TYEE LAKE HYDROELECTRIC PROJECT

FERC NO. 3015

EXHIBIT A

PROJECT DESCRIPTION

TYEE LAKE HYDROELECTRIC PROJECT
(FERC NO. 3015)

APPLICATION FOR LICENSE AMENDMENT
FOR MAJOR PROJECT – EXISTING DAM

EXHIBIT A
PROJECT DESCRIPTION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

1.0 INTRODUCTION

The Southeast Alaska Power Agency (SEAPA) operates the Tyee Lake Hydroelectric Project (Tyee Lake Project or Project) located on Tyee Creek approximately 40 miles southeast of Wrangell, 70 air miles southeast of Petersburg, and 60 miles northeast of Ketchikan, Alaska (Figure 1-1) under a license issued by the Federal Energy Regulatory Commission (FERC or Commission) (FERC No. 3015).

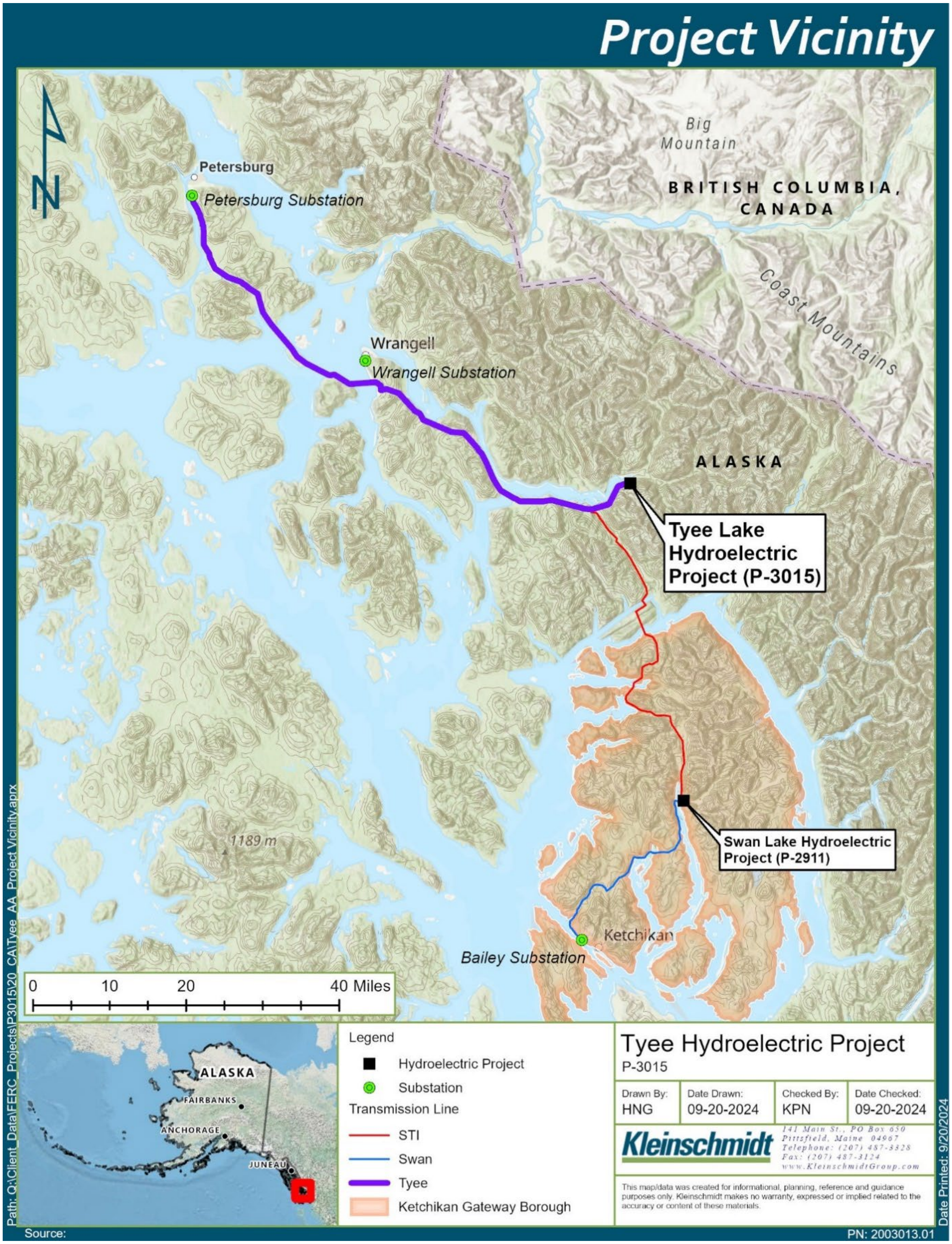

Figure 1-1 Tyee Lake Hydroelectric Project (FERC P-3015) Location Map.

2.0 PROJECT DESCRIPTION AND PROPOSED FACILITIES

Section 2.1 describes the current project configuration; Section 2.2 provides additional details related to the proposed amendment (i.e., the installation of a third turbine generator unit).

2.1 Tyee Lake Project Features

The Tyee Lake Project features consist of a spillway weir, lake tap intake, power tunnel, penstock, powerhouse, switchyard, transmission line, and appurtenant structures (Figure 2-1). The Tyee Lake Project does not include a dam but diverts water to the powerhouse from the naturally impounded Tyee Lake through a lake tap intake. The Tyee Lake Project components and specifications are presented in Table 2-1 below.

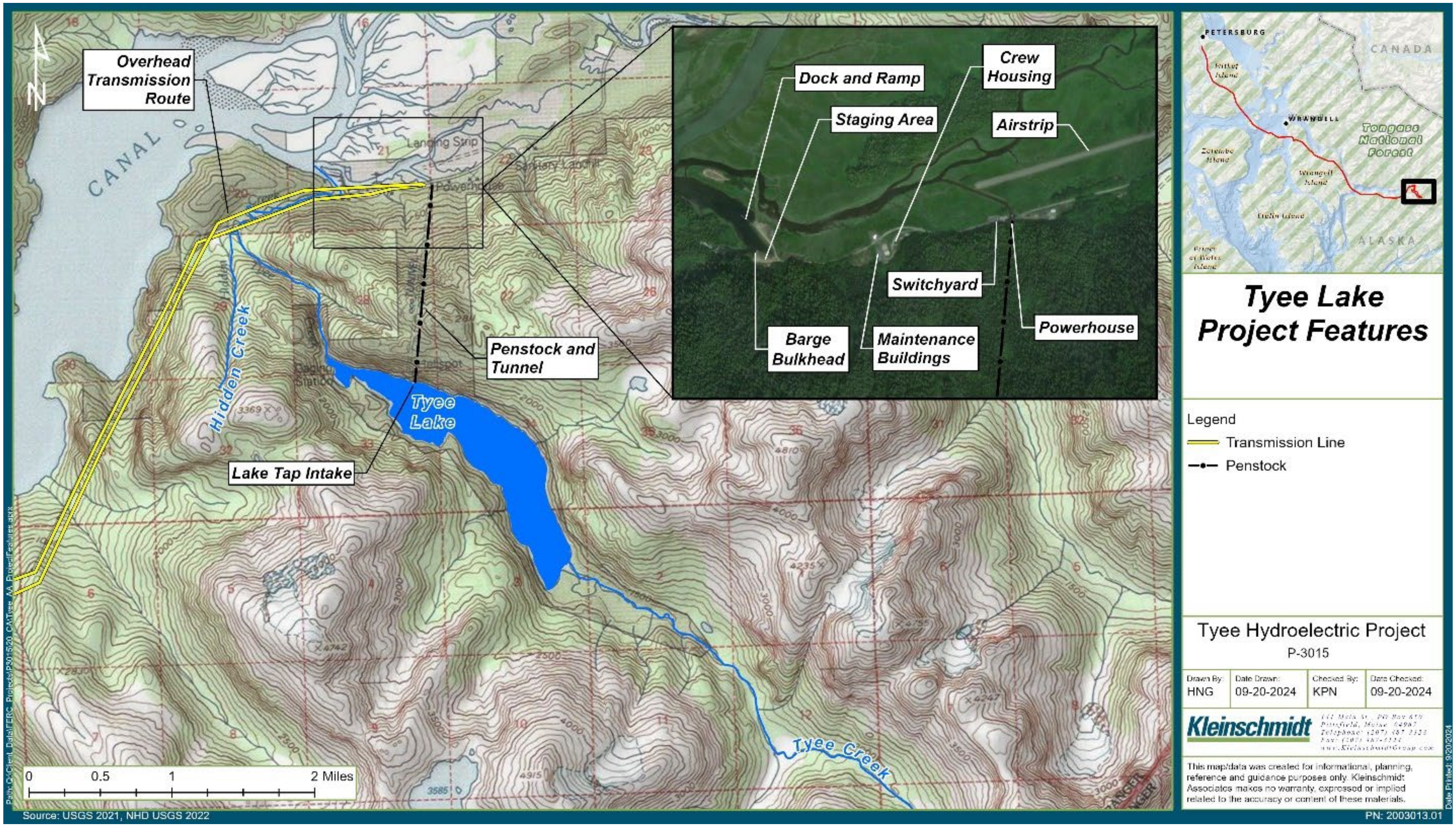

Figure 2-1 Tyee Lake Project Features Map.

Table 2-1 Tyee Lake Project Components and Specifications (Items in Brackets Indicate Final Disposition with Proposed Amendment).

Description	Number or Fact
General Information	
FERC Project Number	P-3015
Owner	Southeast Alaska Power Agency (SEAPA)
Current License Term	50 years
Licensed Capacity	20 megawatts (MW)
Nearest County (Borough)	City and Borough of Wrangell, Alaska
Nearest Town	City and Borough of Wrangell, Alaska
River	Tyee Creek
Drainage Area at the Lake Outlet	14.4 sq. miles (USGS 2016)
River Mile (RM)	1.1
Tyee Lake	
Normal Full Pool Elevation	1,396 ft mllw
Minimum Surface Elevation	1,250 ft mllw
Gross Head	1,221 to 1,385 ft
Net Head	1,306 ft (1,163 to 1,384 ft)
Lake Length	2.3 miles
Surface Area at Normal Full Pool	481 acres (based on TerraSond, Ltd. 2009 survey and USGS 2020 weir elevation of 1398.3 ft)
Gross Storage at Normal Full Pool	86,660 ac-ft (based on TerraSond, Ltd. 2009 survey and USGS 2020 weir elevation of 1398.3 ft)
Usable Storage Capacity	52,400 ac-ft
Lake Tap	
Construction Type	Lake tap
Construction Date	May 1984
Lake Tap Invert	1,228.9 ft NAVD 88 (Terrasond 2009)
Powerhouse	
Construction Type	Reinforced concrete, structural steel and metal panel
Location	Latitude 56°13’01” Longitude -131°29’15”
Dimensions	122 ft long x 38 ft wide
Turbines	
Number of Turbine/Generator Units	2 installed [3]
Minimum Hydraulic Capacity	3 cubic feet per second (cfs)(for station service at 100 kW for the annual 10-day maintenance shutdown; would not change with the addition of a third turbine)

Description	Number or Fact
Maximum Hydraulic Capacity	234 cfs (20 MW FERC License and 25 MVA nameplate capacity) [117 cfs each]
Installed Capacity	20 MW [30 MW with the third unit]
Tailrace	
Length	1,140-ft-long 30-ft bottom width, 2:1 sides
Normal Tailwater Elevation	22 to 24 ft at powerhouse (tidally influenced)
Switchyard/Transmission Lines	
Transmission Line Length	79.5 miles

2.1.1 Tyee Lake

Tyee Lake is naturally impounded, requiring no constructed dam. SEAPA's existing FERC license describes operations from elevations 1,250 to 1,396 feet (ft) mean lower low water (mllw)[1] with an active storage of 52,400 acre-feet (ac-ft). Based on a USGS survey in 2020, using the North American Vertical Datum of 1988 (NAVD 88), the normal full pool elevation is 1,398.3 ft NAVD 88. The lake surface area depends on the elevation of the lake. At elevation 1,398.3 the lake's surface area is 481 acres.

2.1.2 Spillway Weir

A trapezoidal reinforced concrete weir was constructed in 2013 at the natural outlet of Tyee Lake to measure outflow into Tyee Creek (Photo 2-1). The weir was surveyed by USGS in 2020. Based on the survey, the weir is 18-ft-long at an elevation of 1,398.3 ft NAVD 88 (USGS 2020), with 1:4 (H:V) side slopes, and a top elevation of 1,400 ft NAVD 88.

[1] Mean lower low water (mllw) is mean sea level (msl) minus 8 feet, and was the elevation datum used for the original license order, Accession No. 20010120-0701.

Photo 2-1 Tyee Lake Spillway Weir.

2.1.3 Intake Structure/Lake Tap

The hydropower intake structure is located approximately 2,000-ft east of the natural outlet of Tyee Lake on the northern shore of Tyee Lake. The elevation of the intake invert is approximately 1,228.9 ft NAVD 88. The intake structure is fitted with a trash rack and directs water into a drop shaft that connects to the power tunnel.

2.1.4 Power Tunnel and Penstock

An 8,300-ft-long, 10-ft-diameter unlined power tunnel extends north-northwest from the intake structure, connecting to a steel 1,350-ft-long penstock bringing flow into the powerhouse, where the penstock trifurcates; the first two portions connect to turbine-generating units 1 and 2. The third leads to a closed valve in an existing empty bay within the powerhouse. Proposed changes to this third portion are described in Section 2.2 below.

2.1.5 Powerhouse

The powerhouse, which is located near Bradford Canal, is an above ground reinforced concrete substructure and steel superstructure that is 122-ft-long by 38-ft-wide (Photo 2-2). It was constructed with provisions for three turbines. The powerhouse currently contains two horizontal-axis, Pelton-type (impulse) turbines, operating at 720 revolutions per minute (rpm) with a rated capacity of 16,750 horsepower (hp) and 12,500 kilovoltamperes (kVA) under a net effective head of 1,306 ft. Gross head ranges from 1,221 to 1,385 ft and net head ranges from 1,163 to 1,384 ft.

Each existing turbine is coupled to a vertical-shaft synchronous generator rated at 12,500 kVA at 13.8 kilovolt (kV) and 0.9 power factor. The generators can deliver 115 percent rated kVA continuously and each has a static excitation system. The proposed additional unit is described in Section 2.2 below.

Service power to the station is provided by tapping the main leads of each generator and connecting to a 480-volt (V) switchgear through a 13,800/480-V stepdown transformer. Emergency station power is supplied by a pair of 125-kilowatt (kW) diesel generators.

All equipment is designed for local-manual, local-automatic, and remote operation based on the concept that the powerhouse is normally unattended and can be controlled from the supervisory control and data acquisition (SCADA) control center at Wrangell via power line carrier equipment.

Photo 2-2 Tyee Lake Powerhouse, Switchyard, and Tailrace.

2.1.6 Tailrace

The tailrace is approximately 1,100-ft-long and discharges into Airstrip Slough, a side channel of Hydro Creek, which flows into the head of Bradfield Canal. The tailrace is tidally influenced. The normal tailwater elevation fluctuates with the tides, and typically ranges from 22 to 24 ft as measured by National Ocean Atmospheric Administration using the National Tidal Datum Epoch in the upper concrete portion of the tailrace under the powerhouse, and a few feet lower near Airstrip Slough downstream of the powerhouse. The tailrace was constructed to accommodate the operation of three turbines operated at full capacity.

2.1.7 Switchyard

The switchyard is located approximately 200 ft west of the powerhouse. The switchyard includes the generator step-up transformers, circuit switchers, circuit breakers, 138-kV bus, disconnecting switches, line traps, potential transformers, coupling capacitors, and the line take-off structures.

Each generator is connected to a step-up transformer by a 15-kV cable laid in a duct bank. Each step-up transformer is rated at 11,250/15,000 kVA, oil-air/fan-assisted (OA/FA), 13.8/69-138 kV, 3-phase 60 hertz (Hz) with surge arrestors mounted at the high-voltage bushings. The high-voltage side of these transformers is connected to a 138-kV bus via circuit switchers. A 3-phase, 3-wire overhead transmission line is connected to the bus via an oil circuit breaker. The transmission line operating voltage is set at 69 kV.

The switchyard area was originally designed and constructed with room for equipment associated with the proposed third unit (Photo 2-3).

Photo 2-3 Tyee Lake Hydrolectric Project (FERC P-3015) Switchyard.

2.1.8 Transmission Line

Based on the Exhibit K drawings filed with FERC in 2014, the Tyee Lake Project transmission lines extend approximately 40 miles from the Tyee Lake switchyard to the Wrangell Switchyard and then about 40 miles to the Petersburg Switchyard. The transmission system is a 3-phase, 138-kV (maximum) interconnection that includes 68.1 miles of overhead transmission circuit and 11.4 miles of submarine line. The operating voltage is set to 69 kV.

2.1.9 Lands Within Tyee Lake Project Boundary

The Tyee Lake Project is in a remote area of Southeast Alaska on federal, state, borough and private lands. Table 2-2 identifies all lands of the United States that are enclosed within the project boundary described in Exhibit K of the current license. No changes to the project boundary are proposed. Thus, Exhibit K has not been updated for this application. The proposed amendment to add a third turbine-generator unit would occur on state-owned lands.

Table 2-2 Land Ownership within the Tyee Lake Project Boundary.

Ownership	Acreage (Transmission Only)	Acreage (Non-Transmission Only)	Percentage of Total
U.S. Forest Service	1,174.4		38.0
Non-federal, subject to FPA Section 24	205.8	1,161.7	44.2
Non-federal, not subject to FPA Section 24[1]	551.8		17.8
Total	**1,932.0**	**1,161.7**	-

FPA = Federal Power Act
[1] includes submarine transmission lines

2.2 Proposed Facilities

SEAPA is proposing to install and operate a third Pelton-style turbine-generating unit (third unit) at the Tyee Lake Project to better manage peak loads and meet growing energy demands. Adding a third turbine to the Tyee Lake Hydro Project would increase the installed capacity by 50 percent, from 20 to 30 MW with the third unit.

The Tyee Lake Project was designed and constructed with provisions for a third turbine. Construction activities for the third unit would be limited to the transport and installation of the Pelton-style turbine generating unit within the existing empty bay at the powerhouse and installation of a third transformer and associated equipment within the current footprint of the switchyard.

There would be no new ground-disturbing activities associated with installation of the third unit. There would be no changes to the Tyee Lake minimum and maximum normal pool elevations, usable storage capacity, conveyances, or tailrace. There would be no changes to the existing 138-kV transmission line. The line was engineered and built for the capacity of the third unit. The proposed third turbine would be designed to operate in a synchronous condenser mode and as a spinning reserve.

2.2.1 Proposed Third Unit Turbine and Generator

The proposed unit would include a vertical shaft, six-jet Pelton turbine rated at approximately 12,500 kW (not considering a power factor) with a 720 rpm synchronous generator rated at 12,500 kVA, 13.8 kV, 3-phase 60 Hz with an allowable 115 percent continuous overload. It would include brushless excitation and internal bearing oil coolers and a closed-loop cooling water system. It would match the existing units hydraulically with a maximum flow of 117 cfs. The turbine would be designed to the characteristics presented in Table 2-3 The turbine manifold configuration of the selected unit is presented in Figure 2-2.

Table 2-3 Characteristics of the Proposed Third Turbine at the Tyee Lake Project.

Characteristic	Description
Type	Impulse
Orientation	Vertical
No. Units	1
Rated Discharge (cfs)	117
Rated Head (ft)	1,306
Design Turbine Output (kW)	11,800
Unit Speed (rpm)	720
Max Runaway Speed (rpm)	1,278
Runner Pitch Diameter (in)	43.31
Outer Runner Diameter (in)	53.71
Number of Buckets	22
Number of Nozzles	6

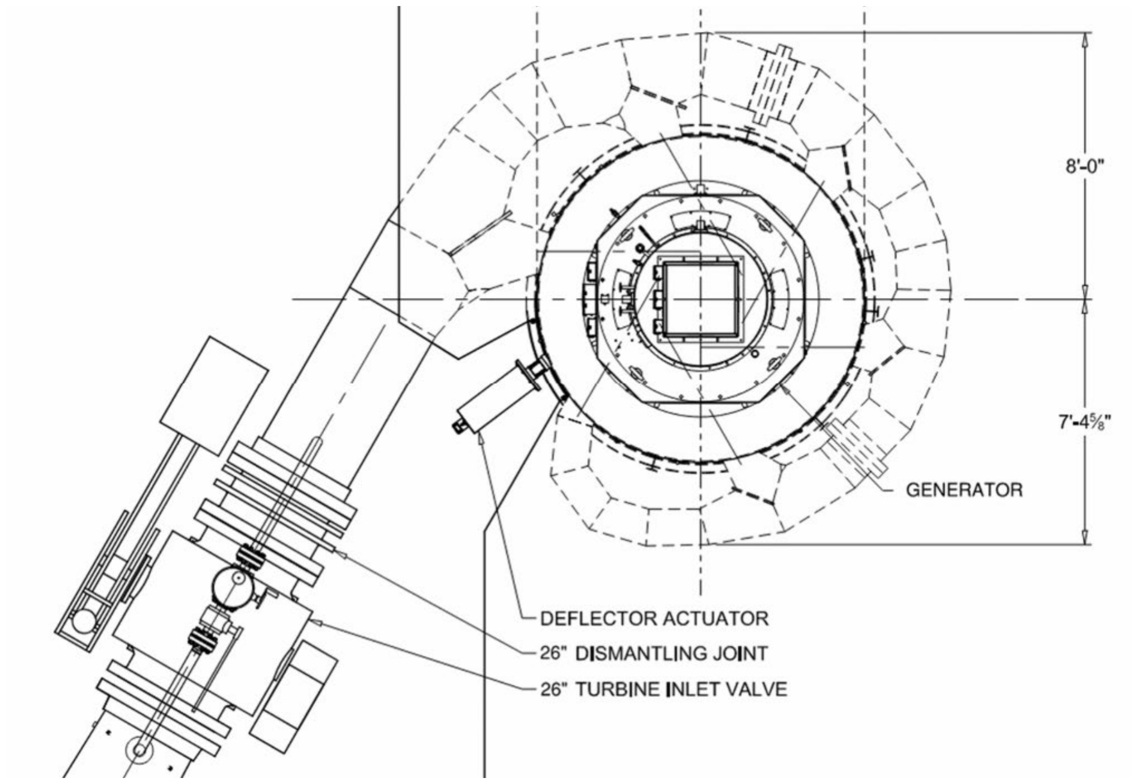

Figure 2-2 Turbine Manifold of the Proposed Third Turbine at the Tyee Lake Project.

2.2.2 Proposed Appurtenant Equipment

Power and control design for the third unit would follow as closely as practical to that which is used in units 1 and 2. Where the hardware used in the existing generator controls are readily available, these would be specified in the design of the third unit. However, where improvements in technology or in cost suggest the use of other devices, these would be considered and implemented where appropriate.

Station service changes for the third unit installation would be minor overall. As explained below, there is an ongoing comprehensive alternating current (AC) station service upgrade project which would be completed prior to completing the third unit installation. Station service upgrades would consist of adding additional local panel boards as necessary. The current 125 volt of direct current (VDC) battery set is believed the battery set size adequate for the third unit, given the standby generator set and that local operators reside on site. The battery set should be sufficient to allow for a timely restoration of station service in the event of a loss, providing power for emergency shutdown and relay operations.

The control design philosophy for operation of the third unit would be nearly identical to that of Units 1 and 2. The local control interface at the main switchboard would look and operate the same, with the same indicator light and switch arrangement. The third unit would also be interfaced with the local real time automation controller (RTAC) to provide the same type of remote control and monitoring. However, some of the hardware would likely be different based on the age of the existing components and availability of newer technology. Controls for the third unit would consist of a standalone digital governor and a voltage regulator (Basler 250N or equivalent feeding the brushless excitation system) for managing voltage and volt-ampere reactive (VAR) output. The governor would control the rotation of the unit (through the hydraulic power unit [HPU] control), as well as operate the cooling and auxiliary systems. Both the governor and voltage regulator would be digitally connected to a new RTAC dedicated to the operation of the third unit which would allow it to be programmed and tested without interfering with the existing plant operation. RTAC for the third unit would be connected to the existing SCADA network and operated remotely similarly to Units 1 and 2.

The existing Units 1 and 2 use external Basler static exciters. These use brushes to apply the 335 ADC at 100 VDC to the rotor. Brush systems are relatively high maintenance items, requiring periodic cleaning, brush replacement, and a vacuum system to maintain a minimum cleanliness (collecting particles from the brush wear). It is proposed that the third unit use a brushless system in lieu of a static exciter and the associated power transformer and electronics.

The design criteria for the switchyard modification are to accommodate the addition of a third generating unit rated 12.5 MVA inside the powerhouse. This requires the addition of a third Generator Step Up (GSU) and circuit switcher and connecting them to the existing main high voltage bus. A new GSU would be added to the switchyard with ONAN/ONAF rating of 11.25/15 MVA.

The basic insulation level of the transformer would be 650 kV at the 13.8 kV secondary side and 95 kV at the 13.8 kV primary side. The primary winding would be delta connected while the secondary winding would employ solidly grounded wye connection with 5x2.5% no-load taps. For consistency with the existing GSUs, the secondary winding would be equipment with a special tap for selection of 138 kV or 69 kV.

3.0 REFERENCES

TerraSond, Ltd. 2009. Tyee Lake Bathymetric Survey Hydrographic and Topographic Survey Report. Prepared for Southeast Alaska Power Agency. September 25, 2009.

U.S. Geological Survey (USGS). 2016. USGS Alaska 5 Meter Lower_Southeast_Alaska_Mid_Accuracy_DEM 1896: U.S. Geological Survey.

USGS. 2020. Tyee Lake Gage and Power House Survey, 1992-2019. Prepared by R. H. Host and E. H. Moran.