**Disclosure of Hydroelectric Generation and Transmission Equipment Issues**

 **at Rocky Reach and Rock Island Projects and other related issues.**

This disclosure document addresses ‘specific’ issues that are not considered to be outages for preventative maintenance, normal maintenance, or unit rehabilitations for equipment normal use and aging. Chelan PUD (“District”) provides a separate list of ‘planned’ outages for both Rocky Reach and Rock Island that should be considered when evaluating the District’s Slice Product. This disclosure document also addresses miscellaneous items associated with District’s Slice Product.

**ROCKY REACH AND ROCK ISLAND RESERVOIR ENERGY CONTENT CURVES:**

**Issue**

The original energy content tables, that have been used from 1999 – 2021, were constructed using data and tail water elevation estimates dating back to the 1970’s and included adjustments for both upstream and downstream encroachment. It has been determined that the energy content tables need updating to correct them for 1. inaccuracies from using 1970’s data and estimates, and 2. removal of the adjustments for both upstream and downstream encroachment energy which is now dealt with separately.

**Remedy**

The District will be revising both the Rocky Reach and Rock Island energy content tables to 1. correct for inaccuracies in the energy content tables and 2. adjust for the removal of the adjustments for upstream and downstream encroachment energy. Recent production data was used to calculate the proposed energy content tables. The Rocky Reach maximum pond has been revised to 2,970 MWh from 3,283 MWh and the Rock Island maximum pond has been revised to 418 MWh from 623 MWh.

The revised energy content tables should alleviate the physical to paper reservoir mismatch that has been continuously ‘worked off’ or ‘trued up’ in the energy accounting software. The performance and flexibility of the slice products should not be materially impacted since the physical reservoir remains the same and only the modeled paper reservoir is being corrected.

**WANAPUM TO ROCK ISLAND ENCROACHMENT ENERGY:**

Pending Litigation Regarding Encroachment. Public Utility District No. 1 of Chelan County v. Public Utility District No. 2 of Grant County, Kittitas County Case No. 20-2-00242-19 (filed May 29, 2020)

**Issue**

Over fifty years ago, defendant Public Utility District No. 2 of Grant County ("Grant") proposed to construct the Wanapum Dam downstream from plaintiff Public Utility District No. 1 of Chelan County's ("Chelan's") Rock Island Hydroelectric Project (the "Rock Island Project"). Grant's proposed Wanapum Dam would cause an encroachment on Chelan's Rock Island Project, thereby reducing the Rock Island Project's generating capacity. In exchange for Chelan's agreement not to protest the construction of Wanapum Dam, Grant committed to make Chelan whole for the losses to hydropower generation at the Rock Island Project caused by the Wanapum Dam's encroachment.

In the decades since, Grant has been delivering to Chelan the hydropower energy necessary to make Chelan whole under the parties' agreements. However, due to a recent change in the delivery mechanism between the parties, as well as statements made by Grant regarding the scope of its commitments under the parties' agreements, Chelan has a well-grounded fear that Grant will fail to meet its obligation to provide Chelan with encroachment power from hydropower sources. Therefore, Chelan seeks judicial relief to declare Chelan's right under the parties' agreements to receive encroachment power from hydropower sources, as well as judicial relief to prevent Grant from failing to honor its commitments under the parties' agreements to make Chelan whole for Grant's encroachment on Chelan's property.

**Remedy**

Pending litigation

**ROCK ISLAND HYDROELECTRIC PROJECT POWERHOUSE NO. 1:**

**Current Unit Status:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Unit | Status as of today’s date | Description | Outage Start | Expected Return |
| B1 | Out of Service | Turbine replacement |  | 9/25/23 |
| B2 | Out of Service  | Turbine replacement |  | 1/08/23 |
| B3 | Out of Service  | Turbine replacement |  | 8/16/22 |
| B4 | Out of Service  | Turbine replacement |  | 5/15/21 |
| B5 | Out of Service | Unit Modernization |  |  9/30/21 |
| B6 | In Service | Contract Warranty Repair Work | 8/26/21 | 3/26/22 |
| B7 | Out of Service | Unit Modernization |  |  7/27/21 |
| B8 | In Service | Unit Modernization | 7/05/22 | 7/28/23 |
| B9 | In Service | Contract Warranty Repair Work | 6/16/23 | 2/07/24 |
| B10 | Out of Service | Turbine Hub Modifications |  |  3/01/21 |

**Background**

Rock Island Powerhouse No. 1 consists of 10 generating units. The four original units (B1-B4) were installed in the 1930’s and an additional six units were added in the 1950’s. Three of the four original units at Powerhouse No. 1 (B1, B3 and B4) have upgraded generator stators and have their original generator rotors and turbine runners. Units B9 and B10 were rehabilitated with new stators, turbines and governor and excitation systems.

A second powerhouse (Powerhouse No. 2) was built in the late 1970’s with eight generating units.

**Rock Island B1-B4 Turbine Corrosion Fatigue**

**Issue**

During the Unit B2 generator stator replacement work, fatigue cracks were observed on the blades of the turbine. From October 2015 through January 2016, District maintenance staff made repeated attempts to grind out the cracks and repair the resulting excavations with various welding procedures. After each repair procedure, inspections resulted in the observation of new fatigue cracks. Engineering analysis indicated the B2 turbine is experiencing a phenomenon known as Corrosion Fatigue. The turbines of Units B1, B3 and B4 are of similar design and vintage as Unit B2. These three units were taken out of service and inspected to determine if similar cracking exists in their turbine runner blades. These turbines also had significant cracking due to Corrosion Fatigue. All four turbines, B1 through B4 will remain out of service until the District can design, procure and install replacement turbine runners.

**Remedy**

The District has completed the development of specifications for the procurement of turbine runners for units B1 through B4. Competitive bids were received on December 22, 2016 and the contract awarded to Andritz Hydro in a Special Commissioner meeting on December 30, 2016. Site work on unit B4 was initiated in October 2018 with an expected return to service date of May 2021. Each of the remaining three units (B3, B2 and B1) are scheduled to have the runners replaced at the completion of the B4 turbine replacement. Each turbine replacement is expected to last 10 months per unit. Each turbine replacement project also has the potential of needing discharge liner repairs which is included in the 10 month duration estimate.

**1) Expected case scenario (as of February 2021)**: All four of the B1 through B4 units will remain out of service until such time the respective turbine is replaced. Each unit is scheduled for turbine replacement and will be returned to service, with the last turbine replacement being complete in January 2023. This scenario performs work on the four units sequentially resulting in the turbine replacement schedule as follows:

UNIT START DATE RETURN TO SERVICE DATE

B4 out of service until May 2021

B3 out of service until August 2022

B2 out of service until January 2023

B1 out of service until September 2023

**Rock Island B5 through B10 Unit Modernizations**

**Issue**

The District initiated a series of sequential outages in January 2007 to modernize units B5 through B10. The scope of work for the modernization contract included the replacement of turbine runners, governor systems, generator stators and rotor poles, and control systems. By May 2017, the contractor selected for this work had completed work on units B10, B9, and B6. In June of 2017, unit B9 suffered a Kaplan pipe failure and remained out of service until repairs were complete on October 3, 2018. In June 2019, unit B10 was removed from service to perform an overhaul and conduct turbine inspections. During the inspection, the District discovered a few internal turbine components had failed or were near failure. Subsequent inspections on unit B9 and B6 yielded similar observations of failed internal turbine components as B10. It was determined that it was safe to run the units in this condition until the final repair could be made so B6 and B9 are currently ‘in service’.

The modernization contractor conducted a root cause analysis of these failures and reviewed their findings with the District in August 2019. The District concurs with the contractor’s findings and is currently negotiating, with the contractor, the cost to the District to restore the units and the also the schedule to complete the work.

**Remedy**

Four repairs were identified to restore B6, B9 and B10. Once final negotiations with the contractor are completed, the District estimates an additional six-month outage to implement the repairs.

Since the remaining units in the modernization project (B5, B7 and B8) are of similar design, the repairs identified above will be performed during the modernization outage.

**Schedule**

Since units B7 and B10 are currently out of service, the restoration repairs identified above will be implemented on these units first. The District estimates repairs to be completed on B10 and the unit returned to service in March 2021 followed by B7 returning to service in July 2021.

**Rock Island Tentative Modernization and Turbine Repair Outage Schedule**

UNIT START DATE RETURN TO SERVICE DATE

B5 Modernization project Out of Service Sep 2021

B6 Turbine repairs Aug 2021 Mar 2022

B7 Modernization project Out of Service Jul 2021

B8 Modernization project Jul 2022 Jul 2023

B9 Turbine repairs Jun 2023 Feb 2024

B10 Turbine repairs Out of Service Mar 2021

**ROCK ISLAND HYDROELECTRIC PROJECT POWERHOUSE 2:**

**Current Unit Status:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Unit | Status as of today’s date | Description | Outage Start | Expected Return |
| U1 | In Service |  |  |  |
| U2 | In Service |  |  |  |
| U3 | In Service |  |  |  |
| U4 | In Service |  |  |  |
| U5 | In Service |  |  |  |
| U6 | Out of Service | Standard Overhaul |  | 4/1/21 |
| U7 | In Service |  |  |  |
| U8 | In Service |  |  |  |

**Rock Island Powerhouse No. 2 U1-U8 Modernizations**

**Background**

The second Rock Island Powerhouse was constructed in 1979 and consists of 8 horizontal bulb generating units. In the late 1980’s, stator frames and stator windings were either replaced or repaired to due deficiencies in design. Since then, no other significant repairs or replacements of turbines or generators has occurred.

A modernization contract is in place for the future replacement of the generator stators and rotors, governor systems, and to convert the turbines to ‘oil-free’ hubs.

**Powerhouse No. 2 Tentative Modernization Schedule**

UNIT DESCRIPTION START DATE RETURN TO SERVICE DATE

## U1 Modernization Nov 2028 Nov 2029

U2 Modernization Dec 2027 Dec 2028

U3 Modernization May 2024 May 2025

U4 Modernization Apr 2025 Apr 2026

U5 Modernization Jan 2022 Apr 2023

U6 Modernization Feb 2027 Feb 2028

U7 Modernization Jun 2023 Jun 2024

U8 Modernization Mar 2026 Mar 2027

**Rocky Reach Hydroelectric Project:**

**Background**

Rocky Reach Powerhouse consists of 11 generating units. The seven original units (C1 - C7) were installed and in commercial operation by 1961. The remaining four units (C8 - C11) were added and in operation by 1971. All turbines, generators, main transformers and control systems were replaced in major upgrade projects beginning in 1995 and completed in 2006.

Current Unit Status:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Unit | Status as of today’s date | Description | Outage Start | Expected Return |
| C-1 | In Service |  |  |  |
| C-2 | In Service |  |  |  |
| C-3 | Out of Service | Turbine hub bushing replacements |  | Jun 2021 |
| C-4 | In Service | Turbine hub bushing replacements | Apr 2021 | Oct 2021 |
| C-5 | In Service | Turbine hub bushing replacements | May 2021 | Dec 2021 |
| C-6 | In Service | Turbine hub bushing replacements | Sep 2021 | Apr 2022 |
| C-7 | Out of Service | Turbine Hub Bushing Replacements |  | May 2021 |
| C-8 | In Service |  |  |  |
| C-9  | In Service |  |  |  |
| C-10 | In Service |  |  |  |
| C-11 | In Service |  |  |  |

**Rocky Reach C8-C11 Large Unit Turbines**

**Background**

As part of ongoing maintenance of District hydro projects, seven Kaplan style turbines (C1-C7) were rehabilitated and four fixed blade turbines (C8-C11) were converted to adjustable blade (Kaplan) at the Rocky Reach Powerhouse from 1996 to 2003 by RIVA HydroArt/Voith Hydro. The purpose of the project was modernization of the turbines to provide higher efficiency while incorporating fish friendly features with a runner blade design life of 50 years.

**Issue**

On March 25, 2013, the District’s unit C10 tripped off-line due to a blade deviation from setpoint. Initial investigation revealed an internal oil bypass condition in the turbine blade servo-motor system along with deposits of metal in the oil return basin. A partial in-place turbine disassembly identified significant wear to internal servo-motor seal rings and bushings as well as to blade trunnion bushings.

Based on initial findings, District staff determined a full generator and turbine disassembly was required to determine all possible causes of the blade deviation, oil bypass and wear conditions. During the turbine disassembly, a crack was discovered in the main servo-motor operating rod. Through engineering analysis and review with District staff, Voith Hydro and MWH Engineering, the cause of the crack was determined to be a design flaw.

On September 23, 2013, units C8, C9 and C11 were removed from service to protect the public, employees, equipment and environmental safety due to having the same turbine design and internal construction. District staff, with Voith and MWH review, proposed a temporary solution for interim operations as fixed blade (propeller) units that allows generator use until a permanent solution is designed and implemented.

This condition is unique to generating units C8-C11 and does not include units C1-C7.

**Remedy**

On November 8, 2013, District crews commenced with interim repairs on unit C11 consisting of welding blocks onto the turbine runner hub to lock the blades in the full steep position providing safe reliable operation as a propeller turbine. Successful operational and index testing was performed on unit C11 and modifications continued to C8, C9 and C10. Units C8-C11 will be operated as interim repaired propeller turbines until final designs and permanent repairs return them to full Kaplan operation. In September 2014, a plan was approved by the District’s Board of Commissioners to restore adjustable blade capability to C8-C11, enhancing power generation and assuring continued successful fish passage at Rocky Reach.

**Schedule**

The implementation of the interim repair program (propeller operation) was completed in April 2014. The final turbine repairs will require unit outages that are estimated to last 14 months and will include the installation of new governor control and exciter systems. The final repair work was completed on unit C8 in Dec 2017. Until all permanent repairs are complete on C9, C10 and C11, each interim repaired turbine will require an inspection at approximately 3800 hours of run time. It is estimated, but not assured, that each inspection requires a unit outage of one week (5 days).

**Remedy and Future Schedule**

All four units have turbine repairs planned for the final repair discussed earlier in the “C8-C11 Servo-Motor Rod” section to return to variable pitch blade Kaplan operation. These planned outages are currently scheduled to be done one at a time. The outage schedule for turbine repairs and rewinds is as follows:

**1) Rocky Reach Tentative Outage Schedule (as of February 2021):**

UNIT DESCRIPTION START DATE RETURN TO SERVICE DATE

C9 Turbine repairs completed

C10 Turbine Repairs Jun 2022 Aug 2023

C11 Turbine repairs Nov 2021 Jan 2023

**Rocky Reach C1-C7 Small Unit Turbines**

**Background:**

In Jan 2018, it was noticed that unit C1 had a leak so it was removed from service to investigate the cause. The investigation determined that the trunnion bushings on the turbine hub were worn and required repair or replacement. C2 through C7 are of similar design to C1 and require trunnion bushing replacements. The C1 and C2 turbine bushings were replaced and the unit returned to service in January 2020 and December 2020, respectfully. C3 and C7 are currently out of service and undergoing the same repairs as performed on C1 and C2.

Units C4, C5, and C6 are in service; however, the trunnion bushings on these units are the same design as C1 and are scheduled for replacement in the future.

**Remedy and Future Schedule:**

The District completed the trunnion bushing replacements on C1 in January 2020, C2 in December 2020, and is currently working on units C3 and C7 to replace the trunnion bushings. Similar repair work as C1 is scheduled for the remaining units C3, C4, C5 and C6.; each requiring approximately 7 months to complete the trunnion bushing replacements.

Best Case Repair schedule:

UNIT DESCRIPTION START DATE RETURN TO SERVICE DATE

C1 Trunnion bushing replacement-completed

C2 Trunnion bushing replacement-completed

C3 Trunnion bushing replacement Out of Service Jun 2021

C4 Trunnion bushing replacement Apr 2021 Oct 2021

C5 Trunnion bushing replacement May 2021 Dec 2021

C6 Trunnion bushing replacement Sep 2021 Apr 2022

C7 Trunnion bushing replacement Out of Service May 2021

Potential Repair Schedule Delays:

The schedule above is dependent on the repairs being completed within 7 months per unit. Due to COVID-19 supply chain issues, the recent turbine repair took 11 months to complete. The District has made several equipment purchases in advance to minimize future delays due to material unavailability. However, there remains the potential discovery of other previously unknown problems requiring the replacement of turbine components resulting in longer outage durations.

Potential impacts to Rocky Reach spring fish spill requirements:

Spring fish spill at Rocky Reach could possibly be implemented if 2 of the 3 units (C1, C2, and C3) are out of service at the same time. C1, C2 and C3 provide the attraction water flow to the Juvenile Fish Bypass which transports juvenile out-migrating fish around the dam as an alternative travel path through the dam. If 2 of these 3 units (C1, C2, and C3) are out of service, it may result in Chinook, steelhead, and sockeye smolts using other passage routes over the dam (turbines) which have slightly measured lower survival. While staff believe the overall survival standard metric of 91 percent combined adult and juvenile survival would still be met, parties to the Rocky Reach Habitat Conservation Plan (HCP) could request spring time spill to supplement the Juvenile Fish Bypass operation (currently Rocky Reach is the only dam on the Columbia that does not spill for fish passage in the spring) since the proposed operation of having at least 2 of the 3 units (C1, C2, and C3) not operational during spring outmigration is different than what was tested under survival studies. Historical Rocky Reach spring fish spill has been zero since 2007. Prior to 2007, the Rocky Reach spring fish spill was between 0 and 25%.

**OTHER ISSUES:**

**Transmission out of Rock Island Project:**

**Background and Issue**

Due to the December 2015 curtailment of a major industrial load near the Valhalla and McKenzie substations, the District has revised its operational protocols.  The curtailment of the large load in this vicinity requires the McKenzie - Valhalla substation 115kV tie line to be operated in an ‘open’ (disconnected) configuration when the ambient temperature is approximately 68F or higher.

This ‘open’ configuration allows the District to operate the Rock Island project normally except when Rock Island generation is above 465 MW and the ambient temperatures are above 86F (dependent on regional generation patterns, planned or emergency line outages, etc.).  The District’s preliminary studies show this condition could happen approximately 20 hours per year based on 10-years of historical data.

When the McKenzie – Valhalla 115kV tie line is operated in the ‘open’ condition and the ambient temperature is above 86F, the BPA Valhalla Substation (Rock Island) Point of Delivery will be limited to approximately 200 MW.  The other Points of Delivery will not be limited due to these conditions.

It is unknown if the major industrial load will return or remain curtailed during the term of the contract.

**Remedy**

The District has developed and implemented emergency transmission line ratings for the 115kV transmission lines that leave McKenzie substation. With the implementation of these emergency transmission line ratings, it is expected when in this ‘open’ configuration **and** the ambient temperature is above 86F, Rock Island generation may likely not have to be limited to 465 MW based on historical information for an all lines in-service condition. The District is currently working on a permanent solution to install a Remedial Action Scheme (RAS) by late-2021 that will alleviate Rock Island generation restrictions for the all-lines in service condition.