The worker suffered a laceration;
7. A worker slipped while descending on scaffold stairs and dislocated their shoulder;
8. A worker pinched their finger between two panels. The worker suffered a laceration;
9. A worker's tool slipped and cut their hand;
10. A worker's hand got caught between a seat band and wheel hub and the worker suffered an injury to their finger;
11. A worker was pulling nails from a piece of lumber punctured their finger by a tie wire; and
12. A metal dumpster lid suddenly closed and worker fractured their hand.

Figure C-1 below provides information on employee and contractor serious incidents/near miss frequency, lost time injury frequency and all-injury frequency from January 1, 2021 to March 31, 2021.

Figure C-1 Employee and Contractor Serious Incidents/Near Miss Frequency, Lost Time Injury Frequency and All-injury Frequency





Employee & Contractor All-Injury Frequency

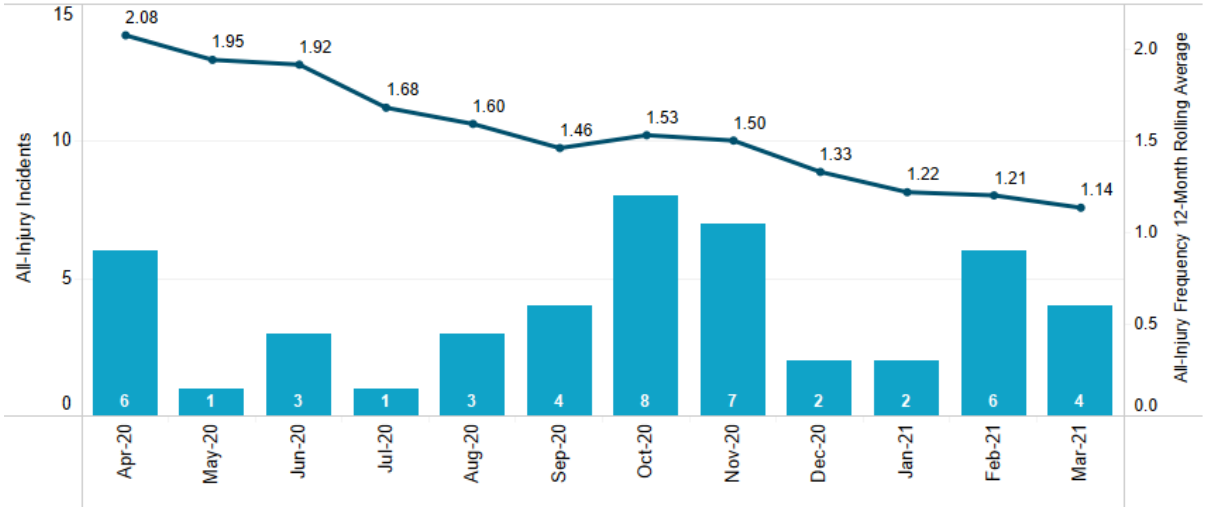


Table C-1 lists the safety regulatory inspections and orders received from January 2021 to March 2021.

Table C-1 Safety Regulatory Inspections and Orders

WorkSafeBC

Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
Inspection #1: WorkSafeBC conducted an inspection on the washroom facilities provided by the general contractor for the generating station and spillways structural works of the hydroelectric dam construction project. Washroom facilities: the temporary washroom facility (wash cart) provided at the intake work location was subject to a freeze cycle resulting in an overflow condition. It was stated that the exterior water line froze and backed-up water into the interior portion of the wash cart. The employers service department conducted the necessary repairs, performed initial clean-up, and sanitized the wash cart. There wasn't any septic and/or effluent involved in the overflow condition. Further, clean-up/sanitation of the wash cart was provided by a third-party contractor. It was also noted that the sites additional temporary washroom facilities located at various locations are to be continually monitored and maintained during the extreme cold temperatures (-30 C to -45 C) that were being experienced in the region at the time.			
		No Orders	February 16, 2021

Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
Inspection #2: WorkSafeBC conducted an inspection as part of the 2021-2023 Construction High Risk Strategy. WorkSafeBC's primary goal is prevention of injuries and prevention of serious/fatal injuries in the construction industry. The Construction High Risk Strategy will focus on four risk areas: 1. Falls from elevation inspections will focus on adequate controls to prevent falls from elevation. 2. Struck by inspections will focus on mechanism of injury as related to mobile equipment work activities. 3. Contact with electricity high voltage limits of approach inspections will focus on hierarchy of controls, 30M33 assurance in writing, worker education and training, work arrangements and procedures. 4. Musculoskeletal injury inspections will focus on high potential for time-loss injuries from some repetitive, poorly planned out tasks (material handling), employer must identify potential for musculoskeletal injury inspections (risk assessment), controls to mitigate risk, over exertion and repetitive strain injury.			
		No Orders	February 16, 2021
Inspection #3: WorkSafeBC contacted the contractor via telephone as a result of a reported incident. The incident resulted in the inadvertent slip and fall to the same elevation, resulting in contact with the ground surface. Minor injury was reported.			
		No Orders	February 23, 2021
Inspection #4: WorkSafeBC contacted the contractor via telephone as a result of a reported incident. The incident involved injury of a worker. A worker who was operating an excavator exited the cab to assist a mechanic conducting repairs to the bucket, accessed onto a frozen compacted snow-covered area, and slipped resulting in a fall to the ground.			
Low risk	Accident Reporting and Investigation	**Order #1 - WCA68(1)(a):** The contractor failed to immediately notify the board of the slip and fall accident that resulted in a serious injury to a worker.	February 23, 2021
Inspection #5: WorkSafeBC conducted an inspection on the general work activities taking place at the time of the inspection which included tower/mobile crane operation, mobile equipment uses, formwork assembly, steel erection, reinforcing steel installation, concrete preparation / placement, and scaffold erection. During the inspection, health and safety items were discussed, including access and egress, indoor air quality, hazardous substances and processes, fall protection systems, first aid facilities and equipment and general.			
		No Orders	February 24, 2021

Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
Inspection #6: WorkSafeBC conducted an inspection to review the contractor's response to the current COVID-19 pandemic in relation to worker health and safety at the workplace. To date, the contractor has implemented the following controls at the workplace to prevent and/or mitigate the risk of contracting COVID-19: • Project and site-specific access screening temperature/questionnaire • A detailed COVID-19 safety plan • Digital touchless sign in procedures and practices via phone app • Daily health check incorporated, with workers required to self-monitor for COVID-19 symptoms, and report symptoms or possible exposure of a suspected or confirmed case to their supervisor • Plexiglass dividers at the reception area to protect workers when social distancing cannot be maintained • Masks are mandatory at all times for workers and visitors on the Project • Hand sanitizer stations and additional wash carts are available at access points throughout the Project • Custom built cubicles incorporated physical barriers to create separation in lunchroom • Additional space for personal items to hang prior to entering lunchroom • Custom exterior phone booth type separation dividers available for workers • COVID-19 physical distancing signage, markers are posted throughout the project • COVID-19 measures are communicated to workers and supervisors • Enhanced cleaning protocols in place			
		No Orders	February 24, 2021
Inspection #7: WorkSafeBC attended the workplace as a result of an incident that involved the release of a large quantity of vermiculite insulation. The employer stated that a garbage truck contacted the outside wall of the building causing a cinder block wall to release vermiculite insulation. The employer removed all staff from the area and contacted an abatement contractor to remove and safely contain any remaining vermiculite. The employer has taken steps to properly address this hazardous material and is being given two directive orders to ensure the health and safety of its staff.			
Low Risk	Procedures	**Order #1 – OHS6.8(1):** BC Hydro is directed to ensure that the vermiculite is removed and further contained in accordance with procedures developed by a qualified person and implemented by a qualified contractor.	February 26, 2021

Risk Level	Theme	Inspection Reports and Orders Received	Date of Inspection
Low Risk	Hazard materials	**Order #2 - OHS20.112(8):** BC Hydro is directed to have an assurance in writing completed to verify that the vermiculite has been properly removed and contained and ensure that asbestos fibres are below the allowable limit.	
Inspection #8: WorkSafeBC contacted the contractor as a result of a reported COVID-19 transmission to workers at the Project. The Provincial Health Officer (Northern Health Authority) representatives, BC Hydro and worker accommodation contractor were notified of a reported COVID-19 transmission to workers at the Project and conducted a joint review with the contractor. Conditions and/or gaps with the employer's COVID-19 response plan were reviewed to determine findings that may be deficient with the Provincial Health Officer orders and/or contractor's practices at this time. The contractor continues to undertake a full investigation to determine the cause or causes, identify any conditions, acts or procedures that significantly contributed to the transmission, and if gaps and conditions, acts or procedures are identified, determine the corrective action necessary to prevent the recurrence of similar transmission.			
		No Orders	March 23, 2021
Inspection #9: WorkSafeBC conducted an inspection on March 26, 2021 following a reported crane incident involving a described minor contact between a tower crane and mobile crane in the spillway area. The preliminary causation is when the tower crane slewed into the overlap zone resulting in the tower crane jib trolley sheave to contact and sever the mobile crane's communications lines affixed to the extended boom.			
Low Risk	Certification following incident	**Order #1 - OHS14.16(2):** The contractor failed to remove the tower crane from service until a professional engineer had certified it was safe for use, following the incident**.**	March 26, 2021
Inspection #10: WorkSafeBC responded a report from the contractor as a result of an incident that involved the potential for a serious injury to a worker.			
		No Orders	March 31, 2021

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Appendix D

Workforce Overview

Table D-1 Current Site C Jobs Snapshot (January 2021 – March 2021[20]

	Number of B.C. Workers and Total Workers	Construction and Non-construction Contractors[21] (including some Subcontractors). Excludes Work Performed outside of B.C. (e.g., Manufacturing)	Engineers and Project Team[22]	Total
January 2021	BC Workers	2,197	665	2,862
	Total Workers	3,136	716	3,852
February 2021	BC Workers	2,181	659	2,840
	Total Workers	3,165	712	3,877
March 2021	BC Workers	2,457	677	3,134
	Total Workers	3,589	732	4,321

Employment numbers provided by Site C contractors are subject to revision. Data not received by the project deadline may not be included in the above numbers.

BC Hydro has contracted companies for major contracts, such as main civil works, who have substantial global expertise. During the month of March 2021, there was one worker in a specialized position working for Site C construction and non-construction contractors, which were subject to the Labour Market Impact Assessment process under the Federal Temporary Foreign Worker Program. Additionally, there were 28 management and professionals working for Site C construction and non-construction contractors through the Federal International Mobility Program.

20 Employment numbers are direct only and do not capture indirect or induced employment.

21 Construction and non-construction contractors total workforce employment number includes work performed on the Site C dam site, transmission corridor, reservoir clearing area, public roadwork, worker accommodation and services.

22 Engineers and Project team are comprised of both on-site and off-site workers. The Project team includes BC Hydro construction management and other off-site Site C project staff. An estimate is provided where possible if primary residence is not given.

Table D-2 Preliminary Site C Apprentices Snapshot (January 2021 to March 2021)

Month	Number of Apprentices
January 2021	100
February 2021	123
March 2021	143

Data is subject to change based on revisions received from the contractors.

Table D-3 Current Site C Job Classification Groupings

Biologists and laboratory	Carpenters	Inspectors	Construction managers/ supervisors	Crane operators	Electricians	Engineers
Foresters	Health care workers	Heavy equipment operators	Housing staff	Heating, ventilation, and air conditioning	Kitchen staff	Labourers
Mechanics	Millwrights	Office staff	Pipefitters	Plumbers	Sheet metal workers	Truck drivers
Underground mining	Welders	Surveyors	Security guards	Boilermakers	Cement Masons	Crane Operators
Ironworkers						

Table D-4 Indigenous Inclusion Snapshot (January 2021 to March 2021)

Month	Number of Indigenous Workers
January 2021	281
February 2021	300
March 2021	346

The information shown has been provided by BC Hydro's on-site[23] construction and non-construction contractors and their subcontractors that have a contractual requirement to report on Indigenous inclusion in their workforce.

[23] On-site includes work performed on Site C dam site, transmission corridor, reservoir clearing area, public roadwork, worker accommodation and services.

Employees voluntarily self-declare their Indigenous status to their employer and there may be Indigenous employees that have chosen not to do so; therefore, the number of Indigenous employees may be higher than shown in the above table.

As with any construction project, the number of workers, and the proportion from any particular location will vary month-to-month and reflects the seasonal nature of construction work. The number of workers will also vary as a contract's scope of work is completed by the contractor.

Women

In March 2021, there were 474 women working for Site C construction and non-construction contractors. The number of women was provided by on-Site construction and non-construction contractors and engineers that have a contractual requirement to report on the number of women in their workforce.

BC Hydro
Power smart

Site C Clean Energy Project

Quarterly Progress Report No. 21

Appendix E

Technical Advisory Board and Technical Review Panel Reports

PUBLIC

Site C Technical Review Panel

[redacted]

REPORT NO. 1
January 22, 2021

EXECUTIVE SUMMARY

The Project Team has, with the support of the independent Technical Advisory Board, decided on the installation of drilled piles downstream of the powerhouse and spillway structures as the preferred right bank foundation enhancement approach. In our opinion, the proposed approach is sound and capable of making the right bank structures both safe and serviceable, however, several details still need to be addressed in the analysis and design. The Project Team is currently progressing the analyses and designs to address these details, and we look forward to reviewing the work as it progresses.

Significant investigations of the right abutment at Site C were completed during the pre-design and design phases of the project, and additional investigations have been completed after the observation of unexpected movements in the right abutment during excavation. The additional investigations showed that there are low strength, persistent bedding planes even deeper in the foundation than anticipated. The investigations, analyses, and evaluations have been and are being completed following current best professional practice methods. In our opinion, the available information, in combination with information being developed from on-going investigations and evaluations, provides adequate data for the design of the foundation enhancements.

Drilled piles were selected as the preferred foundation enhancement after consideration of a range of possible options and completion of a multiple accounts analysis to compare alternatives. We are not aware of any appropriate structural foundation enhancement alternatives that were not considered in this evaluation, and the selection of the drilled pile alternative is reasonable and well supported.

As part of the design development for the foundation enhancement, the final pile system configuration will be optimized, after final selection of design and performance criteria. We look forward to reviewing the optimization work.

INTRODUCTION

Data from geotechnical instrumentation for the Site C Project has indicated that the right bank foundation has lower strengths and stability than anticipated in the original design, and that remedial measures are required.

Hydroelectric projects are considered low risk – high consequence structures. BC Hydro has concluded that the subsurface movements, and related potential instabilities, that have been

identified on the right bank pose undue risks. Certain foundation enhancements have been proposed by the Project Team to address these risks.

The Technical Advisory Board (TAB) for the project has been involved in the development of the remedial measures. Nevertheless, given the scope, cost and schedule implications of the proposed remedial measures, the Project Assurance Board (PAB) has decided to have an additional Third-Party Due Diligence Review undertaken of the proposed remedial measures. That review is being completed by a Technical Review Panel (Panel) composed of two individuals: [redacted] of the United States and [redacted] of Norway. The Panel has been tasked with reviewing the following aspects of the work being completed by the Project Team:

- The characterization of the rock and the properties of the rock mass, bedding planes, shears, etc.
- The design of the seepage control measures in and under the approach channel.
- The water loads assumed in the rock given the seepage control measures.
- The multiple accounts evaluation leading to the selection of piles as the preferred enhancement.
- The results of the field trials to determine the lateral pile load/deflection characteristics.
- The methods of analysis being used to estimate the behaviour of the completed works on the right bank, including stability and deformations under the range of expected normal loads to extreme loads, and unanticipated performance of the seepage control measures.
- The acceptance criteria proposed for normal and extreme loads, including target factor of safety and displacement thresholds.
- The methods used to translate the results of the factor of safety based geotechnical analyses to the structural requirements for the piles, considering applicable limit states and structural codes.
- The process to be used for optimization of the number, size, and spacing of the piles and the resulting optimized configuration.

BC Hydro further asked the Panel to address the following six questions:

1. Do the geotechnical investigations completed to date, coupled with the information from the geotechnical instrumentation at the site and the proposed field-testing program, provide adequate data on which to base the design of the foundation enhancements?
2. Is the proposed approach to the right bank foundation enhancements capable of making the right bank structures:

a) safe – i.e. meet the Canadian Dam Association Dam Safety Guidelines and stability requirements set out in the Project Design Basis[1] provided by BC Hydro?
b) serviceable – i.e. displacements and deformations within the limits set out in the Project Design provided by BC Hydro?

3. Is the proposed approach to optimization of the right bank foundation enhancements (number, size and spacing of piles) capable of resulting in a cost-effective solution that can accommodate any reasonably foreseeable geological conditions encountered during construction? Are there any value engineering considerations that could be included in the design program?
4. Is the proposed approach to estimating, scheduling and procuring the enhancements reasonable? Are there other things that could be considered that would increase the level of confidence in the cost estimate prepared by BC Hydro?
5. Were the engineering attributes considered in the multiple accounts evaluation thorough?
6. Are there any other foundation enhancement measures that could have been considered?

Work completed by the Panel to date includes participation in introductory Project Team briefings to the Panel, participation in web-based Project Team briefings to the TAB, participation in web-based discussion sessions with the Project Team, review of documents provided to the Panel by the Project Team, Panel Team discussions, and preparation of this report.

FINDINGS

The analysis and design work related to the planned foundation enhancements for the right abutment of Site C is still in progress at the time of preparation of this report. In the remainder of this section, the Panel provides its initial responses to the six questions posed by BC Hydro based on the information that has been presented to the Panel to date. The Panel's responses to the six questions will be updated in future reports based on further work to be done by the Project Team.

[1] As amended to:
1. Update foundation properties based on recent investigations, including lateral pile tests.
2. Update the sliding stability analysis for the right bank including geological model, load cases, method, and criteria.
3. Specify design approach and acceptance criteria.

1. *Do the geotechnical investigations completed to date, coupled with the information from the geotechnical instrumentation at the site and the proposed field-testing program, provide adequate data on which to base the design of the foundation enhancements?*

   In our opinion, yes, the available information, in combination with information being developed from on-going investigations and evaluations, provides adequate data for the design of the foundation enhancements.

   Significant investigations of the right abutment at Site C were completed during the pre-design and design phases of the project, and additional investigations have been completed after the observation of unexpected movements in the right abutment during excavation. The investigations have included geologic mapping of surface exposures and exploratory adits, small and large diameter drill holes, geophysical surveys, and advanced field and laboratory testing.

   Field instrumentation was installed to monitor the buttress slopes during excavation and to update the geological model and geotechnical shear strength and deformation parameters (following the "observational method"). Experts with previous experience with similar shale foundation conditions have participated in the geotechnical evaluations.

   After the unexpected right bank slope movements, back analyses were completed to evaluate the movements, and additional investigations were undertaken to provide input for design of the foundation enhancements. It was found that persistent bedding planes with low shear strength exist even deeper in the foundation than previously anticipated, which has significant impact on the foundation enhancement measures considered and designed.

   The work completed at the site has allowed for a very good characterization of the geological, geotechnical, and engineering conditions in the right abutment, including the rock mass, rock stratification, bedding planes, relaxation joints and shears. Analyses and evaluations have been completed following current best professional practice methods.

   Some of the key conclusions that have been reached in the analyses and evaluations are:

1. An active wedge has not developed in the rock mass behind the roller compacted concrete (RCC) buttress; the rock mass consists of strata of intact rock between numerous, nearly horizontal bedding planes, with only limited shears between bedding planes.
2. Close to the excavation face, steeply dipping relaxation joints likely are present, as observed in other locations along the river.
3. Shear strengths on the bedding planes have likely been reduced to near their residual values. Persistent bedding planes with low shear strength exist even deeper than anticipated under the RCC buttress shear key.
4. A release plane does not appear to have been developed in the passive resistance zone (break-out zone) downstream of the powerhouse and spillway structures.

Based on the information provided to us, these conclusions appear to be well supported by the available data, the analyses, and the evaluations performed.

2. *Is the proposed approach to the right bank foundation enhancements capable of making the right bank structures:*
   c) safe – i.e. meet the Canadian Dam Association Dam Safety Guidelines and stability requirements set out in the Project Design Basis provided by BC Hydro?
   d) serviceable – i.e. displacements and deformations within the limits set out in the Project Design provided by BC Hydro?

The Project Team has, with the support of the independent Technical Advisory Board, decided on the installation of drilled piles downstream of the powerhouse and spillway structures as the preferred right bank foundation enhancement approach and concept. In our opinion, the proposed approach is sound and capable of making the right bank structures both safe and serviceable, however, several details still need to be addressed.

The Project Team is currently developing the specific design basis criteria that will be used to design the pile foundation enhancement. The principal design criterion will be to limit the deformations in the foundation to provide both safety and serviceability. The Panel agrees with this approach. Limiting the foundation deformations will provide for safety by preventing the development of an active wedge in the rock behind the RCC buttress and preventing rupture of the lining system to be installed in the approach channel. To address serviceability, the foundation deformations must be limited so that deformations of powerhouse

components and spillway gate systems remain within acceptable limits. Stability of the foundations (factors of safety) is being checked to demonstrate compliance with CDA safety guidelines and project design basis requirements.

Some aspects of the planned deformation and stability analyses are currently being developed and finalized. However, with proper application of available characterization information, the resulting design should appropriately address safety and serviceability.

3. *Is the proposed approach to optimization of the right bank foundation enhancements (number, size and spacing of piles) capable of resulting in a cost-effective solution that can accommodate any reasonably foreseeable geological conditions encountered during construction? Are there any value engineering considerations that could be included in the design program?*

The optimization of the pile design is currently in process. The Project Team is considering alternate pile configurations (e.g. diameters, steel configuration, etc.) as part of the process. The initial estimates of the number of required piles were based on stability analyses that considered the possible presence of or development of an active wedge behind the RCC buttress. Currently, stability analyses are being completed based on a sliding block model, bounded on the upstream side by either a single, full-height relaxation joint or a sliding plane along the rock mass-buttress interface. For both cases, the required numbers of piles are significantly less than originally estimated with the active wedge model.

Value engineering considerations were included in the multiple accounts analyses (MAA) commented on below.

A number of details must be worked out for the pile optimization, but we are confident that a pile design can be developed that is cost-effective and capable of accommodating reasonably foreseeable geological conditions encountered during construction.

4. *Is the proposed approach to estimating, scheduling and procuring the enhancements reasonable? Are there other things that could be considered that would increase the level of confidence in the cost estimate prepared by BC Hydro?*

The approach to estimating, scheduling, and procuring the enhancements is awaiting finalization, or at least further development, of the designs of the piles. Our comments on this question will be provided after further development and specifications of the design.

5. *Were the engineering attributes considered in the multiple accounts analysis thorough?*

   Based on a review of the information provided to us concerning the multiple accounts analysis of the potential foundation enhancement alternatives, the engineering attributes considered appear to have been systematic, thorough, and reasonable.

6. *Are there any other foundation enhancement measures that could have been considered?*

   We are not aware of any other structural foundation enhancement alternatives that could have been considered.

   Additional drainage measures may be used to reduce lateral water pressures and uplift forces under the RCC buttresses. At this time, such additional measures do not appear to be required. If water pressures during the lifetime of the structures rise to values higher than anticipated during design, suitable mitigating drainage measures may be implemented without making any structural changes. Recognition of possible changes in drainage conditions over time and the inclusion of design measures to accommodate drainage mitigation measures are not unusual in current dam design practice.

STATEMENT OF LIMITATIONS

The Panel functioned as independent reviewers of the methodologies used by the Project Team for analysis and design of the proposed enhancements, based on information provided by the Project Team. Given the large amount of work being completed by the Project Team and the associated documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the Project Team. Such detailed checks are provided by the quality control/quality assurance programs for the project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with the BC Hydro.

Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

Site C Technical Review Panel

[redacted]

REPORT NO. 1
January 22, 2021

Respectfully submitted,

[redacted] [redacted]

Site C Technical Review Panel

[redacted]

REPORT NO. 2
February 15, 2021

EXECUTIVE SUMMARY

Additional analyses of the earthfill dam are still in progress, in light of performance observed on the right abutment. However, based on the studies that have been completed to date, we are confident that a safe earthfill dam structure can be constructed at Site C meeting the Canadian Dam Association (CDA) Dam Safety Guidelines. Further, it is our opinion that the earthfill dam type is a particularly appropriate choice for the foundation conditions at Site C, because of 1) the ability to accommodate the low strength foundation bedding planes with flatter earthfill dam slopes, as necessary to provide stability and 2) the earthfill dam's tolerance of deformations, particularly when designed with wide core, filter, and transition zones, as is the case for the Site C earthfill dam design.

The available analyses indicate that for long term steady state conditions, after construction-generated pore water pressures have dissipated, the current earthfill design meets CDA stability guidelines for both the Most Likely Case (MLC) and the Reasonably Worst Case (RWC), both of which we believe have been reasonably estimated. Analyses completed to date also indicate that, for construction conditions including estimated pore water pressure generation and dissipation during construction activities, the CDA stability guidelines can be met with the current earthfill dam design for the MLC and with the addition of a relatively modest amount of stabilizing fill at the downstream slope and toe for the RWC. Further, analyses have indicated that increases of up to 20 percent in factor of safety can be achieved by readily constructible additional berm and toe fill configurations if that should be needed.

In our opinion, the Project Team's estimates of construction-generated pore water pressures are reasonable based on available data. However, the construction-generated pore water pressures constitute one of the greatest uncertainties in the analysis, which must be and are being recognized in evaluating dam safety and the construction schedule/cost risks.

It is our understanding that the additional berm and toe fill configurations referenced above which could increase construction phase stability beyond that required for the RWC are within the Project Team's current budgetary proposal. Part of the Project Team's mitigation strategy to reduce the risk of impacting the schedule during construction is a plan for placement of additional fill downstream of the downstream cofferdam to create a staging area and provide additional stability during construction. The additional staging area fill is sufficient to meet CDA guidelines for the RWC.

Site C Technical Review Panel

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REPORT NO. 2
February 15, 2021

In the very unlikely, but not impossible, event that observed deviation from expected performance is greater than expected (deviates from the RWC), such deviations could still be safely addressed by additional downstream fill placements or temporarily pausing fill placement to allow construction-generated pore water pressures to dissipate. However, such measures could further impact cost and schedule.

In our opinion, the available geotechnical and geological data are satisfactory to characterize foundation conditions for purposes of the earthfill dam design, and the planned observational approach and instrumentation program for the earthfill dam is reasonable and appropriate for monitoring and responding to construction-generated pore water pressures and movements during construction so that adequate stability and safety can be maintained.

INTRODUCTION

The Technical Review Panel's (Panel's) original assignment did not include review of the Site C earthfill dam design and construction, but BC Hydro subsequently asked the Panel to expand its assignment to include review of this structure and the Panel agreed.

The geotechnical investigations for the Project did not include the portion of the earthfill dam foundation beneath the main river channel, as it was not considered safe to use barge mounted equipment due to the river currents.

Portions of the earthfill dam core trench have been excavated on the left and right banks. The exposed bedrock at the base of the core trench in these locations has been mapped and foundation grouting is being performed.

Mapping and grouting of the right bank portion of the core trench identified shears that affected the stability of the right bank section of the earthfill dam. A shear key has been added to improve stability and reduce dam displacements for the right bank section of the earthfill dam, and a three-dimensional analysis has been undertaken to verify that acceptance criteria will be met.

Installation of piles in the cutoffs of the upstream and downstream cofferdams and the associated investigations have provided more information on the foundation across the main river channel.

After completion of the upstream and downstream cofferdams, the remainder of the core trench will be excavated, mapped, and grouted. Until this work has been completed and assessed, there is uncertainty about the foundation conditions for the earthfill dam and whether the current design will meet the acceptance criteria or whether some further enhancements will be required.

There are also uncertainties concerning the piezometric response of both the bedding planes in the foundation and the till core and the strengths of discontinuities (bedding planes and shears) in the foundation.

In Report 21A the Technical Advisory Board (TAB) introduced the concepts of the Most Likely Case (MLC) and the Reasonably Worst Case (RWC) and how these concepts should be considered in the design.

The observational approach is planned to verify the design of the earthfill dam during construction. The geotechnical instrumentation will directly measure the piezometric responses in the core and on the foundation bedding planes and inclinometers will indirectly indicate the strength of the foundation. If the observations indicate that the RWC is developing, design modifications would be implemented to meet acceptance criteria.

The TAB for the Project has been involved in the development of the design for the earthfill dam. Nevertheless, given the possibility of required design changes and the experience with unexpected performance during right abutment excavations, the Project Assurance Board (PAB) has decided to have an additional Third-Party Due Diligence Review completed for the earthfill dam design by this Technical Review Panel. The Panel has been tasked with reviewing the following aspects of the work being completed by the Project Team:

- The geotechnical investigations for the earthfill dam completed to date and the geotechnical instrumentation for the earthfill dam and cofferdams.
- The characterization of the rock and the properties of the rock mass, bedding planes, shears, etc. that control the stability of the earthfill dam and its foundations.
- Pore pressure assumptions during and at the end of construction.
- Adaptations of the design and stability analysis that have been identified to date in consideration of experience on the right abutment.
- Strategies to be adopted to further adapt the design, if necessary, based on mapping of the core trench across the riverbed and/or information obtained from geotechnical instrumentation during construction.

Work completed by the Panel to date related to the earthfill dam includes participation in three web-based Project Team briefings/discussion sessions with the Team, participation in web-based Project Team briefings to the TAB, review of documents provided to the Panel by the Project Team, and preparation of this report.

FINDINGS

Updates to the Site C earthfill dam design in light of the right abutment experience are still in progress at the time of preparation of this report. In particular, the Project Team is completing three-dimensional stability and deformation analyses for the earthfill dam. The Panel has been briefed on the foundation geology and earlier analyses, which have included parametric studies evaluating ranges of estimates for shear strengths and pore water pressure generation during dam construction. In the remainder of this section, the Panel provides initial findings based on the information that has been presented to the Panel to date. The Panel's findings will be updated in future reports based on further work to be completed by the Project Team.

Based on the information that has been presented, the Panel provides initial findings regarding earthfill dam safety, construction schedule/cost risks, geotechnical/geological investigations, and the observational approach and instrumentation.

Earthfill Dam Safety

The available analyses indicate that for long term steady state conditions, after construction generated pore water pressures have dissipated, the current earthfill design meets CDA stability guidelines for both the Most Likely Case (MLC) and the Reasonably Worst Case (RWC).

The Project Team has estimated pore water pressures that will be generated during construction in the earthfill dam core and in the foundation bedding planes for the MLC and RWC. The estimated construction pore water pressures are consistent with pore water pressures measured to date during construction of the upstream cofferdam and the Relocated Surplus Excavated Material (RSEM) sites, and these estimated pore water pressures seem reasonable. However, the construction-generated pore water pressures constitute one of the greatest uncertainties in the analysis, which must be and are being recognized in evaluating dam safety and the construction schedule/cost risks.

Analyses completed to date indicate that, for the estimated construction pore water pressure generation and dissipation, the CDA stability guidelines can be met with the current earthfill dam design for the MLC and with the addition of a relatively modest amount of stabilizing fill at the downstream slope and toe for the RWC. Analyses have indicated that increases of up to 20 percent in factor of safety can be achieved by readily constructible berm and toe fill configurations, if that should be needed.

Based on the range of parametric studies that have been completed, we are confident that a safe earthfill dam structure can be constructed at Site C meeting the Canadian Dam Association (CDA) Dam Safety Guidelines.

In our opinion, the earthfill dam type is a particularly appropriate choice for the foundation conditions at Site C. The slopes of an earthfill dam can be flattened as necessary to provide stability even with the low strength foundation bedding planes. In addition, an earthfill dam is tolerant of deformations, particularly when designed with wide core, filter, and transition zones, as is the case for the Site C earthfill dam design.

Construction Schedule/Cost Risks

The Project Team is well aware of potential impacts to schedule and cost that could result from higher than expected construction-generated pore water pressures or other unexpected foundation and earthfill dam performance, and strategies are being developed to limit the impacts of such occurrences.

Based on the completed analyses, downstream toe berm and fill placements within the currently planned contingencies will most likely address any observations. As noted above, readily constructible berms and fills, which we understand would be within the current budgetary proposal, could increase factors of safety by up to 20 percent, according to the completed analyses. The challenge would be to implement any required changes in a manner that does not adversely affect schedule and cost.

The Project is planning for placement of additional fill downstream of the downstream cofferdam to create a staging area and provide additional stability during construction. The additional staging area fill is sufficient to meet CDA guidelines for the RWC. This additional stability is part of a mitigation strategy to reduce the risk of impacting the schedule during construction, if higher than anticipated pore water pressures are encountered.

Although we believe that it is very likely that any observed unexpected performance could be addressed within the current budgetary proposal, the possibility of deviations from expected behavior greater than the RWC cannot be entirely ruled out. Such greater deviation from expectations could still be safely addressed by additional downstream fill placements or temporarily pausing fill placement to allow construction-generated pore water pressures to dissipate. However, such measures could further impact cost and schedule.

Geotechnical/Geological Investigations

Although geotechnical and geological investigations have been limited to areas outside of the riverbed, we believe that the available data from the earthfill dam investigations and the construction of cofferdams, combined with knowledge of the rock formations obtained from the right abutment investigations, is satisfactory to characterize foundation conditions for purposes of the earthfill dam design.

Site C Technical Review Panel
[redacted]
REPORT NO. 2
February 15, 2021

Observational Approach and Instrumentation

In our opinion, the planned observational approach and instrumentation program for the earthfill dam are reasonable and appropriate. After the experience on the right abutment, the Project Team has added instruments to the originally planned three earthfill dam instrumentation sections and added two more earthfill dam instrumentation sections. The planned instruments should be sufficient to monitor the construction-generated pore water pressures and movements during construction so that adequate stability can be maintained.

STATEMENT OF LIMITATIONS

The Panel functioned as independent reviewers of the methodologies used by the Project Team for analysis and design of the earthfill dam, based on information provided by the Project Team. Given the large amount of work being completed by the Project Team and the associated voluminous documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the Project Team. Such detailed checks are provided by the quality control/quality assurance programs for the Project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with BC Hydro.

Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

Respectfully submitted,

[redacted] [redacted]

Site C Technical Review Panel

[redacted]

REPORT NO. 3
April 6, 2021

EXECUTIVE SUMMARY

This report presents an update to the Technical Review Panel's (Panel's) findings subsequent to Panel Reports Nos. 1 and 2, issued on January 22, 2021 and February 15, 2021, respectively.

In the Panel's opinion, the Engineering Design Team (EDT) has been proceeding well with the design of the right bank enhancements. The principal focus of the recent work has been on analyses to define the number, size, and depth of the pile system, so that the steel for the piles can be ordered. The Panel agrees with this focus, since ordering the steel for the piles soon is required to limit schedule and cost risks.

The optimization work has resulted in a recommended pile system consisting of:

1. A total of 96 concrete-filled steel pipe piles.
2. Each pile will be installed in a 2.4-m diameter drilled shaft.
3. Each pile will include 2.0-m diameter steel casing with 38mm thick wall.
4. This configuration results in a 200-mm thick, concrete-filled annulus outside the steel wall.
5. 50% of the piles will extend to 350-m Elevation and the other 50% of the piles will extend to 360-m Elevation.

The recommended pile system is substantially reduced from the preliminary design developed after the discovery of the unexpected movements beneath the roller compacted concrete (RCC) buttress. The preliminary design consisted of 255 piles, all with 3.0 m diameter. The principal reasons that the recommended pile system is significantly less than that in the preliminary design are that 1) investigations have established that an active wedge does not exist in the rock behind the RCC buttress and is very unlikely to develop due to the deformation restraint from the pile system, and 2) additional investigations, including lateral pile load tests, have provided improved understanding of bedrock properties.

The pile system recommendation is supported by detailed numerical analyses indicating calculated displacements that are less than design criteria established in a revised Design Basis Memorandum (DBM) for all cases identified. In addition, "stress test" deformation analyses indicate that the recommended pile system has reserve capacity to limit deformations for loads even greater than those identified in the DBM. Stability analyses completed by the EDT indicate that the design configuration meets CDA stability guidelines without inclusion of the piles for all load cases identified in the DBM. Hence, including the piles to meet deformation criteria will provide reserve stability capacity beyond that required to meet CDA guidelines.

Site C Technical Review Panel

[redacted]

REPORT NO. 3
April 6, 2021

In the Panel's opinion, the analyses have been completed following best professional practices and the recommended pile system is well supported. It is reasonable to proceed to procure the steel for the recommended system. It is possible that the pile system could be refined and optimized somewhat further, but the risks of costly delay claims from the contractor would likely more than offset the benefits of further optimization.

The EDT has also been progressing a risk analysis for the approach channel water control features and a hydrogeological analysis of the right bank. In the Panel's view, the risk analysis has been thorough and complete and has identified opportunities for refinement of the final design of the water control features. The hydrogeological analysis of the right bank will help to inform decisions on the final design of the water control features for the right bank.

The Panel looks forward to reviewing the final design of the right bank enhancements, supported by the finalization of the numerical analyses, stability analyses, approach channel risk analysis, and hydrogeological analysis.

There have been no significant changes in the earthfill dam design or stability analysis since Panel Report No. 2 issued on February 15, 2021. The Panel's findings remain unchanged from those stated in Report No. 2. BC Hydro has advised the Panel that fill for a construction laydown area will be placed at the downstream toe of the earthfill dam before embankment fill will be advanced to significant height. As noted in Report No. 2, placement of this fill increases the stability of the earthfill dam, and the Panel supports the decision to proceed with its placement.

As the Project prepares for the upcoming resumption of core trench preparation and fill placement, the Panel was recently briefed on the identification of deterioration of some of the protective shotcrete previously placed in the core trench excavation and of a limited depth of the shale underlying the shotcrete. The Panel supports BC Hydro's plan to remove all of the previously placed shotcrete from the cutoff trench excavation and then to excavate any deteriorated shale and prepare the surface immediately before placement of cutoff trench fill to address this critical aspect of the earthfill dam construction.

INTRODUCTION

At the request of BC Hydro, the Technical Review Panel (Panel) has prepared this report as an update to the Panel's previous Reports Nos. 1 and 2, dated January 22, 2021 and February 15, 2021, respectively.

Since February 15, the Panel has attended briefings to the Technical Advisory Board (TAB) by the Engineering Design Team (EDT) on February 24, March 12, and March 29, 2021, during which the EDT updated the TAB on activities related to both the right bank and the earthfill dam. The Panel has also reviewed project information provided by BC Hydro.

Based on the information provided to date, the Panel provides updated findings concerning the proposed right bank design upgrades and the earthfill dam.

FINDINGS

Right Bank Design Enhancements

In the Panel's opinion, the EDT has been proceeding well with the design of the right bank enhancements. The principal activities completed since February 15 include optimization of the pile system design, a risk analysis for the approach channel water control features, and a hydrogeological analysis of the right bank. Work remaining to be done includes finalization of the configuration of the pile cap in the powerhouse tailrace, the approach channel, the foundation drainage system, and the foundation grouting program; compilation of the drawings and specifications for the enhancements; and preparation of a design report documenting the analyses of record for the design.

Pile System Design – The principal focus of the recent work has been on analyses to define the number, size, and depth of the pile system, so that the steel for the piles can be ordered. The Panel agrees with this focus, since ordering the steel for the piles soon is required to limit schedule and cost risks.

The optimization of the pile system design was based on updated design criteria established in revisions to the Design Basis Memorandum (DBM). As noted in Panel Report No. 1, the principal design criterion is to limit the deformations in the foundation to provide both safety and serviceability. The design criteria also include required stability factors of safety to conform to Canadian Dam Association (CDA) guidelines. The design criteria are being considered for a number of assumed loading conditions, ranging from the best estimate of normal operation loading to a loading resulting from the extremely unlikely case of failure of the approach channel lining and failure of the right bank foundation drainage system, such that water pressures in open joints in the foundation rock and at the contact with the rock and the roller compacted concrete (RCC) buttress rise to levels corresponding to the reservoir level (a condition designated Extreme 4).

The criterion established for limiting deformation was a calculated horizontal displacement no greater than 10 mm at the most upstream line of piles. Deformation at the downstream edge of the approach channel liner was also checked in the analyses. The Panel supports both the selected displacement limit at the piles and the check of deformations at the liners.

Furthermore, the computed displacements for the maximum design natural earthquake and estimated seismic events induced by hydraulic fracturing for petroleum development must also be less than the horizontal displacement criterion.

The optimization work has resulted in a recommended pile system consisting of:

1. A total of 96 concrete-filled steel pipe piles.
2. Each pile will be installed in a 2.4-m diameter drilled shaft.
3. Each pile will include 2.0-m diameter steel casing with 38mm thick wall.
4. This configuration results in a 200-mm thick, concrete-filled annulus outside the steel wall.
5. 50% of the piles will extend to 350-m Elevation and the other 50% of the piles will extend to 360-m Elevation.

For optimization of the pile system design, Extreme 4 was the controlling load case. Numerical analyses of this case for the recommended pile system that have been presented to the Panel to date, resulted in calculated horizontal displacements of 5mm at the upstream piles for both the powerhouse and the spillway, and calculated deformations of 11mm and 9mm at the approach channel liner for the powerhouse and the spillway, respectively. The analyses also included consideration of variations in the plan layout of the piles to limit tensile stress development in rock surrounding the piles. Numerical analyses completed to date have also indicated that, for all cases identified in the DBM except Extreme 4, the calculated deformations at the upstream piles are less than 2 mm.

To further test the robustness of the recommended pile system, the EDT completed additional numerical analyses for loads more severe than the Extreme 4 case (i.e. stress testing). The results indicated that the enhanced design with the recommended pile system has significant reserve capacity.

Stability analyses completed by the EDT indicate that the design configuration meets CDA stability guidelines without inclusion of the piles for all load cases identified in the DBM. Hence, including the piles to meet deformation criteria will provide reserve stability capacity beyond that required to meet CDA guidelines.

In the Panel's opinion, the analyses have been completed following best professional practices and the recommended pile system is well supported. It is reasonable to proceed to procure the steel for the recommended system. It is possible that the pile system could be refined and optimized somewhat further, but the risks of costly delay claims from the contractor could likely more than offset the benefits of further optimization. The recommended pile system is substantially reduced from the preliminary design developed after the discovery of the unexpected movements beneath the RCC buttress. For comparison, the preliminary design consisted of:

1. A total of 255 concrete-filled steel pipe piles.
2. Each pile to be installed in a 3.2-m diameter drilled shaft.
3. Each pile to include 3.0-m diameter steel casing with 22-mm thick wall.

4. All piles extending to 350-m Elevation.

In addition, the much larger number of piles of larger diameter in the preliminary design would have required larger and more expensive pile caps. The Panel notes that the principal reasons that the recommended pile system is significantly less than that in the preliminary design are that 1) investigations have established that an active wedge does not exist in the rock behind the RCC buttress and is very unlikely to develop due to the deformation restraint from the pile system, and 2) additional investigations, including lateral pile load tests, have demonstrated the rock is stronger and stiffer than the values provided from the earlier investigations.

Detailed specifications for pile installation remain to be developed, but large diameter drilled pile installations have a long-standing history of application in the construction industry, so established precedents exist for developing the required specifications. Further, successful installation of drilled piles at the site was demonstrated by the installation of the two piles used for the lateral load tests. The Panel looks forward to reviewing the final drawings and specifications for the pile system to be included in the right bank enhancements.

Approach Channel Risk Analysis – The EDT has been completing a risk analysis of the various water control features to be included in the approach channel and the right bank. These features include the approach channel liners and associated under-drains, foundation grout curtains in the vicinity of the approach channel, and right bank drainage features (the right bank drainage tunnel and drilled drain holes). The purpose of the risk analysis is to identify potential measures to improve the robustness and resiliency of the water control features.

The EDT has presented the results of the risk analysis in briefings to the TAB and the Panel. In the Panel's view, the risk analysis has been thorough and complete and has identified opportunities for refinement of the final design of the water control features. The Panel looks forward to reviewing the final design of these features.

Right Bank Hydrogeological Analysis – The EDT has been performing a detailed hydrogeological analysis of the right bank to help inform decisions on the final design of the water control features for the right bank. The analysis is still in progress, and the TAB and the Panel have been briefed on the results to date. The Panel looks forward to reviewing the final analysis and its application to final design of the right bank water control features.

Earthfill Dam

There have been no significant changes in the earthfill dam design or stability analyses since Panel Report No. 2 issued on February 15, 2021. The Panel's findings remain unchanged from those stated in Report No. 2. BC Hydro has advised the Panel that fill for a construction laydown area will be placed at the downstream toe of the earthfill dam before embankment fill will be advanced to significant height. As noted in Report No. 2, placement of this fill increases the stability of the earthfill dam and the Panel supports the decision to proceed with its placement.

Site C Technical Review Panel
[redacted]
REPORT NO. 3
April 6, 2021

The Project has been appropriately focused on the foundation preparation and grouting for the main dam and the upcoming resumption of core trench preparation and fill placement. The Panel was recently briefed on the identification of deterioration of some of the protective shotcrete previously placed in the core trench excavation and of a limited depth of the shale underlying the shotcrete. BC Hydro has advised the Panel, that the planned approach is to remove all of the previously placed shotcrete from the cutoff trench excavation and then to excavate any deteriorated shale and prepare the surface immediately before placement of cutoff trench fill. The contact between the cutoff trench fill and the underlying shale foundation is a critical aspect of the earthfill dam construction, and the Panel supports BC Hydro's plan for addressing this aspect of construction.

STATEMENT OF LIMITATIONS

The Panel functioned as independent reviewers of the methodologies used by the EDT for analysis and design of the right bank enhancements and the earthfill dam, based on information provided by the EDT. Given the large amount of work being completed by the EDT and the associated voluminous documentation, it was not possible for the Panel to perform a detailed review of all of the material in the available time. In particular, the Panel has not performed detailed checks of calculations and designs completed by the EDT. Such detailed checks are provided by the quality control/quality assurance programs for the Project. The Panel provides its opinions concerning the methods and approaches being used based on information provided by the Project Team. However, the ultimate decisions and responsibilities for the designs remains with BC Hydro.

Our review services were performed within the limits prescribed by BC Hydro in a manner consistent with the level of care and skill normally exercised in the current standard of professional engineering practice. No other representation to BC Hydro, expressed or implied, and no warranty or guarantee is included or intended.

Respectfully submitted,

[redacted] [redacted]

Site C Clean Energy Project

Technical Advisory Board

Summary Statement on Safety of Dam Structures

January 22, 2021

Table of Contents

1. Introduction

The design of the Site C Project was conceived on the basis of satisfying all Canadian Dam Association (CDA) guidelines for ensuring the safety of such structures. This was supplemented by worldwide expertise and the experience that BC Hydro together with its engineering consultants has in designing, building and operating such structures. Parameters were developed for Site C that assured CDA compliance would be met, and these were incorporated in a Design Basis Memorandum (DBM), which has been followed as the project developed.

The Project Assurance Board has requested a summary assessment from the Technical Advisory Board (TAB) related to their confidence in the design of the dam structures associated with the Site C Project, particularly with respect to safety and the adoption of best practices. The context of the request is to assist the Project Assurance Board in the evaluation of the technical integrity of the Project as it proceeds to finalize the foundation enhancements that have been found necessary in the right bank of the main dam.

The summary assessment has been developed in response to five questions which are addressed sequentially below.

2. Questions

1. Were the analysis and investigations that formed the basis of the design at the time of the authorization for construction of the Project appropriate and in accordance with best practices?

Investigations for the Site C Project began in 1973. In 1978, it was confirmed that the current site was preferable. The current project was approved in 2014. The specific site investigations that began in 1975 and continued to project approval are listed in Appendix A.

In accordance with best practices:

i. BC Hydro is an experienced dam owner/operator and together with its engineering consultants had intimate knowledge of the geological challenges associated with dam construction at Site C. This arose from their experience elsewhere along the Peace River, an awareness of how severe geotechnical considerations prevail eastward in Alberta and Saskatchewan, and a detailed appreciation of the valley rebound geomechanics that created the complex conditions that had to be addressed.

ii. BC Hydro retained independent Technical Advisory Boards for the period 1978-1989 when feasibility of the Base Case design was evolving and thereafter from 2010 to date when the project was renewed and progressed through final design into construction. This is an established practice for major hydroelectric projects and

allows for leading international experience to be introduced into the planning, design and construction.

iii. BC Hydro and the Engineering Design Team (EDT) retained individual Subject Matter Experts (SME) as appropriate for additional advice throughout the process.

iv. Notwithstanding the comprehensive investigations carried out in the 1970s, additional investigations were initiated in 2008 which concluded that the geological/geotechnical model that had been developed and the associated Base Case design remained valid. This involved diversion tunnels within the left bank of the river valley, an embankment fill dam across the valley, and the powerhouse/spillway structure at the right bank of the valley.

In 2010 the EDT undertook an optimization to compare alternate arrangements to either validate the Base Case or modify it before proceeding to final design. This was an important step in the evolution of the design, and the TAB recommended that a formal structured decision-making process be adopted. It was heavily weighted to minimize geotechnical risk. The earthfill dam with the RCC buttress was confirmed as the preferred general arrangement and this conclusion was supported by the SMEs and the TAB.

At the time of the implementation design in 2014, the deepest bedding plane shear that was identified as potentially impacting the stability of the right bank structure was bedding plane BP 33 at El. 378 m. Hence the foundation of the RCC buttress was set at El. 375 m, 3 m below BP 33. An assessment of a bedding plane shear below this level was also undertaken. However, the assumed resistance for this feature did not indicate a concern with respect to satisfying safety design criteria.

Finally, the need for adoption of the Observational Method was recognized and implemented as an integral part of assessing safe design, construction and long-term performance.

In the view of the TAB, the evolution of the design to the time of authorization, both consistently and diligently, was in accordance with best practices.

2. Were the practices being used during construction of the Project to confirm foundation conditions in accordance with best practices?

The final design adopted for construction employed an RCC buttress on the right bank primarily because this configuration was assessed to be optimal among the alternative choices to manage the geotechnical challenges associated with constructing on or adjacent to the right bank. Nevertheless, uncertainties existed, and they were recognized.

Best practices in the face of geotechnical uncertainties is to employ the Observational Method (OM). This relies on comprehensive instrumentation to validate that the ground

response is performing in a manner consistent with the design intent. To be effective, it also assesses the practicality of invoking mitigative measures if observations and related analyses reveal that they are necessary. The OM to be adopted at Site C is documented in detail in the project records (see Appendix B). It relies on both skillful installation of the appropriate instruments and diligent interpretation. It also relies on validation of the geological model by observations and mapping to confirm that conditions being encountered are as anticipated or whether design modifications are required. BC Hydro has considerable experience with the application of the OM and it was implemented in an effective manner.

Considerable monitoring of the RCC buttress excavation and construction was intended to be executed from the Right Bank Drainage Tunnel (RBDT) prior to the start of the RCC excavation. The construction of the RBDT did not occur in a timely manner, which resulted in an incomplete history of the response of the rock during the excavation of the powerhouse buttress foundation. This was ultimately addressed by instrumentation and drainage measures installed from the surface. As anticipated, excavation-induced movements were observed but none were regarded as sufficiently consequential to affect the design.

In concert with these observations, detailed geological mapping was conducted and compiled in state-of-the-art software that integrated all geological information obtained on site in a three-dimensional framework. This attention to detail, which is invaluable, provides another example of best practices employed at Site C.

Following the recorded movement history associated with the powerhouse excavation and RCC placement, the instrumentation to monitor the spillway excavation was revised and inclinometers that monitor bedding plane slip were installed to depths below El. 375 m, the bottom of the RCC foundation. While potential slip at greater depths had been considered in the design, the resistance along these deeper bedding planes was assessed to be too high to make them critical to the design.

As excavation continued for the spillway, small movements, about 5 mm, developed at El. 372 m at a location now referred to as BP 33e. In many projects, monitoring to this accuracy either would not be undertaken or would not be reliable, and such small movements would not be regarded as consequential. A measure of the best practices executed at Site C is the reliability of the data and the commitment to interpret all data that informs matters of safety.

This latter commitment, making use of numerical modelling techniques that have only become practical and reliable in recent years, revealed that the frictional resistance was significantly less than presumed values adopted in the design for bedding planes. These low values were consistent with lower bound values determined from laboratory tests. When used in design, the factors of safety associated with extreme load cases, as

specified for the project, appeared to be no longer satisfied, prompting a comprehensive study of foundation enhancements to assure dam safety.

The application of the OM produced results as intended in an expedient manner. It is the view of the TAB that without the commitment to best practices, reliable monitoring of the small displacements of concern could not be assured and the related interpretation may have been highly uncertain. The OM in practice relies on a contingency design to be implemented in the event conditions are worse than anticipated and observed. In this case, the contingency case for bedding plane slip at depths below El. 372 m adopted a frictional resistance of 16º. Neither the EDT nor the TAB anticipated that these apparently tight features would mobilize a resistance of ≈11º, near the lower limit encountered in laboratory testing. It could be surmised that had they done so, the mitigation design might have involved foundation enhancements similar to those currently under consideration.

3. Has the project team evaluated and identified the appropriate changes to the design for the RCC buttress foundation?

The project team has identified and evaluated appropriate changes to the design for the RCC buttress foundations. This was accomplished by utilizing field geologic information, evaluating field instrumented data and engaging in a detailed and intensive program of "state-of-the-art" structural analysis based upon the information gained from the detailed geologic, hydro-geologic and structural engineering.

Findings in the right bank arising from the geological / geostructural synthesis have raised concerns with respect to satisfying some of the original Design Basis Memorandum (DBM) requirements. The assessment of these concerns has progressed along a path that originally considered that factors of safety associated with extreme loading cases would not be satisfied. This is no longer the case since newly obtained data on rock strength and stiffness at depth support the view of the TAB that such factors of safety can be satisfied. However, the reassessment of the design has recognized the need to provide measures that would reduce deformations of the supported rock to the degree practical and this is now the primary focus of the foundation enhancements. This will prevent the evolution of loading conditions associated with substantial rock weakening that were not specifically foreseen in the original DBM with the data available at that time for analysis. In addition, extra foundation enhancements provide the robustness and resilience to respond to residual uncertainties that might exist. The TAB and the Engineering Design Team (EDT) engaged in extensive discussions evaluating the new information, the logic of past design assumptions, particularly for the extreme case, the appropriate analyses to be used going forward to analyze the situation in more detail, and a schedule to develop executable enhancement measures.

As a result of recent information and understanding of the foundation conditions within the right bank, the EDT had investigated several foundation enhancements options to

increase the stability of the right bank powerhouse and spillways buttresses. Systems containing shear walls, large diameter piles, prestressed anchors, and concrete filled tunnels were considered.

Since it was and is a very complex condition to analyze both geologically and structurally, an evaluation was conducted using a Multiple Accounts Analysis (MAA). This process helps establish an optimal solution to meet the project objectives; dam safety, regulatory, and engineer-of-record requirements; and achieve owner and operator acceptance. The optimal solution considers construction safety, environmental issues, the long-term quality of the project infrastructure, technical risk, constructability, operability, schedule and cost.

The MAA is effective in integrating multiple points of view, with flexibility in efficiently doing sensitivity studies by modifying the weightings if there is interest in assessing the robustness of the conclusions. It also provides a valuable record of the decision-making process.

The MAA was conducted on both the powerhouse and spillway buttresses and considered several options to increase the stability of the structures. Various options were considered to reduce the driving forces, such as controlling the water load on the structures by introducing drainage facilities and others introduced restraining forces such as anchors and tendons. Still others considered structural foundation features developed within the structures and anchored within the rock foundations, such as shear walls and large diameter piles.

4. Does the design of the Project, including processes followed during construction, incorporate principles of a safe design?

The Site C Project does incorporate safe design as well as construction processes and principles for safe development of a large hydroelectric project. As described in the response to Question 1 above, the best practices have incorporated BC Hydro's and its consulting design team's experiences as well as the advice of several independent and world-wide technical experts. Various alternative project arrangements were evaluated in favor of a more robust and safe design, as well as construction. The safe design principles have been practiced throughout the project, beginning with geotechnical studies in the 1970s and continue through to today, where numerous good practices, like the Observational Method of monitoring the performance of structures during construction, perform a safety function. In other areas, geologic studies and mapping of foundations are conducted to verify anticipated properties and thus safe and efficient designs. The geologic maps and geotechnical studies that are developed during construction not only facilitate and guide competent designs and construction but also form a record for both construction and future reference, should it be necessary.

In addition, the TAB anticipates that the operations manual will ensure that all elements of the facility that are critical for safety will continue to perform as intended.

Methods used in developing safe hydraulic structures at Site C utilize both numerical as well as physical modelling for design of hydraulic structures. The hydraulic structures are major structures and demand special attention for safe and efficient functioning. Major hydraulic structures like the spillways, gates and penstocks are designed to withstand extreme events like floods and earthquakes and must be designed to safely handle these events while also being constructible.

A significant feature of the safety in design is developing and adhering to design criteria developed for the project. This establishes the criteria required by BC Hydro to ensure overall safety and the commitment by the EDT to meet them. Specific criteria are established and factors of safety, which reflect the reserve resistance of the structures against failure, are defined. Different load cases are also specified that must be investigated. The criteria and load cases are consistent with international practice and the practice recommended by the Canadian Dam Association. In addition to meeting the target factors of safety, the current design also recognizes the need to satisfy the limiting deformation criteria. The TAB expects that BC Hydro's existing dam safety program will embrace the long-term assurance of safe performance through its operations manuals and other aspects of its safety program.

Analyses have shown that the biggest factor contributing to the potential instability of the spillway and powerhouse RCC buttresses is water loading within the right bank hillside. A recent hydrogeologic study was conducted to determine and evaluate the in-situ permeability of the various rocks in the right bank. This concern and ability for rock formations to conduct water, both laterally and vertically within the formations, was recognized in the tender design with the provision of a Right Bank Drainage Tunnel and by minimizing the potential for water ingress into the hillside from above by water-proofing the approach channel above the slope. However, the behaviour of the hillside upon excavation has shown an extended potential for relaxation movement and cracking, possibly extending into the approach channel. This has necessitated the robustness of channel waterproofing arrangements to be reviewed as well as the means of generally ensuring the drainage of the hillside. Maximum reliability is essential to achieve the controlling loading requirements in the design. Various arrangements are now being developed and evaluated by the Engineering Design Team (EDT), all of which the TAB supports in principle, with some comments on matters of detail. A detailed Failure Mode Analysis (FMA) is presently being conducted to evaluate all aspects of the approach channel watertightness and robustness.

The evolution of the selected design strategies is documented in a report on the structured decision-making analyses based on the Multiple Account Analysis methodology. In this

procedure, a distinction is made between “musts” and “wants”. Not violating the design criteria, as reflected by the DBM, is categorized as a “must”. With respect to the approach channel, the current FMA also emphasizes the need to minimize risk through adoption of the As Low As Reasonably Practicable (ALARP) considerations.

The development of good and safe practices both during design and during construction is founded in the following elements and principles in order of importance, namely Safety, Quality, Schedule and Budget. Safety is a “must” principle and must be adhered to and practiced, ensuring the safety of all involved in the project. Quality during design, as well as quality of the constructed project, is also a “must” element and feature, since the completed project is a minimum 100-year commitment to the Owner. Quality is an element that ensures both safety in design as well in construction. The elements of Schedule and Budget are “wants” and affect both design and construction.

5. What is the status of the earthfill dam with regard to safe design?

These issues have recently been addressed in TAB reports 21A, 22 and 23. Excerpts follow. The current status remains unchanged.

Excerpt from TAB Report 21A, dated April 2020

Question 4. Does the Board have any comment on the earthfill dam foundation review?

The status of design of the stability of the earthfill dam on its foundation was summarized, together with the past foundation characterization that controlled stability. Detailed assessment of current conditions suggests that this foundation characterization be revised based on the more detailed information currently available.

Progress with respect to this revision suggests that the controlling foundation conditions are more severe than previously used in design with respect to 1) residual strength 2) additional roughness, 3) continuity and depth of controlling bedding planes, and 4) post peak brittleness. The magnitude of pore pressures both at the end of construction and with post construction dissipation remain uncertain and this also has to be considered in the reassessment of stability.

The TAB supports the current effort to advance revised operational properties and to update the stability analysis related to the original design criteria. In so doing, the TAB recommends the following:

1. A distinction should be made for a most likely case (MLC) and reasonably worst case (RWC). Appropriate factors of safety should be recommended for each case and it is recognized that the observational method should be used where appropriate to identify if the reasonably worst case is developing. If the RWC is

developing, a default design will have to be implemented to bring the RWC up to the appropriate standard and must be demonstrated as feasible.

2. It is conceivable that the distinction between the MLC and the RWC will not be large given the significant brittleness displayed by the laboratory data with respect to the shear strength of the bedding planes.

3. It should be recognized that many agencies adopt lower factors of safety when design is based on residual strength or close to it.

The role of the application of the 3D analysis should be considered in these analyses because of the potential large 3D contributions to stability.

Excerpt from TAB Report No. 22, dated June 2020

Question 6. Does the TAB have any comment on the status of the studies on the foundation conditions for the earthfill dam?

Arising from the new findings at the Right Bank, it was timely to undertake an updated assessment of the design of the earthfill dam, particularly related to its foundation. This was presented to the TAB for review on May 8, 2020.

The update contained: 1) a review of the foundation geology, 2) a review of the shear strength mobilized along bedding planes, 3) a review of the rock mass strength, 4) a consideration of the model adopted to forecast pore pressures, 5) stability analyses in both two and three dimensions, 6) an assessment of Right Bank deformations, and 7) a summary of the proposed path forward utilizing the observational method.

New information had become available not only from the Right Bank investigation, but also from studies for the design of the cofferdam by the Contractor and from foundation responses. This has resulted in improved foundation characterization leading to some minor changes in excavation for the dam core trench. Shear strength characterization is little changed from that adopted in design but knowledge of deeper weak bedding planes has revealed some potential reduction in Factor of Safety without involving three-dimensional considerations. There has been increasing reliance on three-dimensional restraints in practice and the TAB is of the view that they can be adopted at Site C, given precedence elsewhere. There has been limited advance with respect to pore pressure response during construction. Stability analyses have assumed that they will dissipate during construction, prior to reservoir filling and this remains a matter of observational confirmation.

One matter of conceptual advance in the design of the earthfill dam is the re-casting of the design in terms of a Most Likely Case (which is the business case and has a Factor of Safety of 1.5) and the Reasonable Worst Case (which is the contingency case and has

a Factor of Safety of 1.1). Observations during construction will be designed to discover whether conditions consistent with the Reasonable Worst Case might be developing. Invoking a Factor of Safety of 1.1 limits the opportunity for unacceptable deformations to develop while a Factor of Safety acceptable for operating conditions is being restored. The updated design has demonstrated that adding downstream berms is one practical method to increase stability if warranted.

Based on this updated review and extension of the observational method to formally recognize both the Most Likely Case and the Reasonable Worst Case, the TAB is content with the status of the studies on the foundation conditions for the earthfill dam and the proposed way forward.

Excerpt from TAB Report No. 23, dated October 2020

> *Question 3 - Does the TAB believe the information presented to date from the u/s cofferdam (pile installation, grouting and piezometric response) and the core trench (mapping, grouting and performance monitoring) supports the Most Likely Case or is the trend towards a Reasonably Worse Case for the earthfill dam?*

The status of the studies on the foundation conditions for the earthfill dam was last reviewed and discussed in Report No. 22, submitted in June 2020. As presented, best practice for the design and construction of dams on clay shale foundations employs the observational method in a precautionary-based design. A distinction is made in design between the Most Likely Case (MLC) which is the basic business case and requires a Factor of Safety under operational conditions of 1.5 and the Reasonably Worst Case (RWC) which is evaluated to recognize the residual uncertainties that exist prior to construction and requires a Factor of Safety of 1.1. The RWC is evaluated to ensure that no uncontrollable displacements could develop while a contingency design is implemented to provide adequate reserve resistance for the service conditions. The development of the required mitigation measures is part of the RWC design assessment.

To date, no information from any studies on performance observations have been obtained to modify the design basis for the earthfill dam. Observations and assessment of performance have always been part of the design. Comprehensive monitoring of deformation and pore pressure are being adopted and if either indicate that conditions are leading to the RWC condition, downstream slope-flattening is recognized as a proven mitigation measure in such cases and would most likely be favoured. Depending on the detailed response, additional advanced deformation analyses might be undertaken to assess the consequences of the trends observed.

However, at the right abutment of the dam, the powerhouse restricts the opportunity to invoke such measures to a large extent and tolerable deformations are more restricted. Recent construction for the earthfill dam indicates that foundation movements are

directed toward the river valley, and not toward the powerhouse. These are favourable observations. Nevertheless, consistent with precautionary-based design, it would be prudent to assess local structural details at the powerhouse service bay boundary that would accommodate additional foundation deformations if they were to occur in this direction. However, deformations in this critical direction are already restrained by three-dimensional effects which limit the scale and likelihood of the need for any mitigation.

3. Summary

In the view of the Technical Advisory Board, the requirements for safe design have been honoured as an over-arching principle in all phases of the Project, from initial feasibility to current construction. In addition, best practices have been adopted from the initial site investigation studies to the current implementation phase. They are expected to continue to the end of construction and thereafter into operation.

Respectfully submitted,

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Appendices

Appendix A – List of Site Investigations

Site investigations at Site C began in 1975. At the time of project approval in 2014, the following investigations had been completed:

- 211 diamond drill holes with a total length of over 13,600 m
- 29 large diameter (0.9 m) drill holes (LDH) with a total length of 1,810 m. The deepest LDH was 96 m
- 202 percussion drill holes with a total length of over 3440 m
- 271 rotary holes with a total length of over 18,180 m
- 10 sonic drill holes with a total length of over 610 m
- 10.4-m-wide 45 m long test chamber on the left bank
- 5 exploratory adits (tunnels) with a combined length of 950 m. Adits 3 and 5 are on the right bank
- 268 test pits with a total depth of 1230 m
- 12 exploratory trenches with a total length of 1,220 m
- 29 seismic lines with a total length of over 13,000 m

Appendix B – References

Site C (2017) Site C Clean Energy Project - Implementation Design RCC Buttress - Observational Method, prepared by Klohn Crippen Berger Ltd. and SNC-Lavalin Inc. for BC Hydro. BKS-03-122

Technical Advisory Board (April 2020) - Site C Clean Energy Project - Meeting No. 21A Report

Technical Advisory Board (June 2020) - Site C Clean Energy Project - Meeting No. 22 Report

Technical Advisory Board (October 2020) - Site C Clean Energy Project - Meeting No. 23 Report

BC Hydro
Power smart

Site C Clean Energy Project

Quarterly Progress Report No. 21

Appendix F

Summary of Individual Contracts Exceeding $10 Million

PUBLIC

CONFIDENTIAL

ATTACHMENT

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Quarterly Progress Report No. 21

Appendix G

Project Progression

PUBLIC

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Quarterly Progress Report No. 21

Appendix H

Detailed Project Expenditure

PUBLIC

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ATTACHMENT