Xcel Energy®

# CABIN CREEK HYDROELECTRIC FACILITY UPGRADE PROJECT

## PROCEEDING NO. 15A-0304E

## 2021 ANNUAL PROGRESS REPORT

MARCH 31, 2022

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# INTRODUCTION

In Decision No. C15-0955 in Proceeding No. 15A-0304E, the Commission authorized Public Service Company of Colorado ("Public Service" or "Company") to proceed with the upgrade to its Cabin Creek Hydroelectric Facility. This report is the sixth annual status report on the Cabin Creek Hydroelectric Facility Upgrade Project and describes the status of the project as of December 31, 2021. Overall, the project is more than seventy seven percent complete. Unit A was placed in-service on July 30, 2021 and the project is forecast to be complete by mid-May 2022.[1] Unit B is forecast to be online and in-service during the first quarter of 2023 and the project is forecast to be complete during the second quarter of 2023. The Upper Reservoir Expansion Project is forecast to be in-service by the end of 2022 and the project is forecast to be complete by the end of 2023. The extended completion date for the Upper Reservoir Expansion Project is driven by a final report by the Board of Consultants that is required one year after the construction is finished and the dam is placed in service.

# OVERALL PROJECT STATUS

On May 6, 2015, Public Service filed an Application for Approval of a Certificate of Public Convenience and Necessity to Upgrade the Cabin Creek Hydroelectric Facility ("Application"). The Application sought Commission approval of two projects at the Cabin Creek Hydroelectric Facility: upgrades to Units A and B to increase generating capacity and improve efficiency ("Upgrade Project"), and the extension of the Upper Reservoir Dam to allow for additional storage capacity ("Upper Reservoir Expansion Project"). Public Service plans to modify its existing pumped storage facility by increasing the existing pump turbine unit capacity from 324 MW to 360 MW, providing an additional 36 MW of capacity. This project will also extend the life of the facility to operate for an additional 40 years and improve the overall round-trip storage efficiency from 64.4 to 72.4 percent. The project will further expand the size of the Upper Reservoir to provide an additional 76 acre-feet of storage capacity. This expansion will provide an additional 112 MWh of energy generation per storage cycle to Cabin Creek's current 1,074 MWh storage capacity.

[1] Equipment is typically placed in service before a project is considered "complete," as completion reflects the resolution of documentation and contractor payments that do not directly affect the operation of the resource.

GE Renewable Energy[2] ("GE"), a subsidiary of General Electric, was awarded an Engineering Procurement, and Construction contract for the rebuild of the pump-turbine motor-generators for both Unit A and Unit B in September 2016. GE performed design and procurement in 2017 and began construction work at Cabin Creek in June 2018. The outage on Unit A for purposes of the upgrade commenced on July 11, 2018. Disassembly of the unit was completed in September 2018. In 2019, GE continued design, procurement, manufacturing, and construction activities. GE completed the Unit A turbine and generator reassembly in 2020, achieving Unit A Mechanical Completion on November 10, 2020.

Several problems were discovered during Unit A commissioning in 2021. In some circumstances the rebuilt unit produced an electrical current that exceeded the isolated bus capacity and caused overheating of some components. Deficiencies were discovered with the original isophase bus installation that contributed to the heating issues. The isophase bus was cleaned and gasket materials were replaced, which allowed the unit to be placed back into service. Another problem occurred with Unit A's turbine shaft seal. It was discovered that a foreign body had been introduced that damaged the seal, requiring replacement of the damaged seal component. Unit A was online and placed in-service on July 30, 2021.

Unit B tripped offline on January 3, 2021. The outage was caused by a problem with the rotor, unrelated to the Upgrade Project. The part that failed was due to be reconfigured and replaced during the Upgrade Project. As a result, Public Service decided to begin the Unit B upgrade work earlier than the planned upgrade outage date of February 2021 rather than attempt a repair to the rotor that was due to be replaced during the Upgrade Project.

During the upgrade work, a problem with the original rotor pole design was recognized and the rotor pole connection was then redesigned for the replacement rotor. Other projects completed during this phase include: asbestos and lead paint abatement; the installation of new Generator Start Up ("GSU") transformers and auxiliary transformer; and GE completed the disassembly work and began restoration activities.

During 2021 there were challenges and problems that had an adverse impact to the project schedule and completion. Issues leading to delays in 2021 included defects and deficiencies of the existing isolated phase bus, overheating of components at or near the isolated phase bus, turbine shaft seal installation defect, plant gantry crane break downs, turbine guide bearing babbitt damages, turbine oil deflector leak, excessive runout at pony motor slip ring, and field lead connection. We are actively collaborating with the project's contractors to address these challenges and continue moving the

[2] Prior to 2020, GE Renewable Energy was known as Alstom Renewable Energy.

project towards completion. Furthermore, as issues arose during the engineering and construction of Unit A, we worked with GE to develop “lessons learned” that will allow us to anticipate and proactively address similar issues that could arise with Unit B.

As in 2020, the project continued to experience delays due to the COVID-19 Pandemic. Pandemic precautions and restrictions resulted in several short disruptions to work on the Project.

## UNIT A

In January of 2021, Xcel Energy contractor ABB completed installation of the new bearing and seals on the phase reversal switch gearbox and GE completed reinstallation of the switch mechanism and gearbox.

Following installation, the Unit A commissioning resumed on January 11, 2021. The pump mode heat run was started but the unit tripped after only running for about one hour. The transformer fire protection system detected high temperatures and activated the deluge, which then tripped the unit. High temperatures at a ground bar and at tray hangers were measured. The commissioning was suspended to investigate the cause of the trip and high temperatures. The team suspected high temperatures were caused by circulating currents outside of the isolated phase bus. The team started work on inspection and replacement of insulating and grounding components for the isolated phase bus on January 14, 2021. During the inspection, it was determined that structures in the transformer yard were not grounded and fire protection components were attached to the ungrounded structures. Heating of those components was determined to be the likely cause of the deluge activation during the pump testing. Additionally, at the isolated phase bus, problems with insulation and grounding were discovered; wrong size bolts at section jumps, loose connections, poor ground connection, amortisseur grid in contact structure, and ground wire touching support beam. Correction work included installing new grounds, insulators, bonding bars and straps, and connection pads.

Following the correction work, the Unit A commissioning resumed, and the pump mode heat run test was completed on January 30, 2021 with positive test results. The first two sets of pump mode index tests were completed on February 2, 2021 with positive test results. However, the Unit A commissioning was put on hold pending resolution of problems discovered with the turbine shaft seal. GE submitted a root cause analysis for the turbine shaft seal failure that found that a washer was accidentally dropped into the seal. The shaft seal installation was delayed until an unrelated oil leak discovered during the repair to the turbine shaft seal was fixed. GE found the ring splits were not flat with defects on the mating surfaces and there were fragments of babbitt at the Unit A turbine guide bearing oil pot. GE completed installation of the refurbished turbine oil

slinger on May 4, 2021. GE completed the reconditioning of the Unit A turbine guide bearing ("TGB"). The TGB was reinstalled on May 4, 2021.

Following the TGB reinstallation, the Unit A commissioning resumed on May 19, 2021. Additional testing of the unit, including the Push Test, Bump Test, Slow Roll, and speed-no-load stabilization were successfully completed. Heat runs at 20%, 75%, and 100% power and a load rejection at 40% power were also successfully completed.

The Unit A commissioning was stopped on May 25, 2021 after a hot spot was discovered at the isolated phase bus in the transformer yard. A plant electrician observed white colored smoke during a commissioning test. Public Service investigated and on May 28, 2021 decided to replace the insulation at the outer covers and at the hat bars between sections for safety. GE diverted personnel from Unit B to Unit A isophase bus work. Additionally, during this repair work, Public Service's contractor SE Energy completed maintenance at the Unit A isolated phase bus.

Following the isolated phase bus work, commissioning continued and while Unit A was generating on July 14, 2021, a contractor reported an arc at the Unit A transformer ground bus. GE completed adjustments to the balancing weights at the exciter level above the pony motor. The additional balancing reduced vibration at the old exciter elevation above the pony motor by about 40%. On July 27, 2021 GE Power, a subsidiary of General Electric contracted by Public Service to supply the new excitation equipment for the Upgrade Project, and Public Service made the exciter program changes and a short test run confirmed that the changes were tracking as expected. On July 28, 2021 Public Service repeated the Large Generator Interconnection tests in both generating and pumping modes. Unit A was placed back into service on July 30, 2021.

Cabin Creek has traditionally served as a black start resource, a critical reliability and resilience resource capable of being restarted without electricity supplied from the grid, for the Public Service system. On September 14, 2021, Public Service conducted a black start test which failed due to a problem with the excitation equipment. GE Power performed engineering design for adding a small transformer and switch at the potential power transformer to make the exciter black start ready. Further work by GE Power is necessary to restore Unit A's black start capability. This work is expected to be complete in September 2022.

A GE Power excitation engineer activated the power source stabilization feature on September 21, 2021. GE Power has competed the WECC PSS 501 tuning study report.

On October 2, 2021 testing indicated a problem with the Unit A rotor. Further investigation and testing isolated the problem to the field leads. It was discovered that the cable that is routed inside of the generator shaft had separated from the connection

lug. The lug had rotated and contacted the shaft causing the ground fault. GE reworked the field lead connection and completed disassembly to access the cables including removing the pony motor rotor. GE completed installation of redesigned insulating blocks and completed the repair of the field leads. The plant gantry crane, which was needed for reassembly of the pony motor, broke down on November 15, 2021 and was not returned to service until December 18, 2021. These further repairs on Unit A were completed in 2022.

## UNIT B

As noted above, Unit B alarmed and tripped on January 3, approximately one month ahead of the scheduled outage for the Upgrade Project. GE inspected the generator on January 4, 2021 and found damage at the stator windings and bars that it believed could not be repaired on site. Public Service decided to begin the Unit B upgrade work rather than attempt a repair of a part that was scheduled to be replaced and GE began the Unit B disassembly work.

Surface dust wipe samples taken from the surfaces at the Unit B generator yielded positive test results for asbestos fibers. Hudspeth, a project contractor, began precautionary cleaning of the surfaces on February 19, 2021. Another contractor, NorthStar, was hired to perform additional lead and asbestos abatement work. NorthStar completed lead paint abatement at the spider, the draft tube, and at the upper and lower brackets; cut the stator bars and cleaned contamination from the generator coolers and completed blast cleaning of lead paint from the stator frame. This abatement work was completed at the end of September 2021.

In May 2021, the pony motor stator and the turbine shaft were shipped off site for refurbishment. GE completed removal of the head cover, bottom ring, runner, rotor rims, bearings, and generator shaft; collected measurements of the generator shaft and embedded parts; and cut the upper rotor rim for transport and disposal.

In July 2021, GE began removal of the stator laminations but stopped work due to concerns with high concentrations of asbestos fibers. NorthStar completed abatement at the turbine area and worked with GE to complete abatement and removal at the generator stator. Abatement at the generator stator was completed in August.

During the disassembly of Unit B, GE submitted as-found reports and while no major damages were found, GE recommended restoration work to the generator shaft, upper and lower bracket, and the thrust block and thrust runner. Other turbine parts embedded in concrete within the plant were found to be in poor condition and are more difficult to restore.

GE received the new rotor spider and rotor laminations on-site on September 1. GE prepared for the embedded components restoration work and received baghouse equipment to be used during welding work. Assembly of the new generator rotor began around September 15. GE has completed installation of the new rotor spider onto the generator shaft, and assembly of the full generator rotor is continuing into 2022. Assembly of Unit B was delayed when the plant gantry crane broke down on September 28 and was fixed within a few days. GE began the Unit B embedded parts restoration work on October 18 and worked two shifts per day on the Unit B embedded parts restoration. Inspection of the removed liner showed severe cavitation damage with holes completely through the steel plates. In November, GE continued to work two shifts per day on the Unit B embedded parts restoration; however, space limitations within the draft tube limited the number of active workers at any given time. As noted above, in November 2021, the plant gantry crane broke down and was out of service for approximately one month. This delayed the assembly of rotor rims, because the crane was needed to lower the crates of rotor rim laminations into the powerhouse.

## TRANSFORMER REPLACEMENTS

In May 2021, oil was drained from the auxiliary transformer and from the GSU transformers. At the end of June, Siemens and their subcontractor, A-Line, completed removal of the GSU and auxiliary transformers. Siemens delivered the first of three GSU transformers on July 6, and then completed dressing the GSU transformers and oil fill. Siemens completed delivery and placing the auxiliary transformer on October 18. Siemens began dressing out the transformer on October 20.

Industrial Constructors/Managers (“ICM”), a contractor of Public Service, mobilized on June 28, 2021 to perform modifications to auxiliary transformer foundation. ICM constructed modifications to auxiliary transformer foundation and poured concrete on July 8, 2021. The concrete strength of the newly poured auxiliary transformer foundation did not meet the minimum code requirements or the minimum design strength and had to be removed and replaced. ICM began concrete removal of the new concrete at the auxiliary transformer foundation on August 16, 2021. Additionally, while the work on the auxiliary transformer foundation was taking place, additional wide cracks were discovered in the existing secondary oil containment slab and a large void was discovered below the slab. ICM removed and replaced the southern half of the auxiliary transformer secondary containment slab to correct the discovered defects. In October, ICM completed their scope of work including the concrete replacements and demobilized.

CoscoFire, a contractor hired by Public Service to upgrade fire protection equipment at the new transformers, completed modifications to the fire protection at the GSU and

auxiliary transformers. CoscoFire completed pressure testing of the deluge pipe systems in November 2021.

## UPPER RESERVOIR PARAPET WALL EXTENSION

In early July of 2021, the Federal Energy Regulatory Commission ("FERC") authorized Public Service to proceed with the construction work for the Upper Reservoir Expansion portion of the project. The contract with American West Construction ("AWC") for the Upper Reservoir Expansion construction was signed on July 23, 2021. AWC started work in early August, beginning with the left abutment. On August 18, 2021 the drill rig for the soil nail shoring was delivered to site and AWC excavated the first bench for the soil nail installation. AWC performed exploratory excavation at the abutments and found the depth of bedrock was shallower than expected. The foundation and foundation drain design was revised due to the shallow bedrock. AWC completed construction of the soil nail wall shoring at the west abutment and the concrete test pour was performed on September 7, 2021. An inspection of the abutment excavations by FERC engineers was performed on September 7, 2021. AWC completed excavation at both end abutments.

On September 22, 2021 AWC completed first excavation segment for the buttress foundation. The excavation was inspected and approved by FERC and the State Engineers Office. On September 29, 2021 AWC completed placing dowels for the first segment of buttress footing. The dowel pullout strength was tested by subcontractor, Terracon, and witnessed by Public Service and the State engineer. AWC completed placing concrete for first segment of buttress footing and completed placing dowels and setting reinforcing steel for the next 160 feet segment of buttress footing. The excavation was inspected and approved by a FERC engineer on October 15, 2021. AWC completed the last concrete pour for 2021 on October 19. HDR, Inc. ("HDR"), the contractor conducting design work for the Upper Reservoir Expansion Project, completed responses to FERC comments regarding revision to the abutments that were necessary to account for shallow bedrock depths. A site walk down with AWC was held on November 4, 2021 and AWC demobilized for the season. AWC plans to resume construction in April or May of 2022 depending on weather conditions.

# PROJECT FINANCIAL PERFORMANCE

The total estimated cost of the Cabin Creek project detailed in our Application in Proceeding No. 15A-0304E was approximately $87 million for the Upgrade Project, as shown in Confidential Attachment 2, and approximately $1.1 million for the Upper Reservoir Expansion, as shown in Confidential Attachment 3. As of December 31, 2021, Public Service estimates that total approximate costs incurred for the Cabin Creek project to date are $84 million for the Upgrade Project and $10 million for the Upper Reservoir Expansion Project.

The budget for the Upgrade Project shown in Confidential Attachment 4, Summary Cost Estimate, is divided into direct costs and indirect costs. The direct cost contracts and purchase orders account for approximately 83 percent of the total project budget, indirect costs account for 15 percent of the total project budget, and general project contingencies account for approximately 2 percent of the total project budget. Certain items are currently estimated to cost more than originally budgeted. For example, the largest deviation from the Upgrade Project budget presented in the Application is for Specialty Contracts. This item in the budget has increased primarily due to the identification of work necessary for the remaining balance of plant electrical work, modernization of the fire protection equipment for the new transformers, concrete work at the auxiliary transformer, and improvements at the isolated phase bus. These increases are accounted for in the contingency allowance, and the current overall Upgrade Project budget is very similar to the original budget. As of December 31, 2021, we have spent approximately $64.5 million or about 77 percent of the current project budget of $83,576,726 for the Upgrade Project.

The budget for Upper Reservoir Expansion Project has increased substantially from the Company's initial cost estimate and the current budget for the project is based on Public Service's contract prices to for the work to be completed. The baseline estimate for the Upper Reservoir Expansion Project was developed from a conceptual design and the scope and scale project has grown to meet safety and adequacy requirements as part of the FERC licensing process. As the detailed design developed, both the height of the parapet wall extension and the duration of the construction increased, leading to increases in the budget. As of December 31, 2021, the Company has spent approximately $2.8 million, or 28 percent, of the expected project cost of $10,116,060 for the Upper Reservoir Expansion Project. While this is a substantial increase relative to the CPCN forecast of approximately $1.1 million, Public Service notes that the net benefits of the project identified in the Application, approximately $316 million over 40 years, still greatly outweigh these incremental costs.

# PROJECTED VS. ACTUAL CONSTRUCTION SCHEDULE

The Company included with its Direct Testimony in Proceeding No. 15A-0304E a project schedule showing completion of the Upgrade Project in May 2020 and the completion of the Upper Reservoir Expansion Project in September 2018. Attachment 5 is the Company's project schedule reflecting current progress and estimated completion dates for both the Upgrade Project and Upper Reservoir Expansion Project. The completion date for the Upgrade Project is delayed due to discovery of damage and wear of the existing equipment, discovery of asbestos needing abatement, and challenges with manufacturing and installation. The completion date for the Upper Reservoir Expansion is delayed due to increases in the scope and scale of the project necessitating additional time for pre-construction design and engineering, as well as additional time for construction. Unit A was placed in-service on July 30, 2021 and the work for the Upgrade Project on Unit A is forecast to be complete during the second quarter of 2022. Unit B is forecast to be online and in-service during the first quarter of 2023 and the Upgrade Project on Unit B is forecast to be complete during the second quarter of 2023. The Upper Reservoir Expansion project is forecast to be in-service by the end of 2022 and the project is forecast to be complete by the end of 2023.