

CONFIDENTIAL (Attachment Only)

Request IR-1:

In the “DESCRIPTION” of NS Power’s application, NS Power notes that “This project is for the refurbishment of Upper Lake Falls Unit 2. The scope includes refurbishment of the turbine, headcover, turbine shaft, turbine bearings and housing, as well as all wear items. A re-alignment of the unit is required to ensure the unit will continue to operate reliably.”

(a) Please provide a description of all major systems within Upper Lake Falls Hydro Station Unit 2. If available, include a system drawing. For each system, please outline:

- Their primary functions,**
- Key components within each system,**
- Typical service life versus current age of those components, and;**
- The factors that influence their operational lifespan.**

(b) Please provide the maintenance and assessment procedures currently in place for Upper Lake Falls Hydro Station.

Response IR-1:

(a) Major systems within Upper Lake Falls Unit 2, their key components, primary functions and factors that influence their operational lifespan include:

Major System	Component	Primary Function	Main Limiting Factors
Turbine System	Turbine runner	Converts water energy into rotational energy.	Cavitation, erosion (sand/silt), fatigue from load cycling, corrosion

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Major System	Component	Primary Function	Main Limiting Factors
	Operating Ring	Rotates to open or close all wicket gates simultaneously	Wear at pins/bushings, bearing surfaces, corrosion, uneven mechanical loading
	Wicket gates	Control water flow to the runner	Wear at pivots, cavitation, erosion, seal degradation
	Turbine shaft	Transmits torque from turbine runner to the generator	Fatigue, misalignment, corrosion
	Thrust block / Thrust/guide/generator bearings	Support the shaft and generator. Handle axial/radial loads	Lubrication quality, vibration, misalignment, contamination
	Turbine headcover	Connects the water conveyance system (scroll case, wicket gates) with the shaft system (bearings, seals, runner)	Fatigue from hydraulic transients, cavitation, corrosion, mechanical stresses at seals and bolting interfaces
	Throat Ring	Forms water passage boundary between turbine runner and bottom of headcover	Cavitation, erosion, runner clearance wear, corrosion.
	Shaft seals	Prevent water from leaking along main shaft	Abrasive wear, misalignment, water chemistry
	Brakes	Pneumatic air brakes stop unit as a secondary system after wicket gates are closed	Moisture/dust in air, cycling, lubrication, speed at engagement, wear on pads
Hydraulic Control & Governor System	Governor	Senses speed/load and sends signal to servomotor to adjust wicket gates	Oil condition, seal/gasket age, mechanical wear, operating time

CI C0059783 – HYD Upper Lake Falls 2 Overhaul (M12455)
NSPI Responses to NSEB Information Requests

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Major System	Component	Primary Function	Main Limiting Factors
	Hydraulic actuators	Hydraulically drives the wicket gates	Seal wear, oil contamination, pressure cycling
	Control linkages	Mechanical links connecting actuators to wicket gates	Wear at pins and bushings, corrosion, fatigue, misalignment, lubrication condition
Water Conveyance & Pressure Containment System	Intake gates	Isolate turbine from water intake to perform maintenance	Corrosion, seal wear, erosion at edges
	Scroll case / turbine housing	Distributes water evenly around turbine runner	Erosion, cavitation, corrosion
	Draft tube	Recovers kinetic energy and returns water to downstream waterway	Cavitation, erosion, vibration fatigue
Auxiliary Mechanical Systems	Cooling water system (piping, exchangers)	Provides cooling for bearings, generator, and guide seals	Scaling, corrosion, fouling
	Lube oil system (pumps, coolers, filters)	Pumps, coolers, filters, and piping for bearings.	Oil quality, pump wear, corrosion

Please refer to the following attachments for system drawings highlighting major components:

- Attachment 1: General Arrangement Sectional Elevation
- Attachment 2: Cross Section of Generating Station and Intake

NS Power leverages the HydroAMP program, developed by the Center for Energy Advancement for Technology Innovation (CEATI) to guide methodology for maintenance and assessment processes for hydro turbines. Maintenance includes preventive maintenance activities such as mechanical/electrical inspections, oil testing program, and regular weekly plant inspections and checks. Unit condition assessments are performed

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1 periodically, with frequency based on operational issues, age, and results of preventive
2 maintenance activities. When possible, condition assessments should be performed 1–2
3 years prior to a planned unit overhaul to fully understand the scope and accurately develop
4 the capital project plan. An experienced mechanical crew performs roughly five condition
5 assessments each year throughout the Hydro fleet, based on a schedule determined by the
6 Hydro Mechanical Asset Strategy Committee (formerly ‘Reliability Team’) considering
7 the factors listed above. Upon completion, the condition assessments are reviewed by the
8 Committee.

9
10 The typical service life for all components varies based on design, operating conditions,
11 and maintenance. Per the Electric Power Research Institute (EPRI) a hydro turbine is
12 expected to run for 25 years between major overhauls under typical operating conditions,
13 so major parts should last this length of time. Parts that experience the most wear (seals,
14 bearings; wicket gate bushings, bearings and links; operating ring; cooling coil) typically
15 have a shorter service life of 8-15 years. The main determinants of component service life
16 include abrasion, cavitation, corrosion, misalignment, thermal stress, and lubrication
17 quality.

18
19 (b) Maintenance and assessment procedures at Upper Lake Falls include weekly plant checks
20 as well as annual oil testing and annual mechanical/electrical inspections. Unit Condition
21 Assessments are completed less frequently (typically every 10 years but dependent on
22 factors such as unit age, results of the last condition assessment, opportunity to align with
23 other planned outages, current operational performance, and overall criticality of the unit).

24
25 Please refer to the following attachments for current templates used:

- 26 • Attachment 3: ULF2 Annual Oil Testing PM w/ Checklist
- 27 • Attachment 4: ULF2 Annual Mech Electrical Inspections w/ Checklist
- 28 • Attachment 5: Weekly Plant Check w/ Checklist
- 29 • Attachment 6: Unit Condition Assessment template

**C0059783 HYD Upper Lake Falls 2 Overhaul Attachments
1-2 have been removed due to confidentiality.**



*** Work Order 169623 ***

BSU:

UNIT:

REVIEW EQUIPMENT ENTRY

SYSTEM:

DO NOT USE



Type:	PM	Job Type:		Planned Date:	2025-07-06
Status:	S	Impact:	OTHER	PM #:	PM99-08
Priority:	1	Severity:	LOW (ANY CATEGORY)	Frequency:	52W
Assigned To:	WHS	Submitted By:	PM SCHEDULER	Standard Doc#:	OILSAMPLE
Isolation:	N	Submitted Date:	2025-06-26	Safety Doc#:	None
HIT/EM Flag:		WO Location:		Can Permit #:	
PowerPlan Proj:	O0000761	PowerPlan Task:	8502.2404	PM Priority:	MEDIUM

----- Equipment -----				
<u>Equipment</u>	<u>Description</u>	<u>Location</u>	<u>Criticality</u>	<u>Tag #</u>
01W1-02-03	GOVERNOR, 6216 , 12.5 X 16 TYPE HR , 300	01W1-02	4	

----- Description -----	
ANNUAL OIL TESTING: BEARINGS, HYDRAULICS, LUBE OIL AND GOVERNORS - ULF #2	

----- Additional Information -----	
<u>High Risk Categories:</u>	
<u>Work Order Attachments:</u>	
<u>Checked Flags:</u>	

----- MATERIAL (ESTIMATED REQUIREMENTS) -----			
<u>Equipment</u>	<u>Part Number</u>	<u>Description</u>	<u>Quantity</u>

----- LABOUR (ESTIMATED REQUIREMENTS) -----				
<u>Equipment</u>	<u>Trade</u>	<u>Function</u>	<u>People</u>	<u>Hrs</u>
01W1-02-03	WHS		1.00	1.00

----- Notes -----	

Completed By:

Completion Date:

Safety Reminder
Keep Eyes and Mind on Task!

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- Checklist PM99 -

Checklist:	PM99	Author:	DirectLine
Description:	ANNUAL OIL TESTING (INCLUDES GOVERNORS, BEARINGS, HYDRAULICS AND LUBE OIL)	Date:	2010-11-29
WO#:	169623		
Building#	-		
Eqp#:	01W1-02-03 - GOVERNOR, 6216 , 12.5 X 16 TYPE HR , 300		

Task	Result	Comments
TRAVEL	_____	
RISK ASSESSMENT	_____	
IF GOVERNOR PM HAS BEEN COMPLETED, VERIFY THAT GOVERNOR OIL SAMPLE. IF NOT, TAKE GOVERNOR OIL SAMPLE	_____	
FOLLOW SAMPLING PROCEDURE AS OUTLINED IN SUPPLIED SAMPLE BOTTLE	_____	
RECORD ALL APPLICABLE INFORMATION AS NOTED ON BOTTLE LABEL	_____	
SEND OIL SAMPLE TO ACUREN	_____	



*** Work Order 169079 ***

BSU:

UNIT:

REVIEW EQUIPMENT ENTRY

SYSTEM:

DO NOT USE



Type:	PM	Job Type:		Planned Date:	
Status:	S	Impact:	PRODUCTION	PM #:	PM02-52
Priority:	8	Severity:	MEDIUM (ANY CATEGORY)	Frequency:	52W
Assigned To:	WHS	Submitted By:	PM SCHEDULER	Standard Doc#:	MDS-ULF2,MECH- INSP,2014- 63600,2014-63602
Isolation:	U	Submitted Date:	2025-06-05	Safety Doc#:	None
HIT/EM Flag:	0	WO Location:		Can Permit #:	
PowerPlan Proj:	O0000761	PowerPlan Task:	8502.2500	PM Priority:	HIGH

----- Equipment -----				
<u>Equipment</u>	<u>Description</u>	<u>Location</u>	<u>Criticality</u>	<u>Tag #</u>
01W1-02-02	TURBINE	01W1-02	4	

----- Description -----	
ANNUAL MECHANICAL/ELECTRICAL INSPECTION - ULF #2	

----- Additional Information -----	
<u>High Risk Categories:</u>	
<u>Work Order Attachments:</u>	
<u>Checked Flags:</u>	

----- MATERIAL (ESTIMATED REQUIREMENTS) -----			
<u>Equipment</u>	<u>Part Number</u>	<u>Description</u>	<u>Quantity</u>

----- LABOUR (ESTIMATED REQUIREMENTS) -----				
<u>Equipment</u>	<u>Trade</u>	<u>Function</u>	<u>People</u>	<u>Hrs</u>
01W1-02-02	WHS		2.00	7.00
01W1-02-02	WHS		2.00	7.00

----- Notes -----	

Completed By:

Completion Date:

Safety Reminder
Keep Eyes and Mind on Task!

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- Checklist INSP-PM-TOOLS -

Checklist:	INSP-PM-TOOLS	Author:
Description:	ANNUAL MECHANICAL INSPECTION TOOLING LIST	Date:
WO#:	169079	
Building#	-	
Eqp#:	01W1-02-02 - TURBINE	

Task	Result	Comments
BARK	_____	
AIR MONITORS	_____	
LONG FEELER GAUGES	_____	
VERNIER CALIPERS	_____	
DIAL INDICATOR & BASE	_____	
PAINT MARKER	_____	
LIGHT (INSPECTION/HEADLIGHT)	_____	
CAMERA	_____	
BORESCOPE	_____	
TAPER GAGES	_____	
HOMEMADE TAPER GAUGES	_____	
WEDGES	_____	
PINCH BARS	_____	
HAMMER	_____	
EXTENSION LADDER	_____	

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- Checklist INSP-PM-TOOLS -

HARNESS AND LANYARD	_____
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TOOL BAG AND ROPE	_____
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CLIPBOARD AND PEN	_____
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RUBBER BOOTS	_____
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RAINGEAR	_____
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- Checklist PM-ELEC01 -

Checklist:	PM-ELEC01	Author:	
Description:	ANNUAL ELECTRICAL INSPECTION	Date:	2021-06-09
WO#:	169079		
Building#	-		
Eqp#:	01W1-02-02 - TURBINE		

Task	Result	Comments
REVIEW PREVIOUS YEAR INSPECTION REPORT		
OPERATIONS ELECTRICAL SHUTDOWN TASKS		
- UNIT ISOLATION (AS PER SYSTEM ISOLATION PROCEDURE)		
RECORD PERMIT NUMBER		
- EXCITER: COMMUTATOR (MEASURE AND RECORD DEPTH OF DEEPEST GROOVES)		
- EXCITER: HOUSING: (RECORD CONDITION DIRTY)		
- EXCITER: BRUSH CONDITION (RECORD AMOUNT OF WEAR 20% 50% ETC)		
- COLLECTOR RINGS: BRUSH CONDITION (RECORD AMOUNT OF WEAR 20% 50% ETC)		
- COLLECTOR RINGS: SLIP RING CONDITION (RECORD CONDITION GROOVED/ARCHING NEEDS TO BE TURNED)		
- STATOR: VISUALLY INSPECT AND RECORD CONDITION OF WINDINGS		

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- Checklist PM-ELEC01 -

- STATOR: CHECK/CHANGE
MECHANICAL LUGS LUGS ON
STATOR LEADS

Condition: Stator: IR/PI testing

CONDITION: Stator: Stator
Winding

CONDITION: Stator: End Turn
condition

CONDITION: Stator: Wedges,
packing, blocking and bracing

CONDITION: Stator: Core
Laminations

CONDITION: Stator: Main and
Neutral Leads

LGB 7 AND 8: INSPECT CHAIN
DRIVEN GUIDE ROLL PINS

- FIELD BREAKER:
INSPECT/CLEAN & TEST TRIP
PROTECTION

- FIELD BREAKER: CHECK
TORQUE AND CONDITION ON
LEADS

- FIELD BREAKER: CHECK
DISCHARGE RESISTANCE

- ROTOR: VISUALLY INSPECT
AND RECORD CONDITIION
ANY BUILD UP ON ROTOR
POLES

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CONDITION: Rotor: IR/PI testing

CONDITION: Rotor: Rotor Hub,
radial arms and rim

CONDITION: Rotor: Field Poles,
keys, collars and pole faces

CONDITION: Rotor: Field
windings

CONDITION: Rotor: Winding
Leads

CONDITION: Rotor: Braking
Surface/ Pads/ Assmby

CONDITION: Rotor: Bearings
(Upper/Lower/Thrust)

CONDITION: Rotor:
Instrumentation Function

****OPERATIONS ELECTRICAL START UP TASKS****

- TRIP PROTECTION TEST:
BEARING TEMPERATURES
(RECORD ALARM SETTING)

- TRIP PROTECTION TEST:
RECORD AND CONFIRM TRIP
SETTINGS - LOWER GUIDE
BEARING

- TRIP PROTECTION TEST:
RECORD AND CONFIRM TRIP
SETTINGS - UPPER GUIDE
BEARING

- TRIP PROTECTION TEST:

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- Checklist PM-ELEC01 -

RECORD AND CONFIRM TRIP
SETTINGS - TURBINE
BEARING

- TRIP PROTECTION TEST:
RECORD AND CONFIRM TRIP
SETTINGS - THRUST BEARING

- TRIP PROTECTION TEST:
RECORD AND CONFIRM TRIP
SETTINGS FOR COOLING
WATER FLOW - UPPER GUIDE
BEARING

- TRIP PROTECTION TEST:
RECORD AND CONFIRM TRIP
SETTINGS FOR COOLING
WATER FLOW - LOWER GUIDE
BEARING

- TRIP PROTECTION TEST:
RECORD AND CONFIRM TRIP
SETTINGS FOR COOLING
WATER FLOW - TURBINE
BEARING

- TRIP PROTECTION TEST:
CONFIRM RELAY
PROTECTION

- TRIP PROTECTION TEST:
CONFIRM LOW GOVERNOR
OIL PRESSURE

- TRIP PROTECTION TEST:
CONFIRM VIBRATION TRIPS

- TRIP PROTECTION TEST:
COMPRESSOR LOW AIR TRIP
(BLOCK TRIP TO THE ONLINE
UNIT - MERSEY LGB, DB, CF
UNITS)

- REMOVE ISOLATION

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- GOVERNOR: BRING UNIT TO
A COMPLETE STOP THEN PUT
START THROUGH

- GOVERNOR: RECORD
INITIAL GATE OPENING

- WATER UP UNIT

- **RUNNING CHECKS**

- TRIP PROTECTION TEST:
CONFIRM CREEP SWITCH
PROTECTION

- TRIP PROTECTION TEST:
MEASURE/RECORD ACTUAL
SPEEDSWITCH SETTINGS
OVERSPEED APPROXIMATELY
115%

- COMPLETE BI-ANNUAL
INSPECTION

- VERIFY SYNCHRONIZER ON

- RESTART UNIT

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- Checklist PM-MECH01 -

Checklist:	PM-MECH01	Author:	
Description:	ANNUAL MECHANICAL INSPECTION	Date:	2021-06-09
WO#:	169079		
Building#	-		
Eqp#:	01W1-02-02 - TURBINE		

Task	Result	Comments
RISK ASSESSMENT		
REVIEW PREVIOUS YEAR INSPECTION REPORT		
OPERATIONS/SHOP: PRE-SHUTDOWN TASKS		
- RUNNING CHECKS: VIBRATION MONITOR UPPER GUIDE 80%		
- RUNNING CHECKS: VIBRATION MONITOR LOWER GUIDE 80%		
- RUNNING CHECKS: VIBRATION MONITOR TURBINE BEARING 80%		
- RUNNING CHECKS: RECORD BEARING TEMPERATURES (UPPER)		
- RUNNING CHECKS: RECORD BEARING TEMPERATURES (LOWER)		
- RUNNING CHECKS: RECORD BEARING TEMPERATURES (TURBINE)		
- RUNNING CHECKS: RECORD BEARING TEMPERATURES (THRUST)		

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- Checklist PM-MECH01 -

- RUNNING CHECKS: RECORD
SHAFT RUNOUT

- GOVERNOR: CHECK LOW
PRESSURE SETTING DURING
UNIT SHUTDOWN

- GOVERNOR: SHUT DOWN
UNIT

☐
☐

YES
NO

- BRAKE: RECORD TIME &
SPEED WHEN BRAKES COME
ON

- BRAKE: RECORD TIME WHEN
UNIT STOPS

- BRAKE: RECORD TIME WHEN
BRAKES RELEASE

- CHECK AMOUNT OF
LEAKAGE IN TAILRACE WITH
UNITS SHUT DOWN

- *NOTE* CHECK FOR
PENSTOCK DIFFERENTIAL
ALARM AT ECC WHEN
DRAINING PENSTOCKS

- UNIT ISOLATION (AS PER
SYSTEM ISOLATION
PROCEDURE)

RECORD PERMIT NUMBER

- ISOLATE UNIT (DRAIN
PIPELINE, LOWER TAILRACE
GATES IF NECESSARY)

- REMOVE MANHOLE COVER
(INSPECT CONDITION OF
STUDS, GASKETS, ETC)

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- Checklist PM-MECH01 -

- PULL DRAIN PLUG/OPEN
VALVES

- ENSURE TO BARK HEAD
GATE (IF REQUIRED)

- INSTALL RESCUE
EQUIPMENT AND LADDER FOR
MANHOLE ACCESS

****SHOP OR OPERATIONS SUPPORT TASKS****

BRAKES/ROTOR: RECORD
CONDITION OF BRAKE RING
(GROOVED & CHECK FOR
LOOSE BOLTS)

BRAKES/ROTOR: MEASURE
AND RECORD THE REMAINING
USUABLE THICKNESS OF THE
BRAKE PADS (NOTE SPRING &
ROD CONDITION)

BRAKES/ROTOR: OIL LEAKS
IDENTIFY CAUSE - SCOPE
REPAIRS

- RISK ASSESSMENT
CONFINED SPACE

HEADCOVER: CHECK TO SEE
IF GREASE IS GETTING TO
LOWER GATE BUSHINGS,
PINS, LINKAGES, ETC

- HEADCOVER: GREASE UNIT
(GATE BUSHINGS, PINS,
LINKAGES, ETC)

REMOVE SCROLL CASE AND
DRAFT TUBE DOOR

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COMPLETE COOLING WATER
LINE INTERNAL INSPECTIONS

ISOLATE GOVERNOR WITH
WICKET GATES OPEN

VISUAL INSPECTION OF
SCROLL CASE ENTRY LADDER

SCROLL CASE: RECORD
CONDITION OF SCROLL CASE,
DRAIN PLUG & CHAIN - TAKE
PICTURES OF ANY PROBLEM
AREAS

SCROLL CASE: CHECK WATER
INTAKE SCREENS

**SCROLL CASE: MEASURE
RUNNER CLEARANCES (TO BE
MEASURED ACCURATELY
WITH FEELER GAUGES)**

**SCROLL CASE: RECORD ALL
MEASUREMENTS LOOKING
UPSTREAM**

SCROLL CASE: RECORD
CLEARANCES UPPER SEAL
RING RIGHT

SCROLL CASE: RECORD
CLEARANCES UPPER SEAL
RING DOWNSTREAM

SCROLL CASE: RECORD
CLEARANCES UPPER SEAL
RING LEFT

SCROLL CASE: RECORD
CLEARANCES UPPER SEAL
RING UPSTREAM

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- Checklist PM-MECH01 -

SCROLL CASE: RECORD
CLEARANCES LOWER SEAL
RING RIGHT

SCROLL CASE: RECORD
CLEARANCES LOWER SEAL
RING DOWNSTREAM

SCROLL CASE: RECORD
CLEARANCES LOWER SEAL
RING LEFT

SCROLL CASE: RECORD
CLEARANCES LOWER SEAL
RING UPSTREAM

SCROLL CASE: VISUALLY
CHECK UPPER & LOWER
TURBINE SEALS THROUGH
OPEN WICKET GATES FOR
ANY DAMAGE (TAKE A
PICTURE & RECORD ANY
PROBLEMS)

SCROLL CASE: VISUALLY
CHECK RUNNER THROUGH
OPEN WICKET GATES FOR
ANY DAMAGE (TAKE A
PICTURE & RECORD ANY
PROBLEMS)

DRAFT TUBE: CHECK THROAT
RING FOR CAVITATION (TAKE
A PICTURE & RECORD
LOCATION SIZE AND DEPTH).

DRAFT TUBE: CHECK THROAT
RING FOR CRACKS LOOSE
RIVETS ETC. (TAKE A PICTURE
& RECORD LOCATION SIZE
AND DEPTH).

SCROLL CASE: REMOVE PLUG
AND CHECK FOR WATER
(KAPLAN RUNNER)

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- Checklist PM-MECH01 -

CONDITION: Turbine	☐	1 - LIKE NEW
Components: Discharge Ring /	☐	2 - BROKEN IN
Lower Seal	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine	☐	1 - LIKE NEW
Components: Stay Ring/ Stay	☐	2 - BROKEN IN
Vanes	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine Runner: Oil	☐	1 - LIKE NEW
Leakage	☐	2 - BROKEN IN
	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine Runner:	☐	1 - LIKE NEW
Motion of Blade Linkage	☐	2 - BROKEN IN
	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine Runner:	☐	1 - LIKE NEW
Runner : Seal Clearance	☐	2 - BROKEN IN
	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED

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	☐	4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Runner: Erosion	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Runner: Corrosion	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Runner: Cavitation	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Runner: Cracking	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED

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SCROLL CASE: POSITION
GOVERNOR WITH WICKET
GATES CLOSED AND UNDER
NO GOVERNOR PRESSURE

**SCROLL CASE: MEASURE
WICKET GATE CLEARANCES
STARTING FROM GATE #1**

GATE 1: A, THICK END TOP

GATE 1: B, THIN END TOP

GATE 1: C, THICK END
BOTTOM

GATE 1: D, THIN END BOTTOM

GATE 2: A, THICK END TOP

GATE 2: B, THIN END TOP

GATE 2: C, THICK END
BOTTOM

GATE 2: D, THIN END BOTTOM

GATE 3: A, THICK END TOP

GATE 3: B, THIN END TOP

GATE 3: C, THICK END
BOTTOM

GATE 3: D, THIN END BOTTOM

GATE 4: A, THICK END TOP

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GATE 4: B, THIN END TOP

GATE 4: C, THICK END
BOTTOM

GATE 4: D, THIN END BOTTOM

GATE 5: A, THICK END TOP

GATE 5: B, THIN END TOP

GATE 5: C, THICK END
BOTTOM

GATE 5: D, THIN END BOTTOM

GATE 6: A, THICK END TOP

GATE 6: B, THIN END TOP

GATE 6: C, THICK END
BOTTOM

GATE 6: D, THIN END BOTTOM

GATE 7: A, THICK END TOP

GATE 7: B, THIN END TOP

GATE 7: C, THICK END
BOTTOM

GATE 7: D, THIN END BOTTOM

GATE 8: A, THICK END TOP

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GATE 8: B, THIN END TOP

GATE 8: C, THICK END
BOTTOM

GATE 8: D, THIN END BOTTOM

GATE 9: A, THICK END TOP

GATE 9: B, THIN END TOP

GATE 9: C, THICK END
BOTTOM

GATE 9: D, THIN END BOTTOM

GATE 10: A, THICK END TOP

GATE 10: B, THIN END TOP

GATE 10: C, THICK END
BOTTOM

GATE 10: D, THIN END
BOTTOM

GATE 11: A, THICK END TOP

GATE 11: B, THIN END TOP

GATE 11: C, THICK END
BOTTOM

GATE 11: D, THIN END
BOTTOM

GATE 12: A, THICK END TOP

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GATE 12: B, THIN END TOP

GATE 12: C, THICK END
BOTTOM

GATE 12: D, THIN END
BOTTOM

GATE 13: A, THICK END TOP

GATE 13: B, THIN END TOP

GATE 13: C, THICK END
BOTTOM

GATE 13: D, THIN END
BOTTOM

GATE 14: A, THICK END TOP

GATE 14: B, THIN END TOP

GATE 14: C, THICK END
BOTTOM

GATE 14: D, THIN END
BOTTOM

GATE 15: A, THICK END TOP

GATE 15: B, THIN END TOP

GATE 15: C, THICK END
BOTTOM

GATE 15: D, THIN END
BOTTOM

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GATE 16: A, THICK END TOP

GATE 16: B, THIN END TOP

GATE 16: C, THICK END
BOTTOM

GATE 16: D, THIN END
BOTTOM

GATE 17: A, THICK END TOP

GATE 17: B, THIN END TOP

GATE 17: C, THICK END
BOTTOM

GATE 17: D, THIN END
BOTTOM

GATE 18: A, THICK END TOP

GATE 18: B, THIN END TOP

GATE 18: C, THICK END
BOTTOM

GATE 18: D, THIN END
BOTTOM

GATE 19: A, THICK END TOP

GATE 19: B, THIN END TOP

GATE 19: C, THICK END
BOTTOM

GATE 19: D, THIN END

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BOTTOM

GATE 20: A, THICK END TOP

GATE 20: B, THIN END TOP

GATE 20: C, THICK END
BOTTOM

GATE 24: D, THIN END
BOTTOM

GATE 21: A, THICK END TOP

GATE 21: B, THIN END TOP

GATE 21: C, THICK END
BOTTOM

GATE 21: D, THIN END
BOTTOM

GATE 22: A, THICK END TOP

GATE 22: B, THIN END TOP

GATE 22: C, THICK END
BOTTOM

GATE 22: D, THIN END
BOTTOM

GATE 23: A, THICK END TOP

GATE 23: B, THIN END TOP

GATE 23: C, THICK END
BOTTOM

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GATE 23: D, THIN END
BOTTOM

GATE 24: A, THICK END TOP

GATE 24: B, THIN END TOP

GATE 24: C, THICK END
BOTTOM

GATE 20: D, THIN END
BOTTOM

**SCROLLCASE: WICKET GATE
VERTICAL CLEARANCES TO
GATES, HEEL TO TOE**

GATE #1 + 2: UPPER

GATE #1 + 2: CENTER

GATE #1 + 2: LOWER

GATE #2 + 3: UPPER

GATE #2 + 3: CENTER

GATE #2 + 3: LOWER

GATE #3 + 4: UPPER

GATE #3 + 4: CENTER

GATE #3 + 4: LOWER

GATE #4 + 5: UPPER

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GATE #4 + 5: CENTER

GATE #4 + 5: LOWER

GATE #5 + 6: UPPER

GATE #5 + 6: CENTER

GATE #5 + 6: LOWER

GATE #6 + 7: UPPER

GATE #6 + 7: CENTER

GATE #6 + 7: LOWER

GATE #7 + 8: UPPER

GATE #7 + 8: CENTER

GATE #7 + 8: LOWER

GATE #8 + 9: UPPER

GATE #8 + 9: CENTER

GATE #8 + 9: LOWER

GATE #9 + 10: UPPER

GATE #9 + 10: CENTER

GATE #9 + 10: LOWER

GATE #10 + 11: UPPER

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GATE #10 + 11: CENTER

GATE #10 + 11: LOWER

GATE #11 + 12: UPPER

GATE #11 + 12: CENTER

GATE #11 + 12: LOWER

GATE #12 + 13: UPPER

GATE #12 + 13: CENTER

GATE #12 + 13: LOWER

GATE #13 + 14: UPPER

GATE #13 + 14: CENTER

GATE #13 + 14: LOWER

GATE #14 + 15: UPPER

GATE #14 + 15: CENTER

GATE #14 + 15: LOWER

GATE #15 + 16: UPPER

GATE #15 + 16: CENTER

GATE #15 + 16: LOWER

GATE #16 + 17: UPPER

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GATE #16 + 17: CENTER

GATE #16 + 17: LOWER

GATE #17 + 18: UPPER

GATE #17 + 18: CENTER

GATE #17 + 18: LOWER

GATE #18 + 19: UPPER

GATE #18 + 19: CENTER

GATE #18 + 19: LOWER

GATE #19 + 20: UPPER

GATE #19 + 20: CENTER

GATE #19 + 20: LOWER

GATE #20 + 21: UPPER

GATE #20 + 21: CENTER

GATE #20 + 21: LOWER

GATE #21 + 22: UPPER

GATE #21 + 22: CENTER

GATE #21 + 22: LOWER

GATE #22 + 23: UPPER

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GATE #22 + 23: CENTER

GATE #22 + 23: LOWER

GATE #23 + 24: UPPER

GATE #23 + 24: CENTER

GATE #23 + 24: LOWER

GATE #24 + 1: UPPER

GATE #24 + 1: CENTER

GATE #24 + 1: LOWER

SCROLL CASE: SUMMARIZE
FINDINGS FROM WICKET
CLEARANCES

CONDITION: Turbine
Components: Wicket Gate
Condition

- ☐
- ☐
- ☐
- ☐
- ☐

1 - LIKE NEW
2 - BROKEN IN
3 - WORN - COMMENT &
PHOTO REQUIRED
4 - CONCERNING -
COMMENT & PHOTO
REQUIRED
5 - UNACCEPTABLE -
COMMENT & PHOTO
REQUIRED

CONDITION: Turbine
Components: Wicket Gate
Bushing

- ☐
- ☐
- ☐
- ☐
- ☐

1 - LIKE NEW
2 - BROKEN IN
3 - WORN - COMMENT &
PHOTO REQUIRED
4 - CONCERNING -
COMMENT & PHOTO
REQUIRED
5 - UNACCEPTABLE -
COMMENT & PHOTO
REQUIRED

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CONDITION: Turbine	☐	1 - LIKE NEW
Components: Wicket Gate	☐	2 - BROKEN IN
Contact surfaces	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine	☐	1 - LIKE NEW
Components: Wicket Gate Stem	☐	2 - BROKEN IN
Seals	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

DRAFT TUBE: STAGE DRAFT	☐	COMPLETE
TUBE (WHERE APPLICABLE)	☐	NOT COMPLETE

DRAFT TUBE: ANODE	☐	COMPLETE
INSPECTION (WHERE	☐	NOT COMPLETE
APPLICABLE)		

DRAFT TUBE: TURNBUCKLE	☐	COMPLETE
INSPECTION (WHERE	☐	NOT COMPLETE
APPLICABLE)		

TURNBUCKLE: CHECK	☐	COMPLETE
TUENBUCKLES FOR	☐	NOT COMPLETE
TIGHTNESS AND INTEGRITY		

TURNBUCKLE: CHECK	☐	COMPLETE
TURNBUCKLES FOR	☐	NOT COMPLETE
TIGHTNESS (WHERE		
APPLICABLE)		

TURNBUCKLE: ARRANGE FOR	☐	COMPLETE
DIVER TO PERFORM	☐	NOT COMPLETE
UNDERWATER INSPECTION		
(WHERE APPLICABLE)		

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DRAFT TUBE: CONDITION
INSPECTION-CHECK ALL
RIVETS FOR SIGNS OF
CRACKING

☐
☐

COMPLETE
NOT COMPLETE

DRAFT TUBE: CHECK BLADES
FOR CAVITATION (TAKE A
PICTURE & RECORD
LOCATION SIZE AND DEPTH).

DRAFT TUBE: CHECK CROWN
FOR CAVITATION (TAKE A
PICTURE & RECORD
LOCATION SIZE AND DEPTH).

DRAFT TUBE: CHECK RIM FOR
CAVITATION (TAKE A PICTURE
& RECORD LOCATION SIZE
AND DEPTH).

DRAFT TUBE: CHECK BLADES
FOR CRACKS (TAKE A
PICTURE & RECORD
LOCATION LENGTH AND
DEPTH (IF POSSIBLE)# BLADE
FOR FUTURE REFERENCE).

DRAFT TUBE: RECORD
DISTANCE FROM THROAT
RING TO BOTTOM OF TURBINE

DRAFT TUBE: CHECK DRAFT
TUBE LINER FOR
DETERIORATION OF
CONCRETE OR STEEL

☐
☐

COMPLETE
NOT COMPLETE

HEADCOVER: CHECK &
RECORD GENERAL
CONDITION

HEADCOVER: OPERATE
GOVERNOR & CHECK ALL
LINKAGES - NOTE EXCESSIVE
WEAR

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HEADCOVER: INSPECT
VACUUM VALVE, SUMP
PUMPS, HEADCOVER PUMPS,
CHECK VALVES, ETC.

☐
☐

COMPLETE
NOT COMPLETE

CONDITION: Turbine
Components: Headcover

☐
☐
☐
☐
☐

1 - LIKE NEW
2 - BROKEN IN
3 - WORN - COMMENT &
PHOTO REQUIRED
4 - CONCERNING -
COMMENT & PHOTO
REQUIRED
5 - UNACCEPTABLE -
COMMENT & PHOTO
REQUIRED

CONDITION: Turbine
Components: Turbine Bearing

☐
☐
☐
☐
☐

1 - LIKE NEW
2 - BROKEN IN
3 - WORN - COMMENT &
PHOTO REQUIRED
4 - CONCERNING -
COMMENT & PHOTO
REQUIRED
5 - UNACCEPTABLE -
COMMENT & PHOTO
REQUIRED

CONDITION: Turbine
Components: Turbine Water Seal
Wear (Carbon, Labyrinth,
Packing)

☐
☐
☐
☐
☐

1 - LIKE NEW
2 - BROKEN IN
3 - WORN - COMMENT &
PHOTO REQUIRED
4 - CONCERNING -
COMMENT & PHOTO
REQUIRED
5 - UNACCEPTABLE -
COMMENT & PHOTO
REQUIRED

CONDITION: Turbine
Components: Turbine Bearing
Run Out

☐
☐
☐
☐
☐

1 - LIKE NEW
2 - BROKEN IN
3 - WORN - COMMENT &
PHOTO REQUIRED
4 - CONCERNING -
COMMENT & PHOTO
REQUIRED
5 - UNACCEPTABLE -
COMMENT & PHOTO
REQUIRED

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CONDITION: Turbine	☐	1 - LIKE NEW
Components: Turbine bearing	☐	2 - BROKEN IN
supply piping	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine	☐	1 - LIKE NEW
Components: Headcover Nuts/	☐	2 - BROKEN IN
Studs	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine	☐	1 - LIKE NEW
Components: Headcover Seal	☐	2 - BROKEN IN
Ring	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine	☐	1 - LIKE NEW
Components: Linkages	☐	2 - BROKEN IN
	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED
	☐	4 - CONCERNING -
		COMMENT & PHOTO
		REQUIRED
		5 - UNACCEPTABLE -
		COMMENT & PHOTO
		REQUIRED

CONDITION: Turbine	☐	1 - LIKE NEW
Components: Vacuum Breakers	☐	2 - BROKEN IN
	☐	3 - WORN - COMMENT &
	☐	PHOTO REQUIRED

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	☐	4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Components: Operating Ring	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Components: Push Rod / Bushing Clearance	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Components: Scroll Case	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED
CONDITION: Turbine Components: Draft Tube and Liner	☐ ☐ ☐ ☐ ☐	1 - LIKE NEW 2 - BROKEN IN 3 - WORN - COMMENT & PHOTO REQUIRED 4 - CONCERNING - COMMENT & PHOTO REQUIRED 5 - UNACCEPTABLE - COMMENT & PHOTO REQUIRED

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TURBINE BEARING : IF UNIT
HAS WOOD BEARING CLEAN
OUT WATER LINES.

GOVERNOR: ENSURE WICKET
GATES ARE CLOSED

SCROLL CASE: INSTALL DRAIN
PLUG (ORIENTATE IN PROPER
POSITION) & INSTALL
MANHOLE COVER & PIPING

- GOVERNOR: BRING UNIT TO
A COMPLETE STOP THEN PUT
START THROUGH

- GOVERNOR: RECORD INITIAL
GATE OPENING

- WATER UP UNIT

- RUNNING CHECKS

- TRIP PROTECTION TEST:
CONFIRM TRASHRACK
DIFFERENTIAL PRESSURE
ALARM - LIFT TRANSDUCER 5-
6FT OR OPERATE LOW LEVEL
SWITCH (WHERE APPLICABLE)

- TRIP PROTECTION TEST:
CONFIRM SCROLL CASE
DIFFERENTIAL PRESSURE
ALARM

☐
☐

COMPLETE
NOT COMPLETE

- TRIP PROTECTION TEST:
CONFIRM HEADCOVER &
SUMP ALARM

☐
☐

COMPLETE
NOT COMPLETE

- TRIP PROTECTION TEST:
CONFIRM PIPELINE

☐
☐

COMPLETE
NOT COMPLETE

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PROTECTION (WHERE
APPLICABLE)

- COMPLETE BI-ANNUAL
INSPECTION

☐
☐

COMPLETE
NOT COMPLETE

- VERIFY SYNCHRONIZER ON

- RESTART UNIT



*** Work Order 172025 ***

BSU:

UNIT:

REVIEW EQUIPMENT ENTRY

SYSTEM:

DO NOT USE



Type:	SRW	Job Type:		Planned Date:	2025-10-09
Status:	S	Impact:	OTHER	PM #:	SRWMER003
Priority:	1	Severity:	LOW (ANY CATEGORY)	Frequency:	1W
Assigned To:	WHS	Submitted By:	PM SCHEDULER	Standard Doc#:	None
Isolation:	N	Submitted Date:	2025-09-29	Safety Doc#:	None
HIT/EM Flag:		WO Location:		Can Permit #:	
PowerPlan Proj:	O0000761	PowerPlan Task:	8502.2500	PM Priority:	LOW

----- Equipment -----				
Equipment	Description	Location	Criticality	Tag #
01W1-GP-04	ULF BUILDING & SERVICES	01W1-GP	2	
02W1-GP-04	LLF BUILDING & SERVICES	02W1-GP	2	
03W1-GP-04	BF BUILDING & SERVICES	03W1-GP	2	
04W1-GP-04	LGB BUILDING & SERVICES	04W1-GP	2	
05W1-GP-04	DB BUILDING & SERVICES	05W1-GP	2	
06W1-GP-04	CF BUILDING & SERVICES	06W1-GP	2	

----- Description -----	
ROUTINE OPERATING - MER	

----- Additional Information -----	
<u>High Risk Categories:</u>	
<u>Work Order Attachments:</u>	
<u>Checked Flags:</u>	

----- MATERIAL (ESTIMATED REQUIREMENTS) -----			
Equipment	Part Number	Description	Quantity

----- LABOUR (ESTIMATED REQUIREMENTS) -----				
Equipment	Trade	Function	People	Hrs
06W1-GP-04	WHS		1.00	8.00

----- Notes -----	
-------------------	--

Completed By:

Completion Date:

Safety Reminder
Keep Eyes and Mind on Task!

ULF HYDRO WEEKLY OPERATIONS ROUTE

Plant	Description	ML Type	Allowable Values	Unit of Measure	Asset Description
ULF	Outside Temperature	Numeric		DEG C	GENERATOR
ULF	Temperature Inside	Numeric		DEG C	GENERATOR
ULF	Record Vibration Monitor Readings For Upper Guide Bearing #1	Numeric		IN/SEC	GENERATOR
ULF	Record Vibration Monitor Readings For Turbine Bearing #1	Numeric		IN/SEC	GENERATOR
ULF	Record Vibration Monitor Readings For Upper Guide Bearing #2	Numeric		IN/SEC	GENERATOR
ULF	Record Vibration Monitor Readings For Lower Guide Bearing #2	Numeric		IN/SEC	GENERATOR
ULF	Generator Output (MW) #1	Numeric		MW	GENERATOR
ULF	RECORD G1 GENERATOR MVARs	Numeric		MVAR	GENERATOR
ULF	RECORD METER READING, #1 UNIT	Numeric			GENERATOR
ULF	Relay Target Flags #1 - Confirm None Down	Character	No Yes		GENERATOR
ULF	Exciter Volts #1	Numeric		DCV	GENERATOR
ULF	Exciter Amps #1	Numeric		AMPS	GENERATOR
ULF	Relay Target Flags #2 - Confirm None Down	Character	No Yes		GENERATOR
ULF	Thrust Bearing Temp.#1 (Trip Set Points @ 80 C)	Numeric		DEG C	GENERATOR
ULF	Upper Guide Bearing Temp #1 (Trip Set Points @ 80 C)	Numeric		DEG C	GENERATOR
ULF	Lower Guide Bearing Temp #1 (Trip Set Points @ 80 C)	Numeric		DEG C	GENERATOR
ULF	Ensure Adequate Generator Oil Flow #1 - Note If Any Added	Character	1-Ok 2-Not Ok		GENERATOR
ULF	Governor Wicket Gate Position #1	Numeric		%	GENERATOR
ULF	Governor Oil Level #1 - Note If Any Added	Character	1-Ok 2-Not Ok		GENERATOR
ULF	Governor System Pressure #1	Numeric		PSI	GENERATOR
ULF	Lubricate Governor #1	Character	No Yes		GENERATOR
ULF	Check Plant Oil Storage Containers For Leaks	Character	1-Ok 2-Not Ok		GENERATOR
ULF	Exciter Volts #2	Numeric		DCV	GENERATOR
ULF	Exciter Amps #2	Numeric		AMPS	GENERATOR
ULF	Thrust Bearing Temp.#2 (Trip Set Points @ 80 C)	Numeric		DEG C	GENERATOR
ULF	Upper Guide Bearing Temp #2 (Trip Set Points @ 80 C)	Numeric		DEG C	GENERATOR
ULF	Lower Guide Bearing Temp #2 (Trip Set Points @ 80 C)	Numeric		DEG C	GENERATOR
ULF	Ensure Adequate Generator Oil Flow #2 - Note If Any Added	Character	1-Ok 2-Not Ok		GENERATOR
ULF	Governor Wicket Gate Position #2	Numeric		%	GENERATOR
ULF	Generator Output (MW) #2	Numeric		MW	GENERATOR
ULF	RECORD G2 GENERATOR MVARs	Numeric		MVAR	GENERATOR
ULF	RECORD METER READING, #2 UNIT	Numeric			GENERATOR
ULF	RECORD STATION SERVICE METER READING	Numeric			GENERATOR
ULF	Lubricate Governor #2	Character	No Yes		GENERATOR
ULF	Governor Oil Level #2 - Note If Any Added	Character	1-Ok 2-Not Ok		GENERATOR

ULF	Governor System Pressure #2	Numeric	PSI	GENERATOR
ULF	Test Asco Drain Valve On Air Comp. Tank	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Test Air Dryer Drain	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Check Tell Tale On Oil Cooler Filter #1	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Check Accumulator Pot On Oil Cooler #1	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Generator Oil Level #1 - Lower Guide - Note If Any Added	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Record Flow Sensor Counter #1	Numeric		GENERATOR
ULF	Clean Generator Bearing Strainer #1	Character	No Yes	GENERATOR
ULF	COUNT EEL/FISH FOUND WHILE CLEANING STRAINERS #1 GEN BRG	Numeric		GENERATOR
ULF	Clean Turbine Bearing Strainer #1	Character	No Yes	GENERATOR
ULF	COUNT EEL/FISH FOUND WHILE CLEANING STRAINERS #1 TURB BRG	Numeric		GENERATOR
ULF	Confirm Turbine Bearing Cooling Water Flow #1	Character	1-Ok 2-Not Ok	GENERATOR
ULF	COMPLETE FLOW SWITCH FUNCTIONAL TEST - ULF1	Character	N/A Not Done Not OI	ULF1 TURBINE BEARING WOOD
ULF	Confirm Generator Bearing Cooling Water Flow #1	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Turbine Shaft Run Out (Max #1 Unit = 0.035")	Numeric	IN	GENERATOR
ULF	Check Gatelinks #1 - Confirm None Damaged	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Confirm Power To Flow Sensors #1	Character	No Yes	GENERATOR
ULF	Check Tell Tale On Oil Cooler Filter #2	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Check Accumulator Pot On Oil Cooler #2	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Generator Oil Level #2 - Lower Guide - Note If Any Added	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Record Flow Sensor Counter #2	Numeric		GENERATOR
ULF	Clean Generator Bearing Strainers #2	Character	No Yes	GENERATOR
ULF	COUNT EEL/FISH FOUND WHILE CLEANING STRAINERS #2 GEN BRG	Numeric		GENERATOR
ULF	Clean Turbine Bearing Strainer #2	Character	No Yes	GENERATOR
ULF	COUNT EEL/FISH FOUND WHILE CLEANING STRAINERS #2 TURB BRG	Numeric		GENERATOR
ULF	Confirm Turbine Bearing Cooling Water Flow #2	Character	1-Ok 2-Not Ok	GENERATOR
ULF	COMPLETE FLOW SWITCH FUNCTIONAL TEST - ULF2	Character	N/A Not Done Not OI	ULF2 TURBINE BEARING WOOD
ULF	Confirm Generator Bearing Cooling Water Flow #2	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Turbine Shaft Run Out (Max #2 Unit = 0.035")	Numeric	IN	GENERATOR
ULF	Check Gatelinks #2 - Confirm None Damaged	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Confirm Power To Flow Sensors #2	Character	No Yes	GENERATOR
ULF	Battery Voltage (135.0 V = Normal)	Numeric	V	GENERATOR
ULF	Battery Charger Amps (2 A = Normal)	Numeric	AMPS	GENERATOR
ULF	Confirm Scada Pak Led's Are Working Properly	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Record Actual Lake Elevation	Numeric	FT	GENERATOR
ULF	MONITOR ICE LOADING: Is ice formed against the structure	Character	No Yes	UPPER LAKE FALLS SPILLWAY

ULF	Record ECC Lake Elevation	Numeric	FT	GENERATOR
ULF	Unit Greased #1 (6 month minimum)	Character	No Yes	GENERATOR
ULF	Unit Greased #2 (6 month minimum)	Character	No Yes	GENERATOR
ULF	Exciter Brush Condition #1	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Slip Ring Brush Condition #1	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Exciter Brush Condition #2	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Slip Ring Brush Condition #2	Character	1-Ok 2-Not Ok	GENERATOR
ULF	Clean Brush Assemblies With Compressed Air Both Units	Character	No Yes	GENERATOR
ULF	Scan Equipment with Thermal Camera - Note Temp Anomalies	Character	Anomalie No Anomal	ULF1 GENERATOR

Hydropower Asset Condition Assessment



Ruth Falls Condition Assessment #3

Date: _____

WO#: _____

Unit Permit #: _____

Crew: _____

Key Points:

--



Measurements Not Captured on Work Order:

Stator Air Gap:

Upstream: _____
 Downstream: _____
 Left Side: _____
 Right Side: _____

Exciter Air Gap:

Upstream: _____
 Downstream: _____
 Left Side: _____
 Right Side: _____

Runner Clearances:

Upstream: _____
 Downstream: _____
 Left Side: _____
 Right Side: _____
 Upper Lower

Turbine - Components Condition Assessment Summary

Date : _____

System: _____

Location _____

Plant : _____

Assessor _____

Unit : _____

General

The following is a list of components, separated into two groups – wetted and dry, that are considered to be within the scope of this assessment. Some components are categorized as “critical.” For this purpose “critical” means a major disassembly of the turbine unit is required to repair or replace the component.

Wetted Components:

Critical

Head Cover	Bottom Ring
Inner Cover	Facing Plates
Intermediate Cover	Wicket Gate Bushings
Outer Cover	Stationary Seal Rings or Wear Rings
Facing Plates	Wicket Gate Stem Seals
Wicket Gate Bushings	Wicket Gate End Seals
Operating Ring Bushings	Bolts, Studs, and Nuts
Stationary Seal Rings or Wear Rings	
Wicket Gate Stem Seals	Throat Ring
Wicket Gate End Seals	
Bolts, Studs and Nuts	Wicket Gates
Deflector Gates	Stem Seal Journals

Non-Critical

Stay Ring	Draft Tube
Upper Stay Ring	Liner
Lower Stay Ring	Drains
Stay Vanes	Uplift Drains
	Draft Tube Door
Spiral Case or Scroll Case and Intake	
Curb Ring	
Runner Seal Water	
Scroll Case Drain	
Access Cover/Door	
Equalizing Valve	

Dry Components

Critical

Kaplan Blade Servomotor

Turbine Shaft

Turbine Shaft Coupling
Mechanical Seals
Stuffing Box

Non-Critical

Gate Operating Mechanism

Servomotors
Shift/Operating Ring
Linkages
Shear Pins
Bushings
Locking Mechanism

Kaplan Oil Head

Turbine Guide Bearing
Guide Bearing Journal

Not Included in Turbine Components:

Greasing Systems
Vacuum Breakers
Headcover Pumps
Bearing Lubrication systems
Cooling Systems
Control and Instrumentation Systems
Air System for Condensing

Turbine Component Inspections, Tests, and Measurements (ITMs)

ITM 1: Crack Evaluation

Perform an evaluation of surface cracks using NDT methods (PT MT, or UT) and record findings, for the purpose of determining where the cracks are located, their size and their progression (or growth). This evaluation is normally done prior to any repair. If the crack is repaired, the repaired condition is used as the baseline for future crack evaluation. If no repair is made, there is no new baseline. On the next evaluation, the CI adjustment is based on the change from the baseline to the as-found condition.



ITM 2: Surface Condition

Perform a comprehensive visual, profilometer and/or depth evaluation of the wetted surface and characterize the amount of area impacted by, surface deterioration (rust), and/or cavitation; the depth of damage and/or total surface area affected. If repairs are made before returning the unit to service, estimate the condition after repair to determine the scoring adjustment (i.e., adjust the Condition Index given the condition after repair, not as found). Cavitation damage should be evaluated per IEC 60041 or established utility standards.

ITM 3: Twisted, Distorted, or Bent Shapes

Assess visually or by measurement, as appropriate, the shape or alignment of the component and its associated segments compared to the “as– new” or original configuration. Determine the amount of twisting, distortion or bending and the number of components affected and the reasons for them.

ITM 4: Clearances

Measure the clearances between components or parts with relative motion with respect to each other. Average the multiple findings to obtain an overall result. Use this average to adjust the Condition Index. Measurements can be obtained using a variety of techniques, including jacking of the shaft, feeler gauges, and/or micrometers.

ITM 5: Loss of Material

This ITM applies to loss of material other than on the surface. Perform a UT thickness test and complete a detail material loss assessment to determine a percent of the original material thickness that has been lost. Compare to original as– installed value and determine amount of decrease.

ITM 6: Separation/Disbonding at Material Interfaces

Visually inspect, UT and/or tap test designated areas of parent to surface contact for separation, movement, disbonding, or other condition that signifies a weakening of the connection or interface. Adjust the Condition Index based on the worst condition for a critical area.



ITM 7: Concrete Condition

Assess the amount (area) of concrete galling and/or spalling within the turbine unit intake and the severity of the damage. Measure area and volume.

ITM 8: Leak Evaluation

Evaluate the presence and amount of any leaks in the area of the split joints, etc.

ITM 9: Run– Out

Measure run– out and compare to “as– installed” values. Run– out measurements must be analyzed to determine the cause of excessive run– out.

ITM 10: Vibration

Assess vibration levels of adjacent components to determine an adjustment to the Condition Index

ITM 11: Mechanical Seal Evaluation

Assess visually the quality of mechanical seals, including rate of sealing material loss, leakage, shaft scoring, overheating and seal vibration.

ITM 12: Unit Plumb and Alignment

Evaluate unit alignment and plumb.

ITM 13: Other Specialized Diagnostic Tests

Additional tests may be applied to evaluate specific turbine component problems. Some of these diagnostic tests may be considered to be of an investigative research nature. When conclusive results from other diagnostic tests are available, they may be used to make an appropriate adjustment to the Turbine – Component Condition Index.

Hydropower Asset Condition Assessment



Turbine - Components Condition Assessment Summary: Headcover

Date : _____ System: _____

Location _____ Plant : _____

Assessor _____ Unit : _____

Head Cover Sub-Components

Inner Cover	Stationary Seal Rings or Wear Rings
Intermediate Cover	Wicket Gate Stem Seals
Outer Cover	Wicket Gate End Seals
Facing Plates	Bolts, Studs and Nuts
Wicket Gate Bushings	Deflector Gates
Operating Ring Bushings	

Hydropower Asset Condition Assessment



Inner, Intermediate and Outer Cover

Cracks; leaks at split joints; visible fretting at split joints or flanges; (movement at split joints or flanges may be a serious safety concern and need to be evaluated from that perspective); severe corrosion or corrosion of the studs and nuts.

ITM: Crack Evaluation

Location: Headcover

Specification: Critical area ex: outer hold down flange, wicket gate bores.

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Headcover	Possible ITM Results	Adjustment to CI
Crack Evaluation in Headcover	No Cracks	☒ 1
	Present but not growing	☐ - 1
	Present and growing (non- critical areas)	☐ - 3
	Present and located in a critical area	☐ - 9

Hydropower Asset Condition Assessment



ITM:	Leak Evaluation
Location:	Split Joint / Flange
Specification:	Leaks can indicate split joint or flange movement

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Headcover	Possible ITM Results	Adjustment to CI
Split Joint or Flange Movement	None	0
	Minor	– 1
	Major	– 6

☐
☒
☐

Hydropower Asset Condition Assessment



Facing Plates

Cavitation damage; wire draw; scrape/galling from wicket gates; for those with movable seals—condition and functionality of the seals; gate– end clearance; ability of the brakes to stop rotation.

ITM: No ITMs
Location: Facing Plates
Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Hydropower Asset Condition Assessment



Wicket Gate Bushings

Movement or displacement of the bushing; cavitation damage; cracked or split bushings; clearance between the bushing and the gate stem journal.

ITM: Clearances

Location: Between wicket gate bushing and gate stem journal

Specification:

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: If wicket gate bushings are not accessible, wiggle the gate or gate arm to check for play. Use best judgement for check box below

Wicket Gate Bushings	Possible ITM Results	Adjustment to CI
Clearances Between Bushing and Gate Stem Journal	Original clearances	☒ 1
	Original to 50% greater	☐ - 0.5
	More than 50% greater	☐ - 3



ITM:	No ITMs
Location:	Operating Ring Bushings
Specification:	General Condition of Component

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Hydropower Asset Condition Assessment



Stationary Seal Rings or Wear Rings (Upper Runner Crown Seal)

loose, displaced, broken or cracked seal rings.

ITM: Twisted, Bent or Distorted Shapes
Location: Stationary Seal Rings or Wear Rings
Specification:

ITM Complete: Yes ☐ No ☐

Comments:

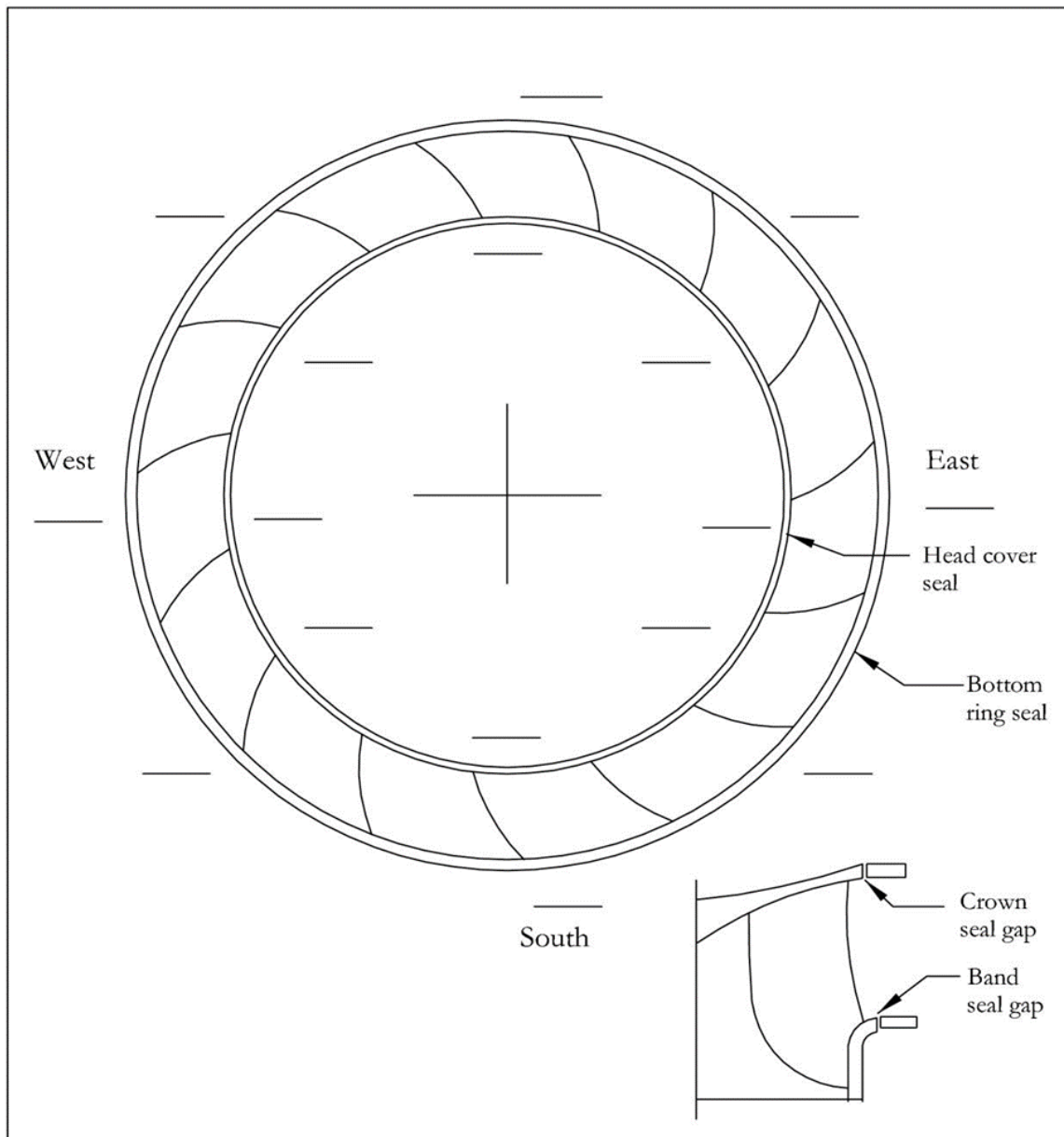
[Insert picture here, additional picture can be attached in "Attachments"]

Stationary Seal Rings/ Wear Rings	Possible ITM Results	Adjustment to CI
Twisted, Bent or Distorted Shapes	No deterioration	☒ 1
	Loose but in place	☐ - 3
	Stationary ring turning with runner	☐ - 8
	Cracked, moving out of position, and/or grooving runner rotating surface	☐ - 10

Hydropower Asset Condition Assessment



Francis Runner Seal Gaps as-found Clearances



Number of the blade at the north position: _____

Hydropower Asset Condition Assessment



Wicket Gate Stem Seals

Broken, displaced, or unusable packing gland studs; broken or problematic packing gland; excessive water leakage (especially for O– rings or lip seals).

ITM: No ITMs
Location: Wicket Gate Stem Seals
Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

No damaged seals

Amendment: No need to take gland apart, a visual inspection is good.

Hydropower Asset Condition Assessment



Bolts, Studs and Nuts

Headcover studs/nuts: tightness; corrosion; cracks (by axial UT); cracks (ring with hammer)

ITM: Crack Evaluation

Location: Headcover Studs

Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: Visual inspection only will suffice.

Bolts, Studs and Nuts	Possible ITM Results	Adjustment to CI
Crack Evaluation of Studs	2% or less affected	☒ 1
	Between 2% and 5% affected	☐ - 4
	More than 5% affected	☐ - 8



**Turbine - Components Condition
Assessment Summary: Bottom Ring**

Date: _____

System: _____

Location : _____

Plant : _____

Assessor : _____

Unit : _____

Bottom Ring Sub-Components

Facing Plates
Wicket Gate Bushings
Stationary Seal Rings or Wear Rings
Bolts, Studs, and Nuts



Bottom Ring

Cracks; leaks at split joints; visible fretting at split joints or flanges; (movement at split joints or flanges may be a serious safety concern and need to be evaluated from that perspective); severe corrosion or corrosion of the studs and nuts.

ITM: Crack Evaluation
Location: Bottom Ring
Specification:

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Bottom Ring	Possible ITM Results	Adjustment to CI
Crack Evaluation in Bottom Ring	No Cracks	☒ 1
	Present but not growing	☐ - 1
	Present and growing (non- critical areas)	☐ - 3
	Present and located in a critical area	☐ - 9

Hydropower Asset Condition Assessment



Facing Plates

Cavitation damage; wire draw; scrape/galling from wicket gates; for those with movable seals—condition and functionality of the seals; gate– end clearance; ability of the brakes to stop rotation.

ITM: No ITMs
Location: General
Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

No cavitation damage

Wicket Gate Bushings

Movement or displacement of the bushing; cavitation damage; cracked or split bushings; clearance between the bushing and the gate stem journal.

ITM: Clearances

Location: Between wicket gate bushing and gate stem journal

Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: As with headcover bushing, wiggle the gate if the bushing is not accessible.

Wicket Gate Bushings	Possible ITM Results	Adjdtment to CI
Clearances between Bushing and Gate Stem Journal	Original clearances Original to 50% greater More than 50% greater	☒ 1 ☐ - 0.5 ☐ - 3

Stationary Seal Rings or Wear Rings (Lower Runner Seal)

Loose, displaced, broken or cracked seal rings.

ITM: Twisted, Bent or Distorted Shapes

Location: Stationary Seal Rings/ Wear Rings

Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Stationary Seal Rings/ Wear Rings	Possible ITM Results	Adjustment to CI
Twisted, Bent or Distorted Shapes	No deterioration	☒ 1
	Loose but in place	☐ - 3
	Stationary ring turning with runner	☐ - 8
	Cracked, moving out of position, and/or grooving runner rotating surface	☐ - 10

Bolts, Studs and Nuts

ITM: Crack Evaluation
Location: Bolts, Studs and Nuts
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional
picture can be attached in
"Attachments"]

Amendment: Visual inspection is sufficient.

Bolts, Studs and Nuts	Possible ITM Results	Adjustment to CI
Crack Evaluation of Stud	2% or less affected	☒ 1
	Between 2% and 5% affected	☐ - 4
	More than 5% affected	☐ - 8

Hydropower Asset Condition Assessment



**Turbine - Components Condition
Assessment Summary: Throat Ring**

Date: _____ System: _____

Location : _____ Plant : _____

Assessor : _____ Unit : _____

Throat Ring Sub-Components

N/A

Kaplan or Propeller - Throat Ring

Cracks; cavitation damage; runner blade 'scrape'; bulges or deformation, 'not round'; separation/disbonding from concrete (tap test); holes or pitting (separate from cavitation damage).

ITM: Crack Evaluation

Location: Throat Ring and Weld to Draft Tube Cone

Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: Visual inspection is sufficient.

Kaplan or Propeller Throat Ring	Possible ITM Results	Adjustment to CI
Crack Evaluation in Throat Ring and Weld to Draft Tube Cone	No Cracks	☒ 1.0
	Surface crack (not through ring)	☐ -0.5
	Through crack	☐ - 3.0

Hydropower Asset Condition Assessment



ITM: Surface Condition
Location: Throat Ring
Specification:

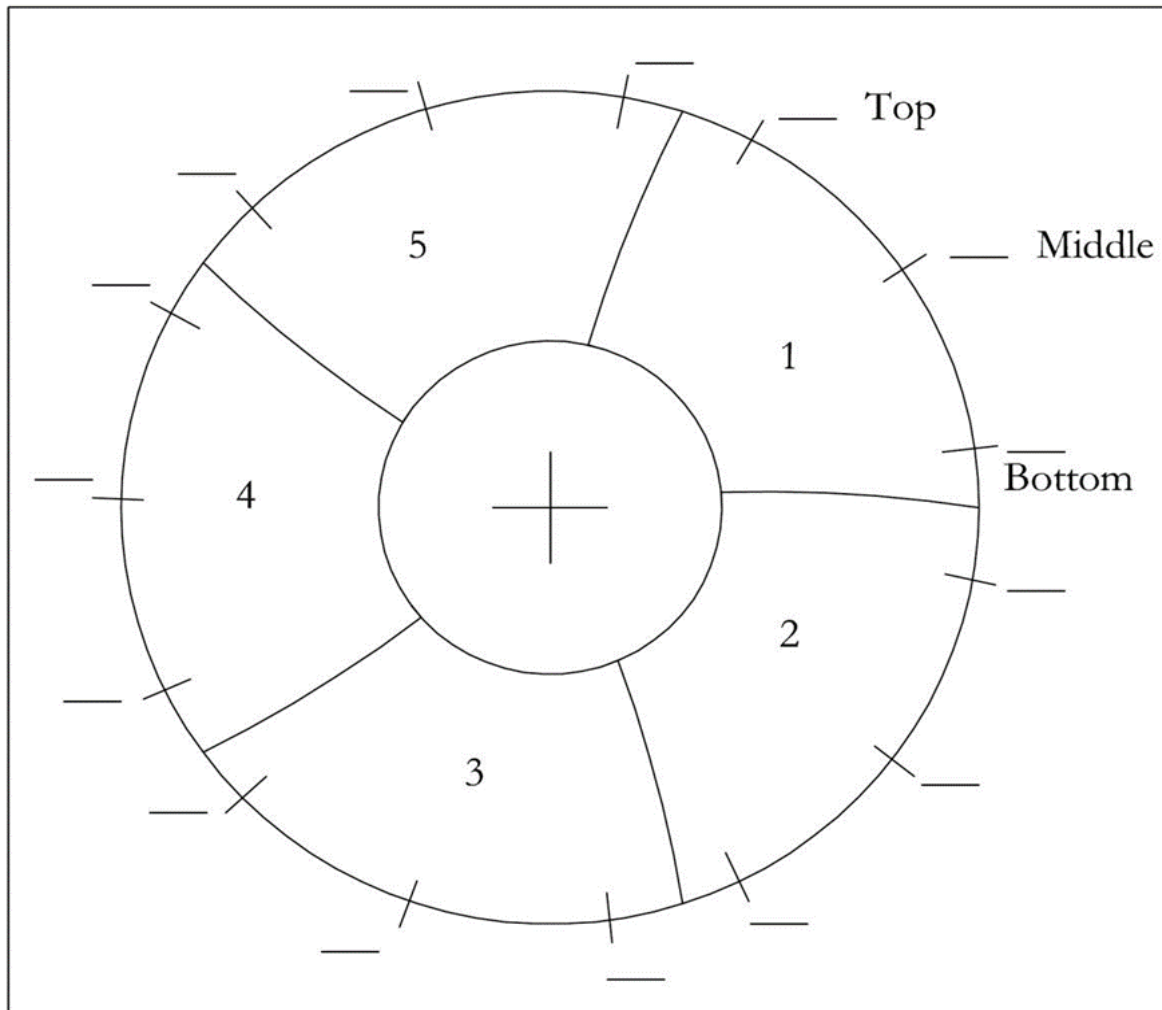
ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Kaplan or Propeller Throat Ring	Possible ITM Results	Adjustment to CI
Surface Condition	No Deterioration	☒ 0.0
	Pitting and material loss no deeper than 1/16 inch remain after repairs	☐ -1.0
	Pitting and material loss greater than 1/16 inch deep remain after repairs.	☐ -5.0

Propeller and Kaplan Runner Blade End as-found Clearances



Number of the blade at the upstream position _____

Note: Take the blade top and bottom clearances 150 mm (6 in.) from the leading and trailing edges of the blades.

Clearances:

	Upper	Lower
Upstream:	.035"	.027"
Downstream:	.027"	.100"
Left Side:	.015"	.036"
Rightside:	.067"	.085"

Hydropower Asset Condition Assessment



**Turbine - Components Condition
Assessment Summary: Wicket Gates**

Date: _____

System: _____

Location : _____

Plant: _____

Assessor : _____

Unit: _____

Wicket Gates Sub-Components

Stem-Seal Journals

Wicket Gates

Wicket gates (including vertical seal faces and end seals): cracking, cavitation damage, severe corrosion, vertical seal deterioration, bent gate stem, distorted/bent gate body.

ITM: Crack Evaluation
Location: Stem to Leaf Junction
Specification:

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: If possible, clean off the stem to leaf junction of one gate to check condition and signs of cracking.

Wicket Gates	Possible ITM Results	Adjustment to CI
Crack Evaluation at Stem to Leaf Junction	None	☒ 1
	Cracks < 5% of stem diameter and not growing	☐ - 2
	Cracks ≥ 5% of stem diameter and not growing	☐ - 3
	Cracks < 5% of stem diameter and growing	☐ - 5
	Cracks ≥ 5% of stem diameter and growing	☐ - 8

Hydropower Asset Condition Assessment



ITM: Crack Evaluation
Location: Leaf Body
Specification:

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: If possible, clean off a section of one gate to check condition and signs of cracking.

Wicket Gates	Possible ITM Results	Adjustment to CI
Crack Evaluation in Leaf Body	None,	☒ 1
	Cracks less than 5% of maximum gate thickness,	☐ - 0.5
	Cracks $\geq$ 5% of maximum gate thickness,	☐ - 2
	Cracks growing	☐ - 3

Hydropower Asset Condition Assessment



ITM: Surface Condition
Location: Wicket Gate
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Wicket Gates	Possible ITM Results	Adjustment to CI
Surface Condition	No Deterioration	☒ 1
	Less than 1/16 inch deep pits or material loss	☐ - 0.5
	Material loss between 1/16 inch and 5% of total material thickness	☐ - 2
	Material loss greater than 5% of material thickness	☐ - 4

Hydropower Asset Condition Assessment



ITM: Leak Evaluation
Location: Vertical Seal
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: Vertical seal is evaluated with wicket gate clearances (table included ahead). Further clarification is needed on "Good, Fair, Poor".

Wicket Gates	Possible ITM Results	Adjustment to CI
Leak Evaluation at Vertical Seal	Good	☒ 1
	Fair	☐ - 1
	Poor	☐ - 3

Hydropower Asset Condition Assessment



ITM: Twisted, Bent or Distorted Shapes
Location: Gate Stem
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: Difficult to tell from scroll case, please note if bent gate stem is obvious.

Wicket Gates	Possible ITM Results	Adjustment to CI
Twisted, Bent or Distorted Shapes – Gate Stem	No indication	☒ 1
	Minor indication	☐ – 0.5
	Major indication	☐ – 3

Hydropower Asset Condition Assessment



ITM: Twisted, Bent or Distorted Shapes
Location: Leaf Body
Specification:

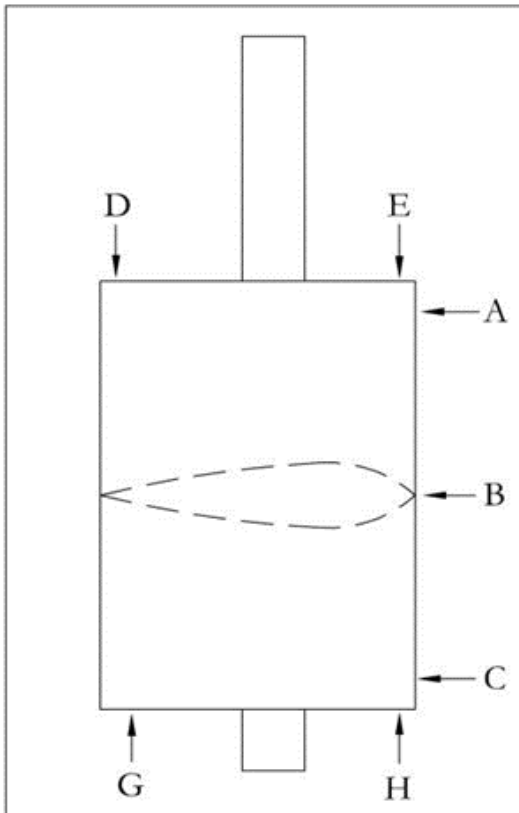
ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Wicket Gates	Possible ITM Results	Adjustment to CI
Twisted, Bent or Distorted Shapes – Body	No indication	☒ 1
	Minor indication	☐ – 0.5
	Major indication	☐ – 3

Wicket Gate Clearances

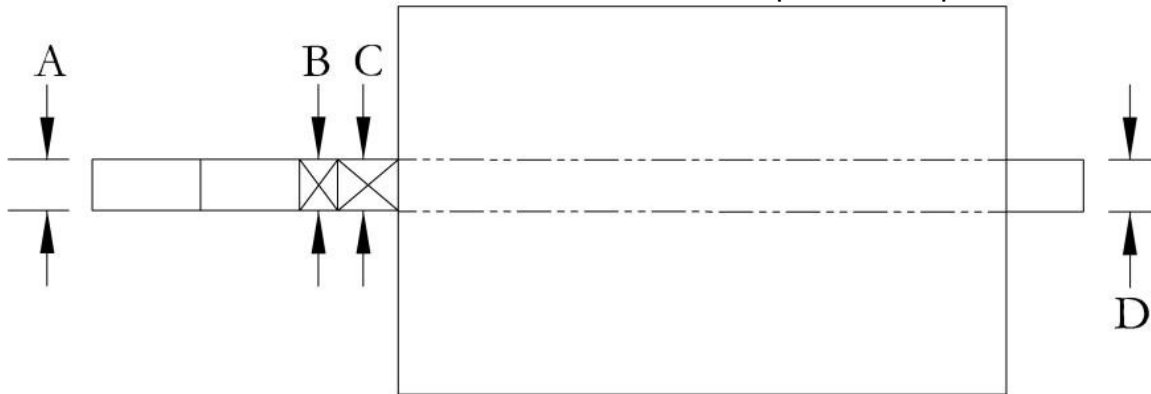


Gate	Top (A)	Mid. (B)	Bot. (C)
20-1			
1-2	0		0
2-3	0		0
3-4	0		0
4-5	0		0
5-6	0		0
6-7	0		0
7-8	0		0
8-9	0		0
9-10	0		0.033
10-11	0		0
11-12	0		0
12-13	0.005		0.01
13-14	0.033		0.027
14-15	0		0
15-16	0		0
16-17	0		0
17-18			
18-19			
19-20			

Gate	Top (E)	Top (D)	Bottom (H)	Bottom (G)
1	0	0	0.052	0.03
2	0	0	0.068	0.06
3	0	0	0.055	0.07
4	0.005	0	0.043	0.064
5	0	0	0.02	0.024
6	0.015	0.008	0.036	0.075
7	0.006	0	0.026	0.1
8	0	0	0.086	0.101
9	0.006	0.005	0.066	0.082
10	0	0	0.115	0.075
11	0	0.005	0.031	0.055
12	0.008	0.008	0.079	0.042
13	0.005	0	0.073	0.065
14	0	0	0.054	0.066
15	0	0	0.048	0.057
16	0	0	0.065	0.063
17				
18				
19				
20				

Wicket gate journals – As found diameters

These measurements can be taken off the spare if one present.



Gate no.	Gate arm fit diameter (A 1 in. from end)	Packing journal diameter (B)	Middle bearing journal diameter (C)	Bottom bearing journal diameter (D)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				



**Turbine - Components Condition
Assessment Summary: Stay Rings**

Date: _____

System: _____

Location : _____

Plant: _____

Assessor : _____

Unit: _____

Stay Ring Sub-Components

Upper Stay Ring

Lower Stay Ring

Stay Vanes

Upper and Lower Stay Rings

Cracks; loss of material due to corrosion or abrasion.

ITM: Crack Evaluation

Location: Stay Ring Decks

Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: Cleaning a small section of the stay ring to determine condition will suffice.

Stay Rings	Possible ITM Results	Adjustment to CI
Crack Evaluation at Stay Ring Decks	No Cracks	☒ 1
	Present but not growing	☐ - 1
	Present and growing	☐ - 5

Hydropower Asset Condition Assessment



ITM: Surface Condition
Location: Stay Rings
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional
 picture can be attached in
 "Attachments"]

Amendment: Cleaning a small section of the stay ring to determine condition will suffice.

Stay Rings	Possible ITM Results	Adjustment to CI
Surface Condition thickness due to corrosion or abrasion	No Damage	☒ 1
	Minor Pitting and material loss not less than 1/16 inch deep	☐ - 0.5
	Pitting and material loss greater than 1/16 but less than 10% of material thickness	☐ - 1
	Pitting and material loss greater than 10% of material thickness	☐ -5

Stay Vanes

Cracks; loss of material due to corrosion or abrasion.

ITM: Crack Evaluation

Location: Stay Vanes

Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Usually coated in
organic matter, if not
too time intensive a
small section could be
scraped away to get a
visual.
~~CML 05/08/2024~~

Amendment: Cleaning a small section of a stay vane to determine condition will suffice.

Stay Vanes	Possible ITM Results	Adjustment to CI
Crack Evaluation at Stay Vanes	No Cracks	☒ 1
	Cracks < 20% of maximum vane thickness	☐ - 1
	Cracks $\geq$ 20% of maximum vane thickness	☐ - 2
	Cracks $\geq$ 20% of maximum vane thickness and growing]	☐ - 5



**Turbine - Components Condition
Assessment Summary: Scroll Case**

Date: _____

System: _____

Location : _____

Plant: _____

Assessor : _____

Unit: _____

Scroll Case Sub-Components

Curb Ring
Runner Seal Water
Scroll Case Drain
Access Cover/Door
Equalizing Valve

Scroll Case

coating condition/corrosion; material thickness (UT thickness gauge); cracks (especially in welded joints); condition of riveted joints.

ITM: Loss of Material

Location: Scroll Case

Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: Visual assessment of the scroll case is adequate for condition assessment scope.

Scroll Case	Possible ITM Results	Adjustment to CI
Loss of Material	No loss or stress evaluation indicates acceptable load bearing	☒ 1
	Material loss less than or equal to 5% of material thickness	☐ - 1
	Material loss greater than 5% of material thickness	☐ - 5

Hydropower Asset Condition Assessment



ITM: Crack Evaluation
Location: Scroll Case
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Amendment: Visual assessment of the scroll case is adequate for condition assessment scope.

Scroll Case	Possible ITM Results	Adjustment to CI
Crack Evaluation	No Cracks	☒ 1
	Crack present in spiral case	- 0.5
	Crack at spiral case to stay ring junction	☐ - 1
	Crack present in spiral case and growing	☐ - 3
	Crack at spiral case to stay ring junction and growing	☐ - 6

Hydropower Asset Condition Assessment



ITM: Concrete Condition
Location: Scroll Case and Intake
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Scroll Case	Possible ITM Results	Adjustment to CI
Concrete Condition	Good	☒ 1
	Minor deterioration	☐ - 0.5
	Major deterioration	☐ - 2

Hydropower Asset Condition Assessment



Scroll Case Drain

ITM: No ITMs
 Location: Scroll Case Drain
 Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Very little leakage. Drain handles all the leakage from headgate

Hydropower Asset Condition Assessment



Access Cover / Door

ITM: No ITMs
 Location: Access Door/ Cover
 Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Replaced gasket on scrollcase man hole cover. Studs were still in good shape.

Hydropower Asset Condition Assessment



Equalizing Valve

ITM: No ITMs
 Location: Equalizing Valve
 Specification: General Condition of Component

ITM Complete: Yes ☐ No ☒

Comments:

[Insert picture here, additional
 picture can be attached in
 "Attachments"]

Amendment: Not present on many of NSP's hydro fleet, by-pass valve on Wreck Cove is the exception.

Hydropower Asset Condition Assessment



**Turbine - Components Condition
Assessment Summary: Draft Tube**

Date: _____

System: _____

Location : _____

Plant: _____

Assessor : _____

Unit: _____

Draft Tube Sub-Components

Liner
Drains
Uplift Drains
Draft Tube Door

Hydropower Asset Condition Assessment



Draft Tube

Galling or spalling of concrete; exposed re- bar.

ITM: No ITMs
Location: Draft Tube
Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Difficult to access, if any visual is possible record observations.
 -CML 05/05/2024

	No cracks
--	-----------

Amendment: Provide comment on the visual assessment of the draft tube, access is often unavailable.

Liner

Coating condition/corrosion; cavitation damage; bond between steel and concrete (tap test); material thickness (UT thickness gauge).

ITM: Loss of Material
Location: Draft Tube Liner
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Difficult to access, if any visual is possible record observations.
-CML 05/05/2024

Amendment: Visual assessment of the draft tube liner is adequate for condition assessment scope.

Draft Tube Liner	Possible ITM Results	Adjustment to CI
Loss of Material	No loss	☒ 1
	Pitting and/or material loss less than 1/16 inch deep	☐ - 0.5
	Pitting and/or material loss greater than 1/16 inch deep	☐ - 1

Hydropower Asset Condition Assessment



Drains

ITM: No ITMs
Location: Drains
Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional
 picture can be attached in
 "Attachments"]

Amendment: Access to draft tube drains and sump often restricted, please
 comment on condition if available.

Hydropower Asset Condition Assessment



Draft Tube Door

ITM: No ITMs
Location: Draft Tube Door
Specification: General Condition of Component

ITM Complete: Yes ☐ No ☐

Comments:

[Insert picture here, additional
 picture can be attached in
 "Attachments"]

Replaced gasket on draft
 tube door. No striped bolts
 were found.

Unit: _____

--

Excessive HPU pump run time.

ITM Complete: Yes ☐ No ☒

[Insert picture here, additional picture can be attached in "Attachments"]

The diagram shows a central rectangular box with a thin black border. This box is positioned between two horizontal lines. Above the box, there are two more horizontal lines, one on each side, which appear to be part of a larger network or system. Below the box, there are three more horizontal lines, also extending across the width of the page. The overall layout suggests a schematic representation of a component within a larger architectural or engineering context.

[illegible]



**Turbine - Components Condition
Assessment Summary: Wicket Gate
Operating Mechanism**

Date: _____ System : _____
Location _____ Plant : _____
_____ Unit : _____

Wicket Gate Operating Mechanism Sub-Components

Servomotors Shift/Operating Ring Linkages Shear Pins Bushings Locking Mechanism
--

Wicket Gate Operating Mechanism

(Operating ring, wicket gate linkages, shear pins and bushings): pin and bushing wear (remove and measure); bushings ‘backing out’; visible ‘slop’ in the mechanism; jerky movement, frequent shear pin breakage.

ITM: Clearance
Location: Pin to Bushing
Specification:

ITM Complete: Yes ☒ No ☐

Comments:

[Insert picture here, additional picture can be attached in "Attachments"]

Wicket Gate Operating Mechanism	Possible ITM Results	Adjustment to CI
Clearance – Pin to Bushing	Design Clearance	☒ 1
	Clearance 0.001 to 0.003 inch greater than design	☐ – 1
	Clearance 0.004 to 0.007 inch greater than design	☒ – 2
	Clearance more than 0.008 inch greater than design	☐ – 5

Operating Mechanism Clearances

Gate Link Numer:	HP Side		MID
	TOP	BTM	
Straight Pin Dia.:	1.3780"	1.3718"	
	1.3774"		
Straight Bore:	1.3787"		
Eccentric Pin Dia.:	1.6197"	1.1213"	1.3726"
		1.1176"	
Eccentric Bore:	1.6266"	1.1257"	1.3750"

Gate Link Numer:	LP Side		
Straight Pin Dia.:	1.3739"	1.3749"	
	1.3703"	1.3710"	
Straight Bore:	1.3765"	1.3776"	
Eccentric Pin Dia.:	1.6180"	1.1184"	1.3727"
	1.6215"	1.1215"	1.3731"
Eccentric Bore:	1.6262"	1.1255"	1.3753"

Push Pull Pin:	DS/US	
Pin Diameter:	2.998"	3.000"
Bore:	2.999"	3.002"

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Request IR-2:

In the “DESCRIPTION” of NS Power’s application, NS Power notes that “Upper Lake Falls Unit 2 was last overhauled in 1999 and is approaching 100 years of service life.”

(a) Please provide the detailed scope of work completed during the 1999 overhaul, including the expected service life of each component that was refurbished or replaced.

(b) Please provide the detailed scope of work proposed for the current overhaul, along with the expected service life of each component to be refurbished or replaced.

Response IR-2:

(a-b) The scope included in the 1999 overhaul is noted below, along with the current proposed project scope. In support of IR-5, scope included in a partial overhaul in 2018 is also included here for full comparison.

Upper Lake Falls Unit #2 Hydro Turbine History			
Component/Task	1999 Complete Overhaul	2018 Partial Overhaul above head cover	Proposed 2025 Overhaul
Headcover	✓	X	✓
Wicket Gates	✓	X	✓
Throat Ring Weld Repairs	✓	X	✓
Turbine Shaft new Stainless Steel Journal Sleeve	X	X	✓
Turbine Runner Blade Inspections and Welding Repairs	✓	X	✓
Turbine Bearing	✓	✓	✓
Turbine Seals	✓	X	✓
Greasing system conversion to greaseless with composite material	X	X	✓

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Upper Lake Falls Unit #2 Hydro Turbine History			
Component/Task	1999 Complete Overhaul	2018 Partial Overhaul above head cover	Proposed 2025 Overhaul
Operating Ring	✓	X	✓
Draft Tube Liner	✓	X	✓
Brakes	✓	✓	✓
Governor Shaft	✓	X	✓
Upper and Lower Guide Bearings	✓	✓	✓
Thrust Bearing Pads	✓	✓	✓
Thrust Block Replacement	X	X	✓
Oil Cooler Testing/Replacement	✓	✓	✓

As noted in IR-1, The typical service life for all components varies based on design, operating conditions, and maintenance. Per the Electric Power Research Institute (EPRI), a hydro turbine is expected to run for 25 years between major overhauls under typical operating conditions, so major parts should last this length of time. Parts that experience the most wear (seals, bearings; wicket gate bushings, bearings and links; operating ring; cooling coil) typically have a shorter service life of 8-15 years, therefore many of these items are included in two or more scopes from 1999, 2018 and 2025. Service life of Hydro Plant Equipment is guided by CEATI's Hydro AMP methodology. The main determinants of component service life include abrasion, cavitation, corrosion, misalignment, thermal stress, and lubrication quality.

Many of these components are still original (such as the Turbine, head cover, and turbine shaft). All components not included in 2018 refurbishment would be greater than 25 years old.

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Request IR-3:

(a) Please list the scope of work for “2025 CI C0042526 HYD ULF2 Stator Refurbishment \$463,793”.

(b) Please confirm whether these Capital Investments (CIs) pertain to separate work not included in the current application.

Response IR-3:

(a) Note the title of this CI should have read HYD ULF2 Generator Refurbishment as the refurbishment of CI C0042526 includes both the generator stator and rotor and auxiliary electrical components. This project includes the refurbishment of generator exciter, replacement of rotor lead cables, replacement of brush/holders, stator wedge replacements and generator rotor and stator cleaning with protective coating replacement on the Upper Lake Falls 2 unit.

(b) Confirmed. While CI C0042526 focuses on the Generator refurbishment (electrical assets), CI C0059783 focuses on the Turbine refurbishment (mechanical assets).

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Request IR-4:

In the “Why do this project” of NS Power’s application, NS Power notes that “The overhaul of Unit 2 ensures continued generation capacity and supports water management operations on the Mersey River, which are critical for downstream safety and system resilience.”

(a) Please describe the specific benefits to downstream safety and system resilience that are expected to result from the proposed overhaul of Unit 2.

Response IR-4:

(a) As noted in the application, Unit 2 (and all units) on the Mersey River is integral to NS Power’s water management strategy, which prioritizes safe, controlled discharge through turbines to support downstream safety and system resilience.

Specifically, the overhaul of Unit 2 will restore its ability to manage water flows through generation rather than relying on spillways. This is critical for maintaining balanced water levels across the six hydro stations along the Mersey River. When units are offline, water must still be passed downstream, often requiring manual operation of spill gates. This introduces operational risk, especially during high-flow events, as the spill gates are original to the system (installed in 1929), and manual operation can be delayed due to factors such as distance (e.g., Upper Lake Falls is 22 km from the operations center), weather conditions, accessibility and available resources.

By completing this scope, NS Power can reduce reliance on manual spill operations and ensure that water is passed through turbines in a controlled manner. This supports:

- Downstream safety: Prevents excessive head pond elevations that could pose dam safety risks and mitigates the risk of uncontrolled releases.

CI C0059783 – HYD Upper Lake Falls 2 Overhaul (M12455)
NSPI Responses to NSEB Information Requests

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- 1 • System resilience: Maintains generation continuity and operational flexibility
2 across the Mersey system, especially during storm events or high precipitation
3 periods.

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Request IR-5:

In the “Why do this project” of NS Power’s application, NS Power notes that “Internal condition assessments were completed by NS Power in 2016 and 2023. Based on these assessments, the operating mechanisms (bushings, bearings, links and pins) were found to have excessive clearances.”

(a) Please confirm whether any work has been undertaken to address the issues identified in the 2016 and 2023 condition assessments.

(b) If any work has been completed, please provide a detailed description of the specific activities undertaken and indicate the expected service life of the refurbishment or replacement.

(c) If no work has been completed to date, please indicate when the work is expected to be performed, particularly activities related to the currently proposed project.

(d) Please submit any professional studies or technical analysis reports that support the proposed overhaul work, and explain the decision-making criteria used.

(e) If no formal report is available, please describe the assessment process and the current condition of the operating mechanisms, and list the specific issues identified.

(f) Please identify any internal or external standards or regulations that guided the assessment and decision-making process.

(g) Please explain the timeline and frequency of internal condition assessments at Upper Lake Falls Hydro Station.

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Response IR-5:

(a) Some issues identified in the 2016 turbine condition assessment were addressed in 2018 for components above the head cover (wear parts such as bushings, bearings, pads). No items identified in the 2023 condition assessments have been replaced since that time.

(b) Please refer to IR-2 in relation to scope items included in the 2018 scope of work. Please refer to IR-1 Attachment 1 to visualize the extent of the 2018 scope with the proposed 2025 Overhaul scope as the unit was only partially disassembled at that time. The estimated service life of these wear components above the headcover is 8-15 years.

(c) No work has been complete since the 2023 condition assessment. This outage for refurbishment under this CI is expected to start in late 2025 or early 2026, depending on timing of completion of other hydro overhauls and resource availability.

(d) No external professional studies or technical analysis were included in the scoping/planning of this CI. Internal resources completed NS Power's condition assessment which is sufficient to define the scope and justify the work required. Please refer to Attachment 1: Upper Lake #2 Condition Assessment (2023). Please note that a new template for condition assessments was developed internally in 2024 therefore the format is different than that included in IR-1 Attachment 6. NS Power leverages HydroAMP to guide the condition assessment process for hydro turbines. HydroAMP is an assessment tool developed by the Center for Energy Advancement through Technical Innovation (CEATI) as part of its Hydropower Plant Equipment program. HydroAMP considers the following parameters when assessing turbine condition:

- Physical condition (erosion, corrosion, pitting, cracking, clearances, vibration, etc.)
- Age of the unit, and/or years since last major overhaul
- Installed technology level
- Operating constraints such as limited maximum flow and vibration limits

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- 1 • Recent maintenance requirements, including recurring issues and forced outages

2
3 The condition assessment provides guidance on assigning the asset condition rating. Along
4 with asset criticality of 4 (out of 5), the condition rating of this asset is 4 (out of 5), which
5 results in a risk score of 16.

- 6
7 (e) The condition assessment process, referenced in part (d) is used to assess condition of
8 current operating mechanisms.

- 9
10 (f) No external standards or regulations were used to guide the decision to prioritize this
11 project. The decision to prioritize this overhaul was made through collaboration of the
12 internal Hydro Mechanical Asset Strategy Committee, with representation from NS
13 Power’s Hydro Operations, Engineering, Maintenance and Enterprise Asset Management.
14 In coordination with other work being planned under CI C0042526 HYD ULF2 Stator
15 Refurbishment, it was agreed that these two separate scopes of work should be completed
16 during the same outage to minimize overall outage time. The results of the 2023 condition
17 assessment informed and guided the scope of work for this project. The condition
18 assessment process was guided using guidelines based on CEATT’s HydroAMP, as
19 described above in part (d), along with OEM specifications and clearances.

- 20
21 (g) The timeline and frequency of Hydro Condition Assessments are in generally on a 10-year
22 frequency at NS Power; however, frequency does vary based on a number of factors. Such
23 factors include, but are not limited to, the age of the unit, results of the last condition
24 assessment, opportunity to align with other planned outages, current operational
25 performance, and overall criticality of the unit.

Upper Lake #2 Condition Assessment

September 2023

W/O# 152291

Unit Permit # MER-2023-037

Runner Type: Kaplan

Crew: Ben Holdright

Aaron Walsh

Dwayne Bond

Jared Blades

Key Points:

Governor pins and bushings showing excessive wear and clearance. Including Quadrant shaft.

Lower guide sump has a slight leak.

Kaplan runner blades are seized.

Number 8 gate stem bushing is pulled up.

Cooling water are lines free.

Brake band was new in 2021.

Measurements Not Captured on Workorder:

All brake pads have over 11/16" wear left.

Operating ring has .010" - .015" of movement.

Stator Air Gap: US - .354"

DS - .380"

LS - .331"

RS - .319"

***All other key points, measurements and notes are captured on the provided work order sheet.**



Photo 1: Exciter Slip Rings

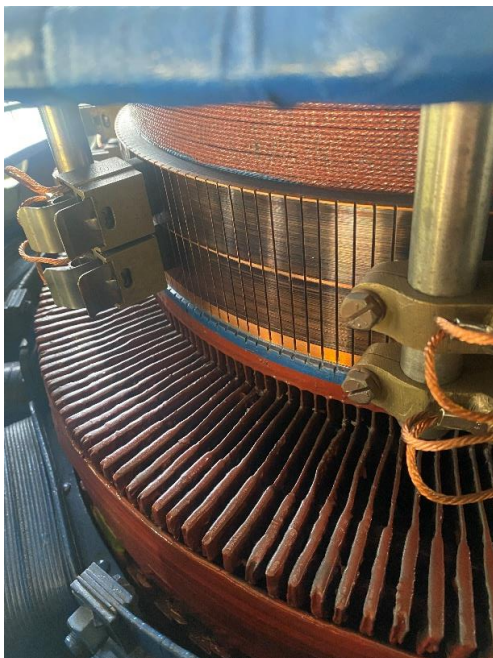


Photo 2: Exciter Commutator



Photo 3: Exciter Poles



Photo 4: Upper Lake Compressor



Photo 5: Turbine Runner Blade tip



Photo 6: Turbine runner cladding and blades



Photo 7: Turbine runner blades



Photo 8: Turbine runner hub



Photo 9: Scroll case looking DS



Photo 10: Scroll case looking US at headgates

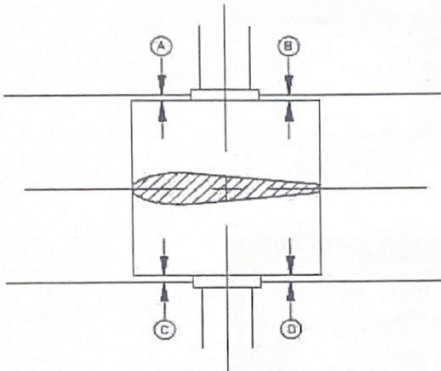


Photo 11: Cooling water screen

MEASUREMENT OF WICKET GATE CLEARANCE

PLANT UPPER LAKE FALLS
UNIT # 2

DATE SEPT. 25 2023
CREW BT, AW, JB, DB
WORK ORDER 152291



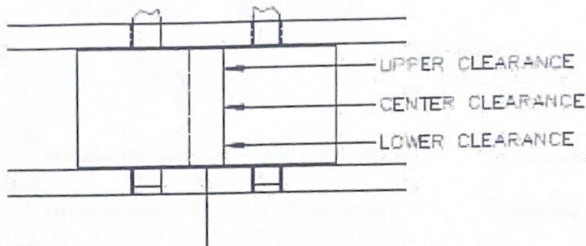
Unit = 1/100 mm

GATE #	A	B	C	D
1	φ	.070	.060	.048
2	φ	.049	.041	φ
3	.014	.035	.041	.020
4	φ	.026	.044	φ
5	.043	.039	.063	.036
6	.091	.043	.105	.101
7	.025	φ	.195	.200
8	φ	φ	.460	.460
9	φ	φ	.200+	.350
10	.064	.061	.300	.273
11	.094	.081	.187	.163
12	.058	.078	.200+	.200
13	.059	.094	.200+	.195
14	.086	.133	.195	.142
15	.075	.127	.134	.096
16	φ	.053	.111	.064
17				
18				
19				
20				
21				
22				
23				
24				

WICKET GATE VERTICAL CLEARANCES TO GATES, HEEL TO TOE

PLANT UPPER LAKE FALLS
UNIT # 2

DATE SEPT. 25 2023
CREW RH, DB, JB, AW
WORK ORDER 152291



GATE #	UPPER	CENTER	LOWER
1 + 2	Ø	.012	.032
2 + 3	.082	.080	.082
3 + 4	.020	.005	Ø
4 + 5	.032	.025	.015
5 + 6	.010	.005	Ø
6 + 7	.051	.026	.035
7 + 8	.010	Ø	Ø
8 + 9	.035	.023	.016
9 + 10	Ø	Ø	Ø
10 + 11	.004	Ø	Ø
11 + 12	Ø	.005	.005
12 + 13	.006	.006	.008
13 + 14	.066	.066	.066
14 + 15	.054	.050	.063
15 + 16			
16 + 17			
17 + 18			
18 + 19			
19 + 20			
20 + 21			
21 + 22			
22 + 23			
23 + 24			
24 + 1			

RUNNER SEAL CLEARANCES

PLANT UPPER LAKE FALLS
UNIT # 2

DATE SEPT. 25 2023

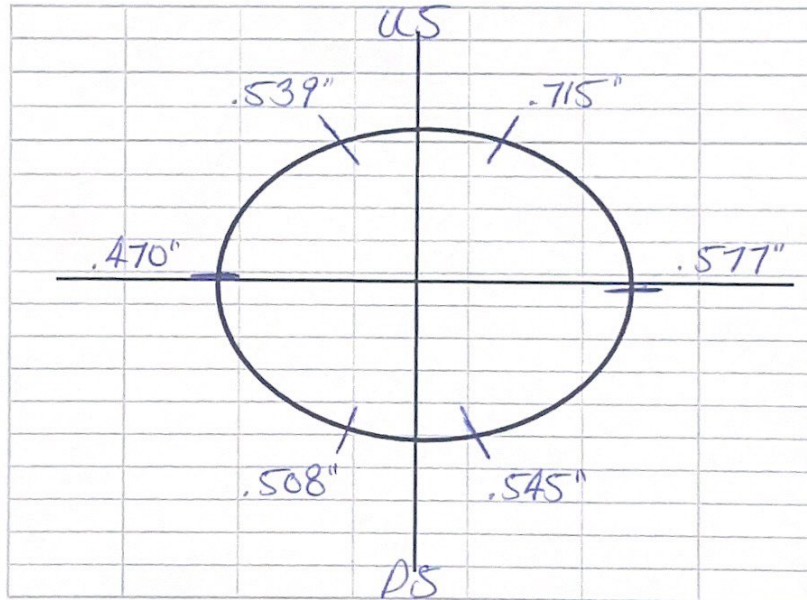
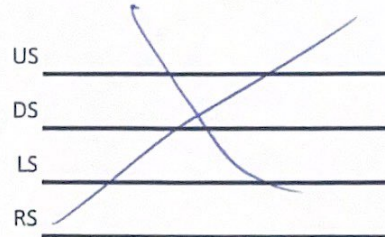
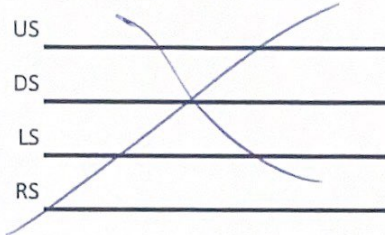
CREW RH, AW, JB, DB

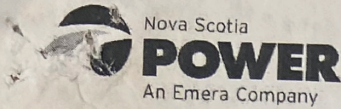
WORK ORDER 152291

UPPER

*KAPLAN RUNNER
6 BLADES

LOWER





*** Work Order 152291 ***

BSU:

UNIT:

REVIEW EQUIPMENT ENTRY

SYSTEM:

DO NOT USE



Type:	CAP	Job Type:		Planned Date:	2023-09-25
Status:	P	Impact:	PRODUCTION	PM #:	
Priority:	8	Severity:	MEDIUM (ANY CATEGORY)	Frequency:	
Assigned To:	HMS	Submitted By:	JENNINGS, JANET	Standard Doc#:	None
Isolation:	N	Submitted Date:	2023-09-22	Safety Doc#:	None
HIT/EM Flag:	0	WO Location:		Can Permit #:	
PowerPlan Proj:	C0056783	PowerPlan Task:	8300	PM Priority:	

<u>Equipment</u>	<u>Description</u>	<u>Equipment</u>	<u>Location</u>	<u>Criticality</u>	<u>Tag #</u>
01W1-02-01	ULF2 GENERATOR		01W1-02		

ULF2 2023 CONDITION ASSESSMENT

High Risk Categories:

Work Order Attachments:

<u>Equipment</u>	<u>Part Number</u>	<u>Description</u>	<u>Quantity</u>
------------------	--------------------	--------------------	-----------------

<u>Equipment</u>	<u>Trade</u>	<u>Function</u>	<u>People</u>	<u>Hrs</u>
01W1-02-01	MHM		4.00	40.00

Printed by S Frank September 25, 2023

Completed By:

Completion Date:

Safety Reminder
Keep Eyes and Mind on Task!

HYDRO UNIT CONDITION ASSESSMENT			
PLANT: <u>ULF #2</u>		DATE: <u>Sept 25/23</u>	
UNIT #: <u>2</u>		CREW: _____	
		WORK ORDER: <u>152291</u>	
Compressed Air System	Rating	Note: Inspection Criteria is to be used in addition to PMI checklists	Reference
Age	<u>2</u>		17-1
Maintenance History	<u>1</u>	<u>installed 2010-11</u>	17-2
Operational Performance	<u>1</u>	<u>Good</u>	17-3
Air/Oil/Water leaks	<u>1</u>	<u>No Leaks</u>	17-4
Vibration	<u>1</u>	<u>No Vibration</u>	17-4
Noise	<u>1</u>	<u>Normal</u>	17-4
Belts	<u>1</u>	<u>Belts in Good Shape</u>	17-4
Controls	<u>1</u>	<u>Good</u>	17-4
Exciter Inspection	Rating	Comments	
Age			12-1
Maintenance History			12-2
Operational Performance			12-3
Cabinet			12-4
Collector Ring Cleanliness	<u>1</u>	<u>Clean</u>	12-4
Exciter Housing Condition	<u>1</u>	<u>Clean</u>	12-4
Missing Parts		<u>N/A</u>	12-4
Damaged Parts		<u>N/A</u>	12-4
Collector Ring Wear	<u>1</u>	<u>Minimal wear</u>	12-4
Commutator Wear	<u>1</u>	<u>No wear/only surface discoloration</u>	12-4
Water ingress			12-4
Overheating	<u>1</u>	<u>No signs of overheating</u>	12-4
Worker safety conditions	<u>1</u>		12-4
Availability of Spare Parts			1=yes, 3=no
Power Circuitry Tests			12-5
Control Circuitry Tests			12-6

Governor Controls Inspection	Rating	Comments	Use tables per control type
Age	2		2-1 or 5
Maintenance History	1		2-2 or 6
Synchronization time and ability			2-3 or 7
Hunting problems			2-3 or 7
Step Response			2-3 or 7
Fly balls			2-4 or 8
Mechanical	2		2-4 or 8
Bushings & Seals	3	Bushings & Pins Worn ALOT	2-4 or 8
Availability of Spare Parts		see WHS OPS.	2-4 or 8
Governor Hydraulics Inspection	Rating	Comments	
Age	2		3-1
Maintenance History	1		3-2
Smoothness of operation	2	No CHATTERING OR HIGH SPOTS	3-3
leakage	2	Minimal	3-4
Gaskets & Seals	2	FEW DRIPS FROM PIPES.	3-4
Quadrant/Terminal Shaft	3	WORN BEARINGS	3-4
Oil Condition	2		3-4
Accumulator tank	2		3-4
Valves	2		3-4
Pumps	2		3-4
Pins/ Bushings/ Bearings	3	Bushings & BEARINGS WORN ALOT.	3-4
Availability of Spare Parts		see WHS OPS	1=yes, 3=no

Rotor Inspection	Rating	Comments	
Age	4		9-1
Maintenance History		Brake Band replaced 2022.	9-2
Voltage and Current overrating			9-3
Operating Limits			9-3
Loss of Field			9-3
Over-speed or runaway			9-3
Rotor Hub, radial arms and rim			9-4
Braking Surface/ Pads/ Assmbly	1	PADS ALL HAVE OVER 1/16" LEFT	9-4
Field Poles, keys, collars and pole faces	2	ABIT DIRTY, SO OIL	9-4
Bearings (Upper/Lower/Thrust)	3	LOWER GUIDE SUMP LEAKING.	9-4
Instrumentation Function			9-4
Field windings			9-4
Connections			9-4
Winding Leads			9-4
IR/PI testing			9-5
Stator Inspection	Rating	Comments	Use tables per winding type
Age	4		10-1 or 6
Maintenance History	2	Stator repaired in 2022 due to brake band issue.	10-2 or 7
routinely operated above 105% rated voltage			10-3 or 8
Out of phase breaker closings			10-3 or 8
History of winding problems	~~2~~	~~WINDINGS CLEAN & OIL FREE~~	10-3 or 8
Operated significantly above maximum allowable temperature (above 120 C)			10-3 or 8
Stator Winding	2	WINDINGS CLEAN & OIL FREE	10-4 or 9
Wedges, packing, blocking and bracing			10-4 or 9
Ring Bus			10-4 or 9
Main and Neutral Leads			10-4 or 9
End Turn condition			10-4 or 9
Core Laminations			10-4 or 9
IR/PI testing			10-5 or 10

It is known from past overhauls (2017 and in 2022 when the brake band section broke free and hit stator) that there is no fit left on the thrust block to rotor shaft. This causes issues with alignment and orbit.

Turbine Components Inspection	Rating	Comments	
Age	4		8-1
Maintenance History	2		8-2
Operational Performance	2	NO OUTSTANDING PROBLEMS	8-3
Headcover	2	NO PHYSICAL DAMAGE.	8-4
Turbine Bearing			8-4
Turbine Water Seal Wear (Carbon, Labyrinth, Packing)			8-4
Turbine Bearing Run Out			8-4
Turbine bearing supply piping	2	NO LEAKS	8-4
Headcover Nuts/ Studs	2	STUDS & NUTS ALL TIGHT	8-4
Headcover Seal Ring	2	NO LEAKS	8-4
Linkages	2	NO PLAY IN GATE ARMS	8-4
Greasing System	2		8-4
Vacuum Breakers			8-4
Operating Ring	3	10-15 THOU PLAY IN RINS.	8-4
Push Pull Rod/ Bushing Clearance	2	BUSHINGS & PINS TIGHT	8-4
Facing Plates		N/A.	8-4
Wicket Gate Condition	2		8-4
Wicket Gate Bushing	2		8-4
Wicket Gate Contact surfaces	2	SEE ATTACHED CLEARANCE READINGS.	8-4
Wicket Gate Stem Seals	2	NO LEAKS.	8-4
Discharge Ring/ Lower Seal	1		8-4
Stay Ring/ Stay Vanes	2		8-4
Scroll Case	2		8-4
Draft Tube and Liner	1	VERY GOOD	8-4

- NO work done to headcover / below head cover during overhaul in 2017.
- Turbine bearing housing will need work during next overhaul. Bearing is adjustable, should be reworked to have a different adjusting system, more like the downriver plants (LGB/DB/CF).

Turbine Runner Inspection	Rating	Comments	use tables per turbine type
Age	4		4-1 or 6-1 or 7-1
Maintenance History	2		4-2 or 6-2 or 7-2
Vibration			4-3 or 6-3 or 7-3
Allowable operating ranges	2		4-3 or 6-3 or 7-3
Oil Analysis			4-3 or 6-3 or 7-3
Hot Bearings/ Instrumentation			4-3 or 6-3 or 7-3
Initiation sequence			4-3 or 6-3 or 7-3
Oil Leakage	1		4-3 or 6-3 or 7-3
Motion of Blade Linkage	4	BLADES SEIZED	4-3 or 6-3 or 7-3
Runner - Seal Clearance	2	SEE ATTACHED NOTES FOR CLEARANCES	4-4 or 6-4 or 7-4
Erosion	2.1		4-4 or 6-4 or 7-4
Corrosion	2.1		4-4 or 6-4 or 7-4
Cavitation	2.1		4-4 or 6-4 or 7-4
Cracking	2.1		4-4 or 6-4 or 7-4
Breakers Inspection	Rating	Comments	use tables per breaker type
Age			13-1 or 13
Maintenance History			13-2 or 14 or 19
Operational Performance			13-3 or 15 or 20
Broken, missing or inoperable parts			13-4 or 16 or 21
Physical damage			13-4 or 16 or 21
Water ingress			13-4 or 16 or 21
Frayed, damaged or exposed wiring			13-4 or 16 or 21
Worker conditions			13-4 or 16 or 21
Dielectric Tests			13-5 or 17
Contact resistance test			13-6 or 18

See WTS 213.

Runner is a manually pitched, variable pitched blade runner that is seized. Not able to be pitched to maximize varying head pond elevations to get optimal generation.

See WHS ops

Batteries Inspection	Rating	Comments	
Age			15-1
Maintenance History			15-2
Operational Performance			15-3
Case			15-4
Impedance test			15-5
float voltages			15-5
temperature readings			15-5
connection resistance			15-5
Charger			15-5
Revised Generic Inspection Rating System, Please follow rating guide where possible.			
1) Component is within tolerance. No Change since Last Inspection			
2) Component is above normal operating range (wear, temperature or leakage) but does not affect unit operation. Repairs recommended within 5 years			
3) Component is in excess of normal tolerance and is affecting unit operation but is not likely to cause immediate failure. Repairs Required within 3-5 years (Economics, Runners, Spill)			
4) Component deficiencies are affecting unit operation and are likely to fail prior to next annual inspection. Requires repair within one year			
5) Component has failed or is likely to fail within the next six months. Immediate Repair Required (Safety, System Security, Lost Generation)			

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Request IR-6:

In the “Why do this project now” of NS Power’s application, NS Power notes that “The last major overhaul was completed in 1999. A subsequent minor refurbishment was done in 2018 but only addressed components above the headcover without completely removing the unit. Based on condition assessments a complete refurbishment is necessary to address the major issues identified that would otherwise lead to unit failure.”

(a) Please explain the minor refurbishment implemented in 2018.

(i) List the specific work completed during 2018 and indicate the expected service life of that solution.

(b) Please compare the scope of works between the 2018 refurbishment and the currently proposed complete refurbishment.

Response IR-6:

(a) The minor refurbishment in 2018 included replacement of wear components (bushings, pins, links, brakes) above the turbine headcover. The turbine was not disassembled. Please refer to IR-1 Attachment 1 on the right side of the diagram where the dotted line distinguishes the extent of the 2018 scope. The table in IR-2 compares the scope items included in the 2018 scope of work with that included in the 1999 overhaul and proposed 2025 overhaul. The service life of these wear components above the headcover are expected to be 8-15 years.

(b) Please refer to IR-2 for a list of scope items included in the 2018 scope in comparison to the proposed complete refurbishment in 2025. At a high level, the 2025 scope will include wear components above the head cover in addition to full disassembly of the unit to allow

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- 1 for refurbishment of additional items such as headcover, wicket gates, turbine shaft, and
- 2 thrust block.

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Request IR-7:

In the “Why do this project this way” of NS Power’s application, NS Power notes that “Refurbishing this unit through the replacement of specific worn components is the most economical way to achieve the intended project scope, considering both the current condition of its components and the unit’s age. This approach meets all the requirements and constraints of the intended project scope and is significantly more economical than a full unit replacement.”

(a) Please compare the scope of work between the proposed overhaul project and a full unit replacement, highlighting key differences in approach and deliverables.

(b) Please provide a cost estimate for both the overhaul and the full unit replacement, including a breakdown or rationale for the cost difference.

Response IR-7:

(a) Generally, a full unit replacement would involve the removal and replacement of all major mechanical and electrical components within the existing concrete structure of the powerhouse. In contrast, the proposed overhaul focuses on refurbishing individual components as needed.

(b) A cost estimate for the replacement of a smaller unit in 2021 suggests that full replacement of a unit of this size would be in the range of \$8 - \$10 million for base scope. This estimate was not specifically developed for Upper Lake Falls. Both replacement and refurbishment alternatives would achieve similar operational outcomes, but the replacement alternative requires significantly higher capital investment than the refurbishment alternative. Installation of a new unit requires significantly higher capital investment but does not extend the refurbishment interval beyond 25 years. Also, known issues with alkali-aggregate reaction (AAR) reaction within the powerhouse concrete at Upper Lake Falls

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1 make full unit replacement an unsuitable option as the concrete could continue to see
2 movement and growth due to the AAR. These site-specific conditions, combined with the
3 uncertainty around the timing and scope of Mersey Redevelopment or partial
4 decommissioning, make a full replacement an impractical and uneconomical option at this
5 time.

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Request IR-8:

In the “Why do this project this way” of NS Power’s application, NS Power notes that “This overhaul will maintain the reliability of Upper Lake Falls 2 and ensure the unit remains available to support ongoing water management on the Mersey River. Running the unit to failure is not considered a technically feasible option due to the negative impacts its unavailability would have on ongoing water management operations.”

(a) Please list all safety concerns and operational risks associated with the option of running the unit to failure.

Response IR-8:

(a) In general, the safety and operational risks that NS Power mitigates on a continuous basis while operating a hydro unit such as Upper Lake Falls to failure include:

Failure Type	Safety concern / Operational Risk
Public Safety	Uncontrolled water release due to unit unavailability could endanger downstream communities, damage riverbanks with significant cultural resources, or harm aquatic ecosystems.
Environmental	Oil leaks from bearings, governors, or hydraulic systems could contaminate waterways, violating environmental regulations.
Mechanical hazards	Turbine runner, shaft, or bearing failure could result in high-energy component ejection or catastrophic vibration, posing safety risk to personnel if employees were in the line of fire of component vibration / pinch points.
Electrical hazards	Generator winding failure or insulation breakdown could cause arc flashes, electrical fires, or damage to protection systems.

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Failure Type	Safety concern / Operational Risk
Hydraulic hazards	Loss of governor control may overspeed the turbine, risking mechanical disintegration and loss of water control.
Operational Risks	Sudden failure of critical components would force immediate shutdown and typically higher costs with long lead times for refurbishment on short notice.

1
2 In addition to these risks, the unit's unavailability would reduce NS Power's ability to
3 manage water flows through generation, increasing reliance on manual spill gate
4 operations. This introduces further risk, especially during high-flow events, given the age
5 of the spill gates and the logistical challenges of accessing remote sites under adverse
6 conditions.

7
8 The proposed overhaul mitigates these risks by restoring the unit's reliability and ensuring
9 it remains available to support controlled water discharge, consistent with NS Power's
10 system-wide water management strategy and sustaining capital principles.

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Request IR-9:

In the “Reason for Variance” of NS Power’s application, NS Power notes that “The decrease of \$96,139 from the 2025 ACE Plan subsequent submittal estimate of \$1,678,153 is due to updating the project scope resulting in fewer contracts and less labour than previously estimated.”

(a) Please explain why the project scope was revised after the submission of the proposal in the 2025 ACE Plan and provide additional details on what specific work was undertaken to refine the scope.

(b) Please provide the original project scope as outlined in the 2025 ACE Plan budget (\$1,678,153) and identify which components of the work are now considered unnecessary, along with the reasoning for their exclusion.

Response IR-9:

(a) This project was listed in the 2025 ACE Plan as a project for subsequent submission, indicating that the project scope and estimate were not ready for submission at that time. At that stage, the 2025 ACE Plan forecast included a modification of the turbine runner hub to allow for adjustment of the runner blades within the hub. However, as more detailed project planning was completed, it was determined that this risk did not warrant mitigation, therefore was removed from the project.

(b) The original project scope, as outlined in the 2025 ACE Plan budget, included all elements of the current scope plus the turbine runner hub modification. This specific work has been removed from the current scope. The 2025 ACE Plan budget of \$1,678,153 included on the Subsequent Submittal list was an estimate at the time of filing, and was not considered complete nor detailed enough for NSEB review; therefore, more work was required to finalize the project scope and estimate. Since then, the budget has been refined to a Class

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1 3 estimate. The work completed to refine the project scope included coordination with
2 internal work groups to confirm labour requirements based on the revised scope, and
3 updating contract and material cost estimates with recent quotes from vendors on similar
4 jobs.