Hydropower 5-year Plan and MIL
The Risk Factors

[redacted]

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U.S.ARMY

US Army Corps of Engineers
BUILDING STRONG®

Ranking Criteria for Capitalized Work in Plants (Ranking Worksheet)

Hydropower Relative Risk Index (1-5)- Primary Ranking

- Condition Index
- Consequence Rating Criteria
- Hydropower Relative Risk Values

Availability Risk

Public Safety and Health

Environmental Concerns

Legal Concerns

Impact to Other Business Lines

Formulate a Condition Index Rank- 1=High Risk; 5= Minimal Risk

Integration into 5-year Plan

SWPA 5-year Expense Projection

- Excellent Opportunity to collect information.
- Much of it is transportable into our 5-year Plan.

Utilize Relative Risk Index (INDEX) to rank Capitalized and Major Repair work

- HydroAMP Criteria is known- need rankings for balance of plant.
- Utilize information we have- reduce field requests.

Risk Matrix and Balance of Plant

- Utilize the HydroAMP criteria and the Risk Worksheet to rank packages based upon Risk.

- Include Balance of Plant

- Which packages have enough Risk that E&D/ Engineering Analysis needs to be done first?

- The Condition, Consequence and Relative Risk Matrix are used to identify the Relative Risk Index.

hydroAMP/ Equipment Condition Classification Categories

Condition Classification Guidelines	
Condition Classification	**Definitions**
F **Failed**	The feature has FAILED and is no longer operable without further tests, repairs, or replacement.
D **Poor**	The feature does not perform well under normal operating conditions, and it does not meet engineering or industry standards. Physical signs of serious damage or deterioration are present (equipment failing). Significant restrictions to operation and/or extensive non-routine maintenance are necessary.
C **Marginal**	There is a low level of confidence that the feature will perform well under normal operating conditions, and it does not meet engineering or industry standards. The feature requires additional investigation or studies to confirm adequacy. Restricted operation and/or non-routine maintenance are necessary.
B **Fair**	There is a medium level of confidence that the feature will perform well under normal operating conditions, although it may not specifically meet engineering or industry standards. The feature may require additional investigation or studies to confirm adequacy. Minimal restrictions to operation and/or minor maintenance may be necessary.
A **Good**	There is a high level of confidence that the feature will perform well under normal operating conditions. This confidence level is supported by data, studies, or observed characteristics which are judged to meet current engineering or industry standards. Routine O&M is recommended.

The Condition of the equipment is assessed

Consequence Rating Criteria

Consequence Category	Consequence Rating Criteria
I	**High:** - Public or Life Safety Impact and/or - Violation of Legal Requirement(s) and/or - Forced Outage /Closure resulting in Highest Economic Loss and/or - Greatest Decrease in Performance (e.g., efficiency, capacity, reliability) and/or - Greatest Increase in Life Cycle Costs and/or - Greatest Increase in Critical Maintenance Backlog
II	**Medium-High:** - Forced Outage / Closure resulting in High Economic Loss and/or - Great Decrease in Performance (e. g., efficiency, capacity, reliability) and/or - Great Increase in Life Cycle Costs and/or - Great Increase in Critical Maintenance Backlog
III	**Medium:** - Forced Outage/Closure resulting in Moderate Economic Loss and/or - Moderate Decrease in Performance (e.g., efficiency, capacity, reliability) and/or - Moderate Increase in Life Cycle Costs and/or - Moderate Increase in Critical Maintenance Backlog
IV	**Low:** - Forced Outage/Closure resulting in Minor Economic Loss and/or - Minor Decrease in Performance (e.g., efficiency, capacity, reliability) and/or - Minor Increase in Life Cycle Costs and/or - Minor Increase in Critical Maintenance Backlog
V	**Minimal:** - Forced Outage/Closure resulting in Minimal Economic Loss and/or - Minimal Decrease in Performance (e.g., efficiency, capacity, reliability) and/or - Minimal Increase in Life Cycle Costs and/or - Minimal Increase in Critical Maintenance Backlog

The consequences are listed for the equipment

Hydropower Relative Risk Values (1-25)

F – I = 1	D – I = 2	C – I = 4	B – I = 5	A – I = 11
F – II = 3	D – II = 6	C – II = 7	B – II = 12	A – II = 16
F – III = 8	D – III = 9	C – III = 13	B – III = 17	A – III = 18
F – IV = 10	D – IV = 14	C – IV = 19	B – IV = 20	A – IV = 23
F – V = 15	D – V = 21	C – V = 22	B - V = 24	A - V = 25

Based upon the Condition and the Consequence measures, a relative risk value is assigned.

Hydropower Relative Risk Categories

High Risk

Med- High Risk

Moderate Risk

Low Risk

Minimal Risk

Hydropower Relative Risk Index Matrix

Consequence / Condition		Condition Classification				
		F Failed	D Poor	C Marginal	B Fair	A Good
Consequence/Economic Impact	I	1	1	2	2	3
	II	1	2	2	3	4
	III	2	2	3	4	4
	IV	2	3	4	4	5
	V	3	4	4	5	5

The Condition, Consequence and Relative Risk Matrix are used to identify the Relative Risk Index.

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Condition Assessments

The condition assessments for the equipment listed below shall be completed utilizing the HydroAMP system. These assessments shall be completed at each unit outage or anytime an event occurs with a component that would change its condition rating.

- Generators
- Turbines
- Transformers
- Circuit Breakers
- Governors
- Exciters
- Cranes
- Batteries
- Compressed Air Systems
- Emergency Closure Gates
- Surge Arrestors

Balance of Plant Assessments

The condition assessments of all other power plant specific equipment (see Balance of Plant list) shall be completed by utilizing the generic non-HydroAMP equipment condition indicators.

These condition assessments follow the framework of the HydroAMP system but do not have specific assessment guides to determine the final condition assessment.

These assessments shall be completed at each unit outage or anytime something happens to a component that would change its condition rating (e.g., failure, replacement, refurbishment, etc.).

Balance of Plant Equipment

Equipment	Remarks
SCADA-	Assess the SCADA system as a whole.
Communication System-	Assess the communication system as a whole.
Security System-	Assess the Security System as a whole.
Battery-	Assess each battery separately. Use hydroAMP assessment.
Battery Charger-	Assess each voltage system separately
Inverter-	Assess each voltage system separately
DC Distribution System-	Assess each voltage system separately. Excludes Battery and chargers.
Essential AC Distribution System-	Assess each voltage system separately, excludes inverter.
Other AC Distribution System Intake, spillway, etc.-	Assess each system separately.
480V Station Service Switchgear-	Assess the station service switchgear as a system.
Motor Control Centers-	Assess the motor control centers as a system.
Lighting and Power Boards for Station Service-	Assess all lighting, lighting panels and non-MCC powerboards as a system.
Roof -	Assess the roof as a whole.
Fire Suppression System-	Assess each fire system separately. Fire detection devices should be included here.
Air System-	Assess each air system separately. Assess all components including the air compressors.
HVAC System-	Assess each HVAC system separately.
Raw Water System-	Assess all piping, pumps, valves and other components external to the generators as a whole system.
Cranes-	Assess each crane separately.
Line Protective Relaying-	Assess all line protective relaying as a whole system.
Generator Protective Relays-	Assess all protective relays associated with a single generator as a whole system.
Station Service Protective Relaying-	Assess the station service protective relaying as a whole system.
Plant Control System-	Assess the plant control system (generator, lines, station service) as a whole system.
Elevator-	Assess each elevator separately.
Generator Air Coolers-	Assess the air coolers associated with a single generator as a whole system. Includes the piping inside the air housing.
Switchyard Disconnect Switches-	Assess all switchyard disconnect switches as a whole system.
Other Disconnect Switches-	Assess each remaining disconnect switch by system separately.
Emergency Generator-	Assess each emergency generator separately.
Trash Racks-	Assess each trash rack separately
Emergency Intake Gate/Valve-	Assess each emergency intake gate/valve separately.

Balance of Plant Equipment

Equipment	Remarks
Bearing Oil Coolers-	Assess the bearing oil coolers associated with a single bearing as a whole system. Includes the piping inside the generator/wheel pit.
Station Service Medium Voltage Cables-	Assess the station service medium voltage cables as a system.
Draft Tube Gates-	Assess each set of draft tube gates separately.
Stop Logs-	Assess each set of stop logs separately. This item includes non-emergency intake gates.
Station Service Transformers-	Assess each set of station service transformers separately.
Unwatering and Station Drainage System-	Assess the unwatering and station drainage system as a whole.
Main Unit Neutral Grounding Equipment-	Assess each units neutral grounding equipment separately.
Main Unit Bus and/or Cable-	Assess each units bus and/or cable system separately.
Lubricating and Insulating Oil System-	Assess the pumps, purifiers, tanks, valves, piping, etc. as a system.
Switchyard Bus and Insulators-	Assess the switchyard bus and insulators as a system.
Switchyard Structure-	Assess the switchyard structure as a system.
Penstock-	Assess the penstocks as a system.
Sewage Treatment System-	Assess the sewage treatment system as a whole.
Potable Water System-	Assess the potable water system as a whole.
Switchyard Instrument Transformers-	Assess all switchyard instrument transformers as a whole.
Non-Main Unit HV Circuit Breakers-	Assess each non-main unit HV circuit breaker separately.
Non-Main Unit MV Circuit Breakers-	Assess each non-main unit MV circuit breaker separately. This includes station service breakers.
Generator/Turbine Shaft-	Assess each generator/turbine shaft separately.
Surge Arrestors -	Assess all surge arrestors with a common voltage system as a system.

New Data Sheet Format

Data Sheet has been refreshed

- Standard Layout with drop down menu

Phase 1 and Phase 2 Designation for complex or higher effort work packages

- Phase 1 is for Engineering and Design, Plans and Specs, or a study
- Phase 2 is for execution of work.
- Goal is to have better estimate for Phase 2

Questions?