• FCRPS Hydropower Program Overview & History
• Capital Program Strategy
• O&M Program Strategy
• Asset Management and O&M Excellence
• The Future of Federal Hydropower
FCRPS Hydropower Program Overview & History
FCRPS Hydropower Program
Top Down Funding Levels
Longer term strategic view
Risk Informed Decision Making
Focus on continuous improvements
The Past
- Targeted specific classes of equipment
- System-wide analysis of individual components prioritized “low-hanging fruit” equipment with very high NPV.
- New O&M requirements were funded through budget increases when acceptable.

The Future
- Targeting critical plants with greatest risk of lost generation
- Unit by unit analysis to drive decisions – replace vs. rehab vs. maintain vs. defer
- Constrained O&M funds – absorb growth through efficiencies and accept additional short-term risk
Capital Program Strategy
Capital Program Strategy

FCRPS Asset Planning

- Strategic Asset Management Plan*
- Investment Identification and Development
- Investment Portfolio Optimization
- System Asset Plan

*Formerly the Hydro Asset Strategy
• Unconstrained: Running lifecycle cost minimization model for each asset without budget, resource or outage constraints
### 2018 IPR Recommended Capital Investment (Nominal $ Millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
<th>2031</th>
<th>2032</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>206</td>
<td>217</td>
<td>238</td>
<td>256</td>
<td>281</td>
<td>300</td>
<td>306</td>
<td>313</td>
<td>319</td>
<td>326</td>
<td>333</td>
<td>340</td>
<td>347</td>
<td>354</td>
<td>362</td>
</tr>
</tbody>
</table>

### Recommended Capital Investment Level History

- **2010, 2012 IPR**
- **2014 IPR**
- **2016 IPR**
- **IPR Approved Levels**

[Graph showing historical investment levels with different IPR years highlighted]

**BONNEVILLE POWER ADMINISTRATION | IPR JUNE 2018**
Reduces Lost Generation Risk beginning in the mid-2020s

Risk mitigation results in an Incremental NPV of $500 million compared to Status Quo
Capital Program Strategy

**Average Annual Large Capital Investment (FY18-FY37)**

- Bonneville
- Chief Joseph
- Grand Coulee
- John Day
- McNary
- The Dalles
- Hungry Horse
- Ice Harbor
- Libby
- Little Goose
- Lower Granite
- Lower Monumental
- Area Support
- Local Support

**Average Annual Reduction in Lost Generation Risk (FY18-FY37)**

- Bonneville
- Chief Joseph
- Grand Coulee
- John Day
- McNary
- The Dalles
- Hungry Horse
- Ice Harbor
- Libby
- Little Goose
- Lower Granite
- Lower Monumental
- Area Support
- Local Support

Legend:
- Unit Reliability
- Water Control
- Station Service
- Operations Support
- Cranes
- Infrastructure
- Opportunity
Capital Program Results

Assets in Poor Condition

- Proposed Plan - $300 million Poor Condition
- Status Quo - $200 million Poor Condition
Major Capital Projects

Grand Coulee
- G19-21 Modernization (2022-2029)
- Grand Coulee Arc Flash Mitigation (2023-2045)
- G1-18 Electrical Modernization (2030-2038)

McNary
- Exciter and Governor Upgrades (2020 to 2022)
- Turbine Replacement (2023 – 2030)

Chief Joseph
- Generator Rewinds (2022 – 2032)
- Currently in preliminary design and scoping

John Day
- Turbine Replacement and Generator Rewinds (2032 – 2043)
- Currently in preliminary design and scoping

*Dates reflect the current Asset Plan – timelines may change
Capital Program Efficiencies

- Smart Investment Decisions
- Efficiency and Capacity Improvements
- Minimize Planned Outages
- Regional Strategies
O&M Program Strategy
O&M Cost Management Strategy

• Strategy
  – Top down funding level approach
  – Staffing
  – Travel and training
  – Prioritize preventative maintenance
  – Optimize outage plans
  – O&M efficiencies

• Additional needs being absorbed
  – Trades and crafts wage increases
  – OPM – approved special engineering salary rate
  – Material cost increases

• Communication via road shows
• Future Plan:
  – FY20 and FY21 held to FY18-19 average
  – FY22 to FY28 levels will be contained to inflation or less
### Proposed O&M Funding Levels

<table>
<thead>
<tr>
<th>Agency</th>
<th>Year</th>
<th>Total Budget</th>
<th>Base Program</th>
<th>Fish &amp; Wildlife</th>
<th>Cultural Resources</th>
<th>WECC/NERC</th>
<th>NREX - non-CRSO</th>
<th>NREX - CRSO</th>
<th>Wheeling Expenses/Leavenworth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corps</td>
<td>2018</td>
<td>$256,057</td>
<td>$173,553</td>
<td>$48,894</td>
<td>$5,510</td>
<td>$22,000</td>
<td>$6,100</td>
<td></td>
<td>$500</td>
</tr>
<tr>
<td>Reclamation</td>
<td>2018</td>
<td>$164,609</td>
<td>$110,621</td>
<td>$3,966</td>
<td>$2,164</td>
<td>$44,928</td>
<td>$1,430</td>
<td></td>
<td>$1,000 $500</td>
</tr>
<tr>
<td>Corps</td>
<td>2019</td>
<td>$256,057</td>
<td>$173,553</td>
<td>$48,894</td>
<td>$5,510</td>
<td>$23,400</td>
<td>$4,700</td>
<td></td>
<td>$500</td>
</tr>
<tr>
<td>Reclamation</td>
<td>2019</td>
<td>$162,623</td>
<td>$113,962</td>
<td>$4,084</td>
<td>$2,228</td>
<td>$38,990</td>
<td>$1,859</td>
<td></td>
<td>$1,000 $500</td>
</tr>
<tr>
<td>Corps</td>
<td>2020</td>
<td>$256,057</td>
<td>$173,553</td>
<td>$48,894</td>
<td>$5,510</td>
<td>$24,600</td>
<td>$3,500</td>
<td></td>
<td>$500</td>
</tr>
<tr>
<td>Reclamation</td>
<td>2020</td>
<td>$162,899</td>
<td>$123,625</td>
<td>$3,707</td>
<td>$1,859</td>
<td>$30,378</td>
<td>$1,830</td>
<td></td>
<td>$1,000 $500</td>
</tr>
<tr>
<td>Corps</td>
<td>2021</td>
<td>$256,057</td>
<td>$173,553</td>
<td>$48,894</td>
<td>$5,510</td>
<td>$26,600</td>
<td>$1,500</td>
<td></td>
<td>$500</td>
</tr>
<tr>
<td>Reclamation</td>
<td>2021</td>
<td>$164,333</td>
<td>$127,566</td>
<td>$3,833</td>
<td>$1,920</td>
<td>$28,058</td>
<td>$1,456</td>
<td></td>
<td>$1,000 $500</td>
</tr>
</tbody>
</table>

*C = Corps; R = Reclamation
Corps O&M Cost Management

• Current actions
  – Operating Project
  – Road Shows
  – Prioritization of work
  – Culture
  – Maintenance Management
 Corps O&M Cost Management

• Corps Cost Management Areas
  – Staffing
  – Overtime
  – Investment planning
  – Compliance Programs
  – Travel & Training
  – Performance Awards
Regional Prioritization Process

- **Purpose**
  - Increase internal detail and transparency
  - Align program with budget targets
  - Prioritize and balance non-routine activities

- **Labor/Staffing**
  - Analyzes impacts at 1%, 3%, 5% reductions

- **Non Routine**
  - Risk Based Budgeting
    - Risk factors are assigned to impact and ability to execute
    - Statistical model assists determination of priorities
### Reclamation Reductions in FY20 and FY21

<table>
<thead>
<tr>
<th>Facility</th>
<th>Activity</th>
<th>Reduction (000's)</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Coulee</td>
<td>Third Power Plant Overhaul</td>
<td>$9,900</td>
<td>Does not provide funding for G-22 potential contract modifications. Any needed modifications will require additional funding.</td>
</tr>
<tr>
<td>Grand Coulee</td>
<td>Non Routine Unscheduled</td>
<td>$2,200</td>
<td>Limits ability to respond to non-routine unforeseen circumstances. Risk of increased forced outage rates.</td>
</tr>
<tr>
<td>Grand Coulee</td>
<td>World Class Hydro</td>
<td>$1,000</td>
<td>Prolong implementation of initiatives which impacts planning, documentation, and knowledge capture initiatives.</td>
</tr>
<tr>
<td>Cultural Resources</td>
<td></td>
<td>$1,000</td>
<td>Reschedule large stabilization projects.</td>
</tr>
<tr>
<td>Leavenworth Fish Hatchery</td>
<td></td>
<td>$800K</td>
<td>Limits ability to perform infrastructure maintenance efforts important for mission accomplishment.</td>
</tr>
<tr>
<td>FCRPS Performance Awards</td>
<td></td>
<td>$650</td>
<td>Suspend for foreseeable future. Potential impacts to recruitment and retention.</td>
</tr>
</tbody>
</table>
FCRPS Asset Management and O&M Excellence
• Goals
  – Focus on value: Identify and implement processes to extract value from assets
  – Holistic approach: Align the activities of both the O&M and Capital programs with assets’ criticality and value
Goal - Sustain the value of hydro assets with constrained funds by improving efficiencies

- Build a culture of value-focused work
- Eliminate redundant or lower-priority efforts
- Align costs with benefits
- Examine and implement the use of alternative technologies and business practices to reduce cost
- People – knowledge, training, safety
- Maintenance practices and effectiveness
O&M Excellence – Corps

- Future Actions
  - Management controls
  - Tiered Approach
  - Benchmarking
  - Remoting Studies
O&M Excellence – Reclamation

- **Infrastructure**
  - Assets, equipment, tools
- **Procedures**
  - Practices, procedures, manuals
- **Knowledge**
  - Training and experience
- **Communications**
  - Communications plan
- **Safety**
World Class Hydro Accomplishments

- Unit Availability
  - 22 of 24 Units Available
  - 5 of 6 in Third

- Safety
  - Reorganized training office
  - Created training database
  - Provided specialized training

Grand Coulee Availability FY18

<table>
<thead>
<tr>
<th></th>
<th>YTD</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td>69.3%</td>
<td>53.4%</td>
<td>60.2%</td>
<td>68.6%</td>
<td>65.3%</td>
<td>77.3%</td>
<td>80.5%</td>
<td>80.9%</td>
</tr>
<tr>
<td>Target</td>
<td>61.4%</td>
<td>40.4%</td>
<td>51.7%</td>
<td>52.2%</td>
<td>65.3%</td>
<td>69.5%</td>
<td>73.7%</td>
<td>77.7%</td>
</tr>
</tbody>
</table>

Recordable Cases

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>14</td>
<td>21</td>
<td>34</td>
<td>37</td>
<td>22</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

DART Cases

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>7</td>
<td>9</td>
<td>7</td>
<td>10</td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

DART Rate

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td>1.52</td>
<td>2</td>
<td>1.48</td>
<td>2.01</td>
<td>1.39</td>
<td>0.41</td>
<td>0.7</td>
</tr>
</tbody>
</table>
World Class Hydro Next Steps

- Develop:
  - Infrastructure planning, execution, and closeout process
  - Action plans to address inadequate procedures
  - Knowledge Capture process

- Implement recommendations regarding:
  - Recruitment and Retention
  - Warehousing Strategy report
  - Fleet Management Strategy report

- Continue to develop CARMA policies and procedures
The Future of Federal Hydropower
Future Cost of Hydropower

- O&M and Capital funding plans are heavily weighted towards plants with highest risk of lost generation.
- Based on these plans, cost of production for FCRPS hydro generation should average below $11/MWh over the next 30 years

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>% of Average Annual Generation</th>
<th>% of Capital Forecast</th>
<th>% of O&amp;M Forecast</th>
<th>Levelized Cost of Generation ($/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Stem Columbia</td>
<td>77%</td>
<td>68%</td>
<td>65%</td>
<td>$9.03</td>
</tr>
<tr>
<td>Headwater/Lower Snake</td>
<td>18%</td>
<td>17%</td>
<td>22%</td>
<td>$11.41</td>
</tr>
<tr>
<td>Area Support</td>
<td>4%</td>
<td>12%</td>
<td>10%</td>
<td>$30.83</td>
</tr>
<tr>
<td>Local Support</td>
<td>1%</td>
<td>3%</td>
<td>3%</td>
<td>$44.28</td>
</tr>
<tr>
<td><strong>FCRPS TOTAL</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>$10.56</strong></td>
</tr>
</tbody>
</table>
The Way Ahead

• Our goal
  – Reliable, cost-effective hydropower
  – Safe and efficient operation of the FCRPS
  – Ensure environmental compliance obligations are met

• Economic Efficiency

• Commitment to cost management

• Strategic investment in reliability
QUESTIONS?
FINANCIAL DISCLOSURE

This information was publicly available on June 18, 2018, and contains information not sourced directly from BPA financial statements.