

# ROCK ISLAND POWERHOUSE 1

## B1-B4 Unit Modernization Hydro Work Schedule Analysis

Commission Meeting  
June 20, 2016



# Purpose of Presentation

## **B1-B4 Turbine Evaluation**

- Present current state of B1-B4 generators and turbines
- Review of alternatives considered
- Discuss value of the B1-B4 units
- Present a recommendation for rehabilitation

## **Hydro Repair Schedule Acceleration Evaluation (RR and RI)**

- Work plan evaluation – Schedule alternatives
- Present a recommendation for work plan

## **Action Requested**

- Approve Resolution to establish a project budget and to hire staff necessary to complete hydro work over the next 6 years



# Current State

- Generators
  - Stators replaced 2010 to 2016
  - Rotors original 1931
    - Poles
    - Rim
    - Spider



# Current State

- Turbines original 1931 equipment (85 yrs)
  - Blades welded to Hub in 1980s
  - Significant number of blade cracks discovered on B2 in 2015
  - B2 Blade crack repairs unsuccessful to date
  - B1, B3, B4 inspected 2016 and similar cracks found



# Current State – Blade Cracks

	B1	B2	B3	B4
<b>Inspection Date</b>	23 MAR thru 28 MAR 2016	08 FEB 2016 after weld repairs	24 FEB thru 02 MAR 2016	15 MAR thru 18 MAR 2016
<b># cracks in blade 1</b>	25	7	11	26
<b># cracks in blade 2</b>	19	2	27	19
<b># cracks in blade 3</b>	16	5	13	37
<b># cracks in blade 4</b>	35	4	47	15
<b># cracks in blade 5</b>	21	3	13	24
<b># cracks in blade 6</b>	34	5	59	4
<b># cracks total</b>	<b>150</b>	<b>26</b>	<b>170</b>	<b>125</b>

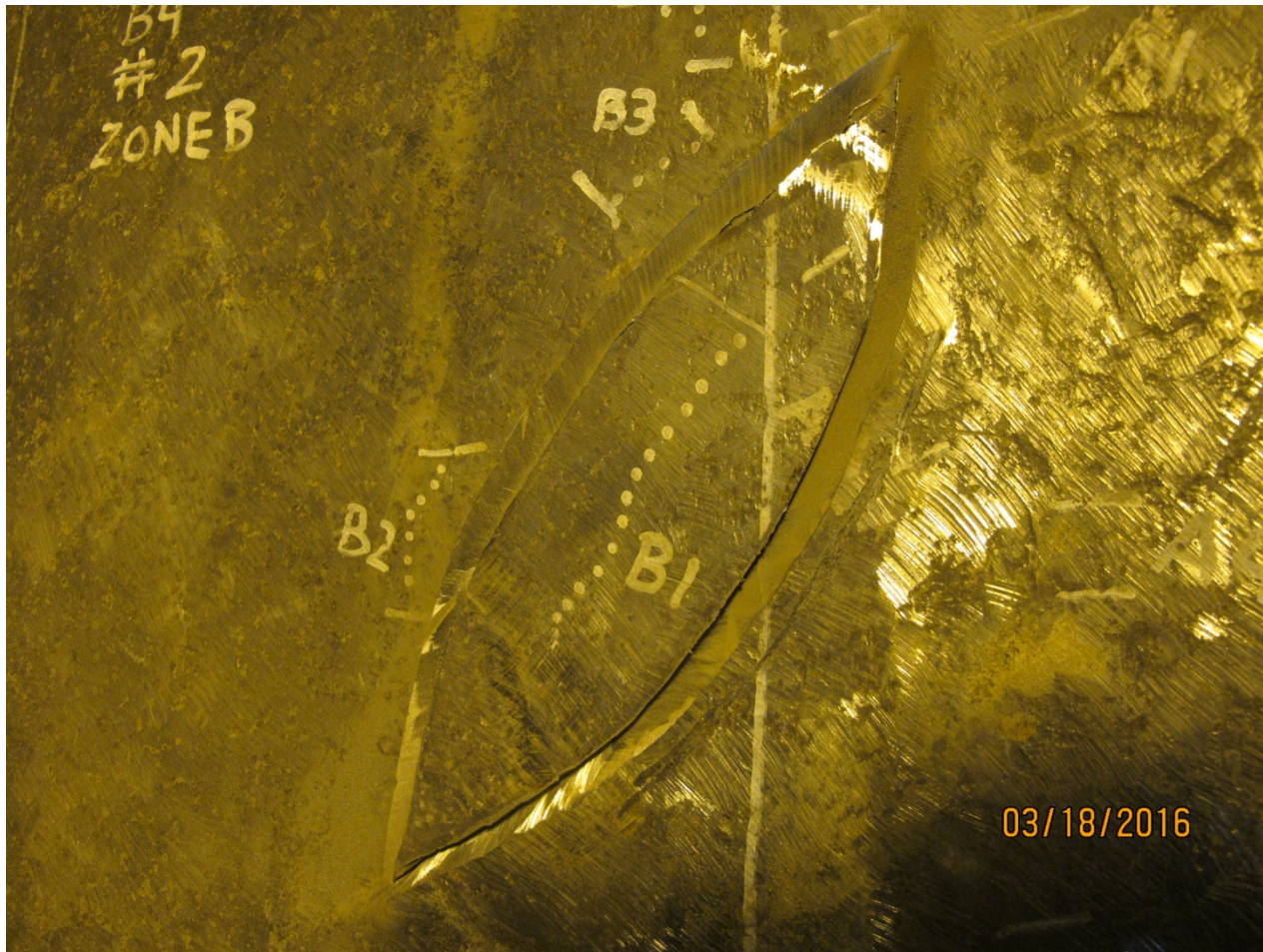
# Current State

## Unit B4 Blade 1, Area B





# Boat Sample – metallurgical testing



# Unit B4 Boat Samples





# Current State

- B1-B4 out of service until rehabilitation
- Continue efforts to determine if temporary interim repair solutions are viable (unlikely)



# Alternatives Considered

## 1) Retirement

- Permanently remove from service

## 2) Inactive Reserve

- Prepare for long term storage
- Postpone decision for retirement or rehabilitation

## 3) Rehabilitation

- Turbine runner
- Generator rotor



# Alternative Issues

## 1) Retirement

- Lost revenue from energy, capacity, encroachment, flexibility, carbon free
- FERC project license amendment
- Technical challenges to replace hydraulic capacity
  - Turbine water passage modifications?
  - Spillway modifications?
- Environmental studies
- Schedule risk to complete changes prior to HCP check-in
- Cost to retire approaches cost of rehabilitation



# Alternative Issues

## 2) Inactive Reserve

- FERC and resource agency consultation
- Reduced hydraulic capacity through turbines results in additional spill
- Increased reliance on spillway to mitigate risk of overtopping (26 Kcfs)
- Increased spill could result in higher total dissolved gas
- Units out of service during HCP check-in (different conditions than last check-in)
- Cost and effort to store/have ready to return to service
- Uncertainty for power purchasers/slice contracts
- Lost revenue





# Alternative Issues

## 3) Rehabilitation

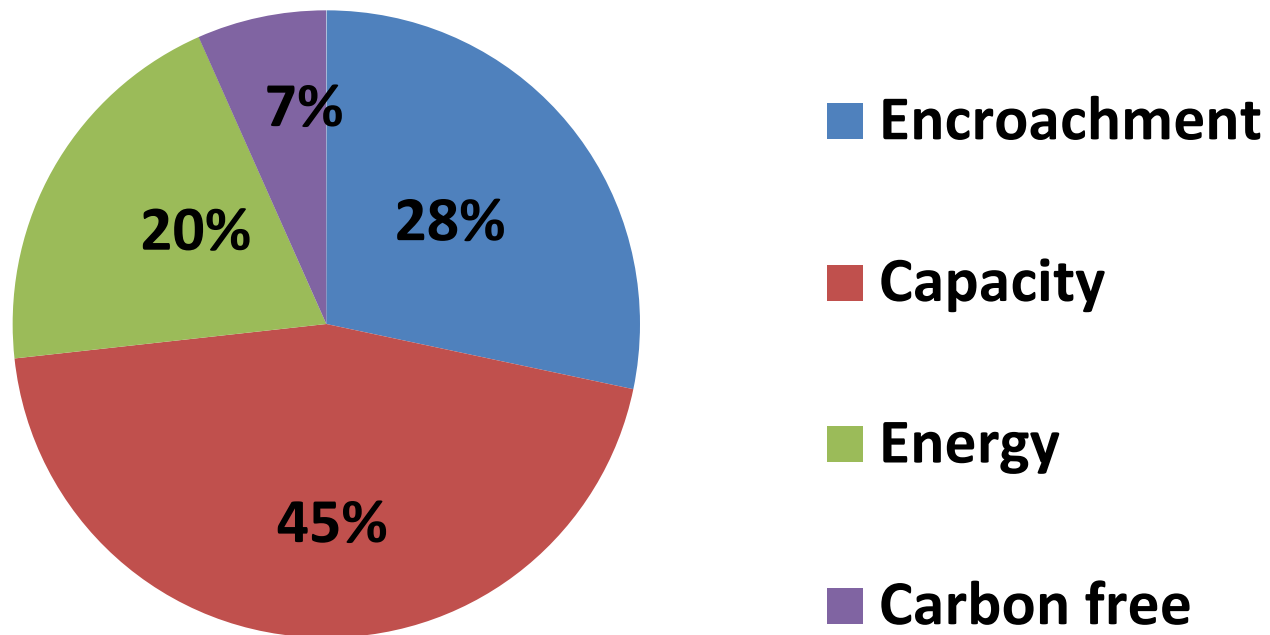
- Financial viability
- Execution risk
  - Technical solution
  - Construction safety
- Impact on existing contracts (B5-B8 rehab)



# Value of B1-B4 Units (50 yr)

Revenue Estimate

\$101 million present value



# Value of B1-B4 Units

- Operational
  - Headwater control
  - Maintenance flexibility
  - PH2 Rehab support (2.5 B1-B4 Units = 1 PH2 Unit)
- Natural Resources
  - Mitigates Total Dissolved Gas
  - Supports Juvenile Fish Passage

## Rehabilitation Recommended



# Rehabilitation Options

1) Turbine Replacement in kind (old design)

2) Turbine replacement with modern design

Turbine Includes:

- Draft Tube
- Runner and Hub
- Discharge liner
- Bottom Ring
- Wicket gates, gate operating ring, servos
- Head cover
- Turbine shaft





# Rehabilitation Options

- Benefits of Modern Design
  - Higher efficiency/more energy
  - Increased hydraulic capacity
  - More fish friendly
  - Oil free hub
  - Manufacturing details
  - Cost savings: don't buy features that aren't needed (adjustable blades)



# Scope Recommendation

- Labor resources B1-B4
  - Contract unit disassembly / reassembly
  - District wireman perform electrical work
- Turbine
  - All new except, assess wicket gates, turbine guide bearing and gate operating ring for possible reuse
- Generator
  - Reuse stator
  - Replace rotor spider, poles and rim
- Other Projects
  - Governor Controls, Excitation, Fire Protection previously budgeted. Complete during turbine outage.

NOTE: The scope recommendation included an economic evaluation of spending less money than recommended above by refurbishing some components rather than replacing:

- Incremental outage time vs. deferring cost proved not to be economical
- Did not meet the “doing the best for the most for the longest” test



# Financial Value of Recommendation

## Key metrics of economic analysis with selected sensitivities:

- Estimated Budget - \$15 million per unit
- Estimated \$46 Million net present value (NPV)
  - Compared to a no cost alternative
  - All other alternatives have costs and no revenue
- 12.2% Internal rate of return (IRR)
- 9.0% IRR computed without Wanapum encroachment
- 7.0% IRR with 15% cost increase, no encroachment, carbon free premium at current rates, reduced capacity and energy markets down 6% from forecast
- Sensitivities pencil out to provide economic value to customers
  - Before District awards contract, key assumptions and value components will be revisited to confirm economic value



# Work Plan Evaluation

- B1-B4 prompted a review to optimize hydro project outages and work schedules
  - RR C8-C11 large unit turbines, windings, bridge cranes, head covers, C1-C7 overhauls
  - RI B5-B8 rehab, PH2 governor control upgrades, B1-B4 end of life, PH2 modernization
  - HCP Check-in
- 16 repair schedule options considered at both projects
- Three leading options: Status Quo, Option 7 and Option 11



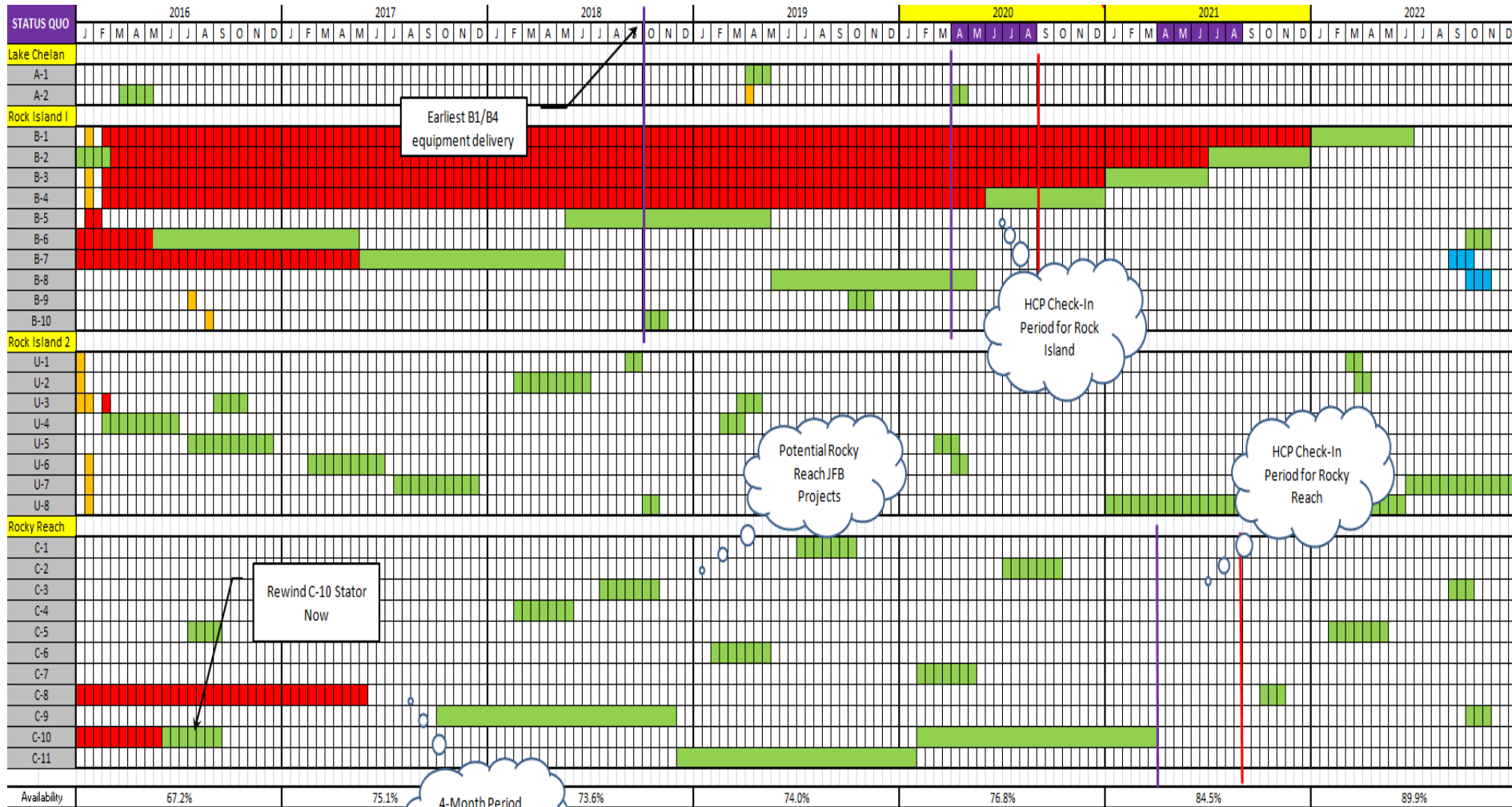


# Work Plan Evaluation

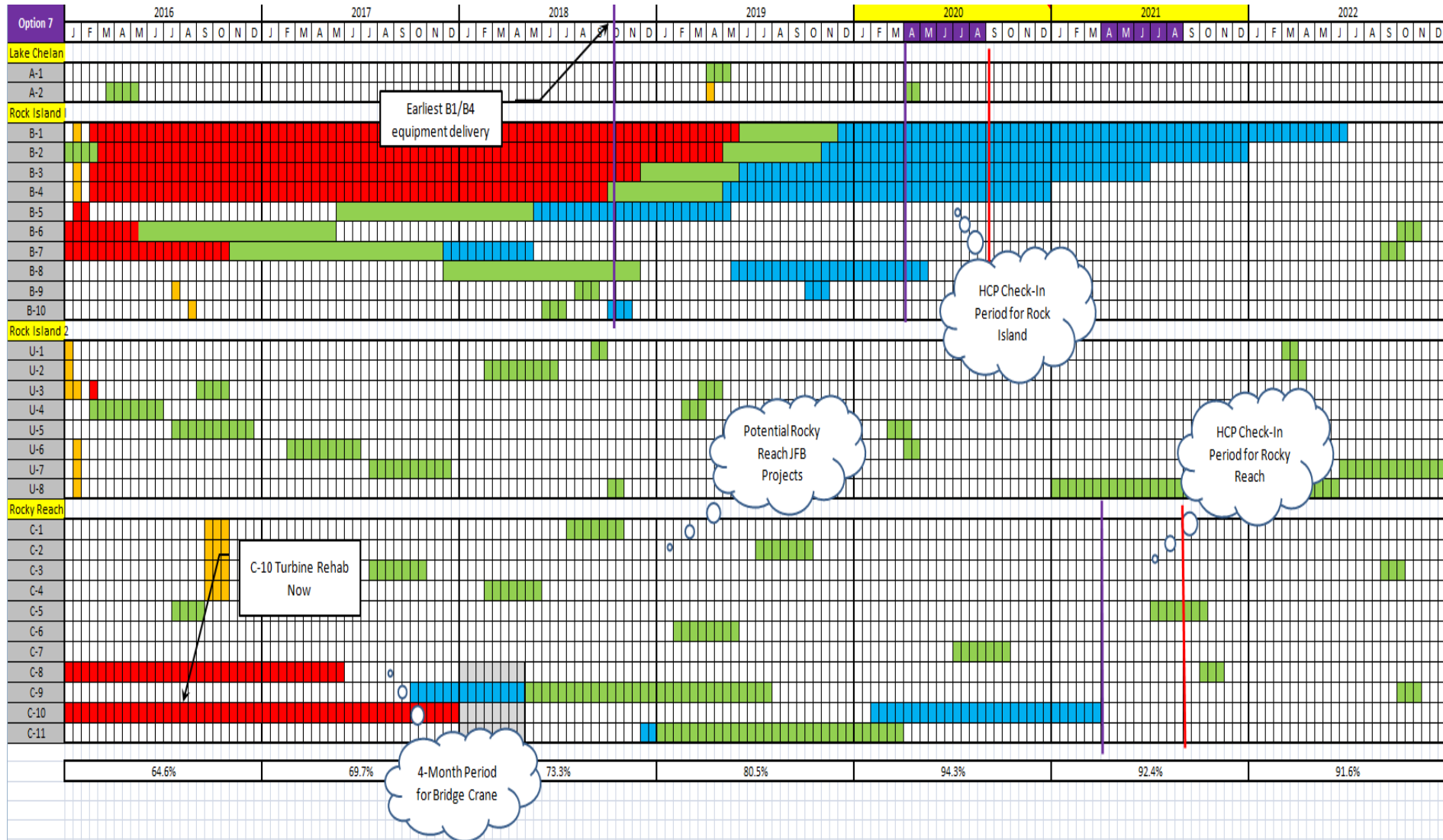
- “All Hands On Deck” comprehensive analysis, including:
  - Internal/external labor and resource impacts
  - Project management and impacts to schedules / priorities
  - Revenue benefits vs. cost impacts with labor and contracts, etc
  - Internal stakeholder outreach to draw on expertise for respective area impacts and considerations
  - Risk mitigation, protection of value and potential impacts to external stakeholders



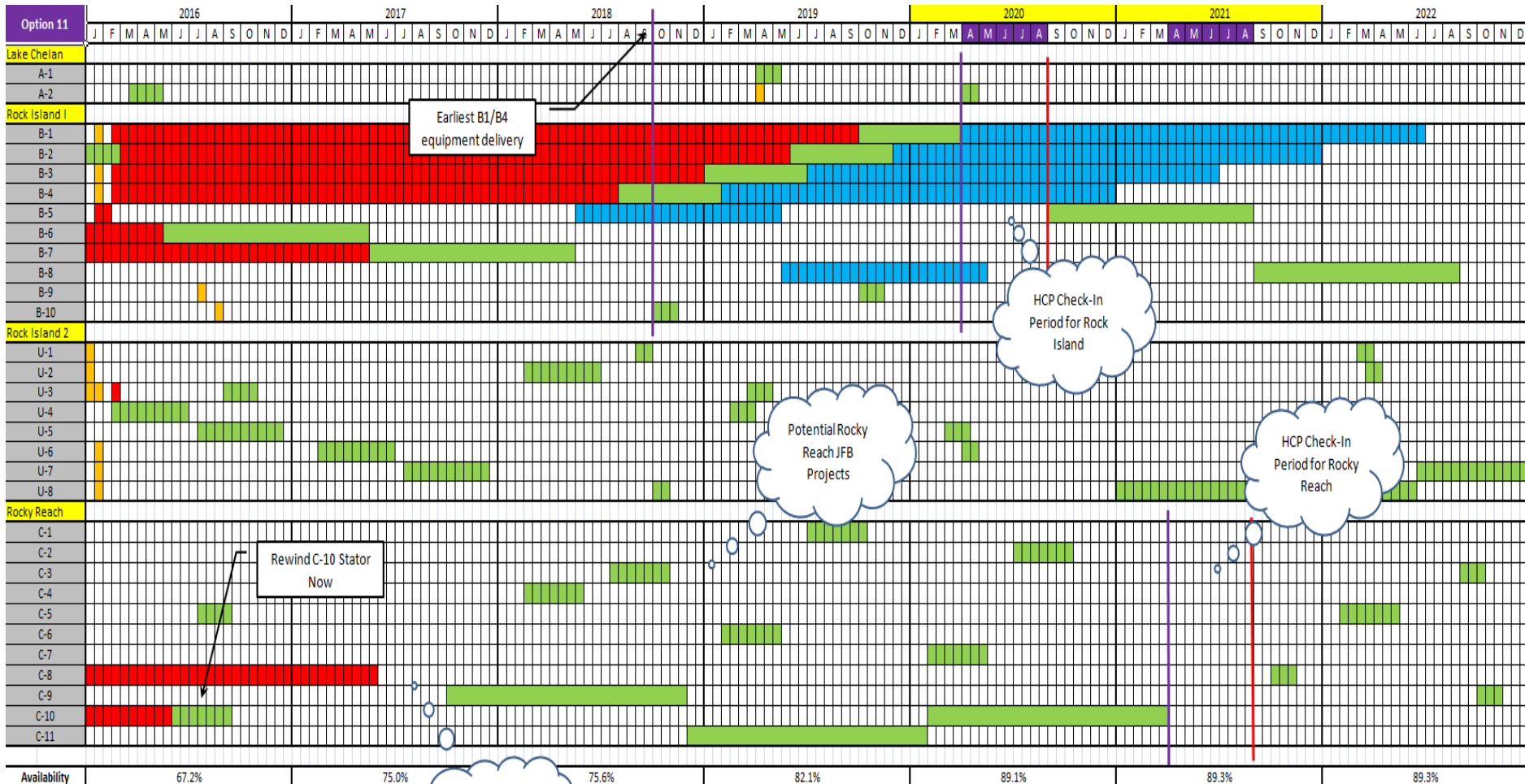
# Schedule Option 1: Status Quo



# Schedule Option 7: ASAP



# Schedule Option 11 - Recommended



4-Month Period for Bridge Crane Projects



# B1-B4 Activity Schedule

- Advertise bids by Sept. 2016
- Award contract by Jan. 2017
- Revise schedule for B5 and B8
- Start 1<sup>st</sup> unit disassembly Aug. 2018
- New equipment onsite by Oct. 2018
- Work Complete Mar. 2020



# Resources to Execute Recommendation

- District Workforce Impacts

Current planned work in addition to B1-B4 work requires the additional workforce:

- Need 4 additional wiremen and 2 technicians
- Need 2 additional control systems engineers earlier than forecasted
- Need 1 additional project manager and 1 additional construction manager (includes PH2 rehab prep work)
- HR has additional hiring, payroll and benefits workload
- PCS/Legal: additional bids, PO's, and contract changes
- Added craft resources in short term will help address succession planning, and attrition is expected to bring back down to current levels.



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# Assumptions

- Blade cracks are not repairable for long term operation
- B5 and B8 operate through 2021
- PH2 Units operate through 2021
- Can acquire new equipment by fall 2018
- HCP check-in successfully completed in 2020
  
- Additional unit outages may result in an alternate schedule.



# Decision Evaluation Criteria

1. What is the impact on our Customer-Owners?
  - Economic value to customer-owners returning an expected internal rate of return of 12.2% with increased capacity value, encroachment value, energy value and added flexibility
  - Inserting B1-B4 prior to B5 and B8 optimizes unit availability, labor/contract costs and mitigates risk
  - Requires incremental capital of \$15M/unit currently not in the forecast
  - Increased reliability for 50 years with reduced outage time
  - Supports strategic objective to invest in long-term assets that provide value



# Decision Evaluation Criteria

2. What are the stewardship implications and impact to the environment?
  - Reduced spill volumes (TDG)
  - Less reliance on spillway to mitigate risk of flooding
  - No risk of oil leak given their fixed blade design
  - Modern smaller hub design provides more efficiency (less water for same production)
  - Reduces potential injury to downstream migrating salmon and steelhead



# Decision Evaluation Criteria

## 3. What are the legal implications?

- Most likely no impacts to current license and does not impact District's initiative to optimize relicensing efforts
- Other alternatives have a higher level of FERC license risk
- Contract bid will provide flexibility in scope for District to obtain best value
- Schedule timing may impact other contracts and work at the District (B5-B8 rehab) that may add incremental costs



# Decision Evaluation Criteria

## 4. What are the workforce/operations implications?

- Optimized work plan will require additional District FTE's
- Significant impacts to existing projects and will require continued evaluation to optimize internal versus contracted work
- Requires careful planning and coordinated effort with multiple projects occurring introducing potential project execution risk





# Decision Evaluation Criteria

5. What are the other stakeholder implications?
  - Maintaining capacity and energy capability and operational flexibility will be preferred by power purchasers
  - Incremental costs will be capital so no immediate impact to cost-plus purchasers
  - Fish agencies would support modern design if results are lower mortality
  - FERC would be supportive of returning hydraulic capacity sooner rather than delaying decision/action



# Decision Evaluation Criteria

## 6. What are the impacts to Values?

- Safety: Increased short-term risk associated with construction work. Reduced long-term risk from less complex operations, reduce maintenance outages, reduced risk of damage to plant/personnel using old equipment
- Stewardship: maintains hydraulic capacity, supportive of maintaining fish passage, provides incremental value to customer owners
- Trustworthiness: supports long-term relationships with power purchasers through value creation, supports current power contracts, avoids costs and uncertainty associated with alternatives, consistent with strategic plan
- Operational Excellence: supports continuous improvement in operational flexibility, realizes efficiency improvements, provides crews with developmental opportunities and knowledge transfer



# Proposed Next Steps

## Commission Actions

- June 20 - Approve Resolution for 2016 Work
  - \$350,000 for District staff and consultants to prepare bid documents, solicit bids, and notify agencies.
  - Hire staff in identified positions to complete work
- Sept. 2016 - Resolution to Advertise Bids
- Jan. 2017 - Award of Contract



# Project Approval Means

- \$60 million Capital budget forecast
- Set up Capital project at \$350K for 2016
- Additional FTE's
  - 4 additional wiremen
  - 2 technicians
  - 2 control systems engineers
  - 1 project manager
  - 1 construction manager
- Change to B5-B8 contract



# Questions ?

