



Bonneville
POWER ADMINISTRATION



INTEGRATED PROGRAM REVIEW

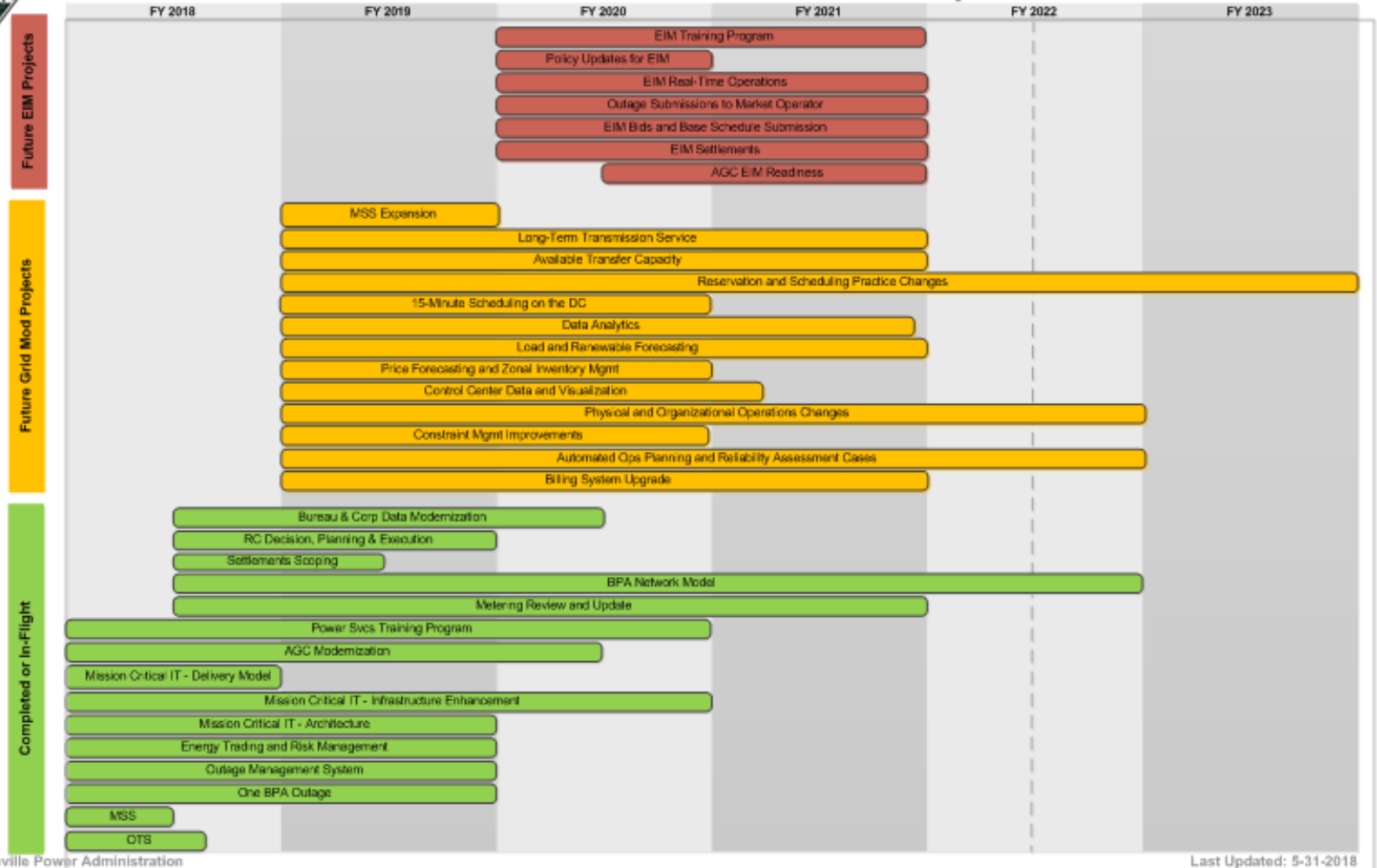
Appendix: Grid Mod Projects

June 20, 2018

Grid Modernization Roadmap



Grid Modernization Roadmap



In-flight Grid Modernization Projects

Energy Trading and Risk Management System

- **Description:** Replace existing system that uses outdated and unsupported software with new capabilities aligned with the current and future energy markets.
- **Objectives:**
 - Comprehensive toolset
 - Capabilities more reflective of evolving markets and products
 - Effective and efficient integration into related systems
- **Business Benefits:**
 - Improved supportability and integration
 - Increase efficiency in trading activities
 - Improved analytics

One BPA Outage

- **Description:** Develop Integrated Work Planning capability that aligns the schedule for upcoming upgrades, additions and maintenance for a specific site or area. Develop Continuous Outage Assessment capability to allow for a probabilistic look at the likelihood a planned outage can actually take place as planned. Additionally pursue longer-term coordination with neighboring entities and participation in more regional outage planning than BPA currently does.
- **Objectives:**
 - Reduced outage times or frequency
 - Ability to coordinate outage needs further in advance
 - Improved ability to manage outages to specific criteria
- **Business Benefits:**
 - Improved collaboration, fewer outage moves & more effective sequencing of work
 - Increased efficiency
 - More lead time to manage risk
 - Improved outage duration accuracy

Outage Management System

- **Description:** Upgrade or replace the existing outage management system and processes that track generation and transmission system outages.
- **Objectives:**
 - Increased standardization and automation
 - Support outage coordination further in advance,
 - Improved outage integration
 - Safe and reliable operations
- **Business Benefits:**
 - More effective outage management
 - Improved sustainability and supportability at lower cost
 - Increased accuracy and reduced manual processes
 - Improved integration with external partners

AGC Modernization

- **Description:** Modernize Automated Generation Control (AGC) system to improve supportability, enable Power Services to market new products and services, and improve communication within BPA as well as between BPA, neighboring BAs and FCRPS generators.
- **Objectives:**
 - Streamlined code with minimal customizations
 - More flexibility in how FCRPS carries reserves
 - Enable participation in markets without risking BiOp objectives
 - Compatibility with neighboring BAs
 - Standardized visualization
 - Improve Frequency Responsiveness Reserve (FRR) estimate calculation
 - Capability for generator remote set point control
- **Business Benefits:**
 - Expanded revenue opportunities
 - Improved system visibility/understanding
 - More efficient dispatch of resources

RC Decision, Planning and Execution

- **Description:** Bonneville is exploring all options for reliability coordinator services. To ensure there are no gaps in service, we are currently conducting project planning activities in the event we choose to change RC service providers effective December 31, 2019. If Bonneville chooses to change RC service providers, a full project is expected to be initiated in the fall of 2018 and parallel operations are expected to begin in the fall of 2019.
- **Objectives:**
 - Preserve Bonneville’s flexibility to continue evaluating RC service providers
- **Business Benefits:**
 - Reliability is maintained or enhanced
 - Costs are managed and reasonable
 - Compliance obligations are met
 - Impacts of multiple reliability coordinators in the West are mitigated

Mission Critical IT Architecture

- **Description:** Develop future state Mission Critical IT architectures that leverage best practice approaches including architecture of systems, integration, security practices and technologies.
- **Objectives:**
 - A more robust, modern, consistent and structured architecture
 - Consistent approach across the IT spectrum
 - Robust operational reliability
- **Business Benefits:**
 - Increased efficiency
 - Greater agility in managing applications
 - Lower cost to maintain

Mission Critical IT Infrastructure

- **Description:** Modernize BPA's infrastructure environment for Mission Critical IT systems with a modern network and hardware technology.
- **Objectives:**
 - Consolidated IT infrastructure
 - Improved alignment with the core businesses
 - Capability to virtualize environments
 - Common controls
 - Modernized network
- **Business Benefits:**
 - Standardization
 - Improved supportability
 - Greater agility and mobility
 - Reduced total cost of ownership
 - Reduced operational, compliance and security risks

Mission Critical IT Service Management

- **Description:** Implement consistent and standardized technology services with predefined technology service offerings and Service Level Agreements that help the organization accomplish its important mission for the enterprise.
- **Objectives:**
 - Standardized delivery of services
 - Predictable, efficient, flexible and agile services
- **Business Benefits:**
 - Improved quality & efficiency
 - Consistent predictable support
 - Optimized team and resource capacity

Metering

- **Description:** This project develops and implements a strategy to improve metering capabilities at generation, intertie and load sites.
- **Objectives:**
 - Increased visibility of measurement
 - Reduce uncertainty in generation
 - Increased time-granularity of data
 - Improved data collection capability
- **Business Benefits:**
 - Increased accuracy of settlements
 - Improved hydro management capability
 - Increase communication with partners
 - Capability to participate in markets

Network Modeling

- **Description:** Develop the capability to provide consistent data inputs to network modeling needs from a common data source using standardized naming conventions and the ability to both download and upload model data via the industry standard Common Information Model (CIM).
- **Objectives:**
 - Ability to meet the growing network modeling needs
 - Provide consistent modeling data
 - Enable efficient model exchange
 - Enable automation of study cases
- **Business Benefits:**
 - Increased accuracy
 - Reduction in maintenance effort
 - Smoother integration
 - Increased efficiency

Settlements Strategy

- **Description:** This project seeks to learn in depth how the EIM settlements work, and develop a strategy for how BPA would address market settlements should the decision be made to join the market.
- **Objectives:**
 - Detail understanding EIM settlements
 - Understand EIM Entity settlements with load and generation customers
 - Perspective on potential improvements to CAISO EIM settlement
 - Conceive options for conveying EIM settlements to BPA customers
 - Clarity and improvements for BPA transfer customer EIM settlements
- **Business Benefits:**
 - Simplification of settlements processes
 - Transparency, efficiency and equity
 - Inform potential EIM negotiations
 - Inform EIM implementation considerations

Power Services Training Program

- **Description:** Develop a formal structured training curriculum using modern technology for Power Services generation scheduling and trading functions.
- **Objectives:**
 - Improved quality and timeliness
 - Use of standardized assessments
 - Prepare for new technology and industry change.
 - Ability to keep current with business changes
 - Ability to expanded program to other staff functions
- **Business Benefits:**
 - More efficient staff development
 - Improved ability to respond to change
 - More consistent business execution

Bureau and Corp Data Modernization

- **Description:** Optimize meeting hydro system coordination and operational requirements through improvements in data quality and bolstered communication and operational planning with the Bureau and the Corp.
- **Objectives:**
 - Improved efficiency in matching generation and load
 - Improved planning and coordination
 - Predictable management of generating assets
 - Maximize the value of the operational flexibility
 - Enable options for market participation
 - Continue satisfying non-power obligations
- **Business Benefits:**
 - Improved operational coordination
 - More precise hydro management
 - Reduced operational risk
 - Consistency of execution
 - Maximize revenues

Future Grid Modernization Projects

Load and Renewable Forecasting

- **Description:** Develop improved load forecasting and renewables forecasting through focused process change and tool enhancements to provide ability to better manage the actual meter data and correct errors in real-time. The project also includes the development of graphical and numeric visualization tools.
- **Objectives:**
 - Improvements to load forecasting methodology
 - Improvements and better utilization of renewable forecasts
- **Business Benefits:**
 - Reduced forecasting uncertainty
 - Reduced cost of operating FCRPS

Billing System Upgrade

- **Description:** The Customer Billing Center (CBC) system is directly affected by changes to policy, products, and services offered by both the Power and Transmission business groups and will no longer be supported by the vendor (Oracle) by 2022. The CBC application requires replacement to be kept current with BPA Rate Cases and to accurately apply all billing elements.
- **Objectives:**
 - System fully supported by vendor
 - Capability of billing for power and transmission contracts
 - Minimization of customizations
- **Business Benefits:**
 - Continued timely billing of customers
 - Reduced data errors and fewer bill revisions
 - Improved bill review process through automated processes
 - Reduced support costs

Fifteen Minute Scheduling on the DC

- **Description:** Pursue development of the capability to allow customers to schedule on a 15 minute basis.
- **Objectives:**
 - Enable 15 Minute Scheduling on the PDCI
 - Enable potential future move to dynamic transfer on the PDCI
- **Business Benefits:**
 - Align transmission products and services with western markets
 - Optimize use of PDCI
 - Increase customer satisfaction
 - Potential to increase transmission revenue

Reservation and Scheduling Practice Changes

- **Description:** Implement changes to Transmission scheduling practices including policy and tariff changes to some of the transmission products that are offered and may include the elimination of or changes to transmission products, changes to information and/or process and requirements, and changes to how the data would be processed and managed by the scheduling group.
- **Objectives:**
 - Alignment with Transmission Business Model changes
 - Practices that align with changes to transmission products
- **Business Benefits:**
 - Increased efficiency & consistency
 - Systems that are easier to understand & support

Available Transfer Capacity

- **Description:** Redesign the transmission Available Transfer Capacity (ATC) systems, organizational responsibilities and methods to be managed in real-time, to accurately reflect the scheduled use of the system and that are consistent with transmission products and policies and oriented around standardization of products.
- **Objectives:**
 - ATC that reflects expected availability at a more granular level
 - ATC that reflects transmission products and policies
 - Optimize the commercial availability of the grid
 - Increase use of automation
 - Clear ownership, responsibility & accountability for inventory management
- **Business Benefits:**
 - Maximize service to customers
 - Inventory reflects acceptable curtailment risk
 - More efficient, granular and repeatable results
 - ATC decisions aligned around measurable data and quality-based metrics

Long-Term Transmission Service

- **Description:** Develop an integrated and iterative approach for managing Long-term service looking at the reliability needs and economic needs of the system as well as probabilistic analysis. A part of this will be the development of new queue management policies and practices to perform aggregate transmission service studies and generation interconnection studies in a timely manner, with mechanisms to minimize delays in processing transmission service requests.
- **Objectives:**
 - Sustainable, integrated long-term transmission planning processes
 - Ensure customer loads are served reliably into the future
 - Meet commercial transmission service sales needs
 - Ensure the customers can maximize rights and flexibility
- **Business Benefits:**
 - More efficient processing of the queue
 - Improved ability to identify associated system upgrades

Automated Ops Planning & Reliability Assessment Cases

- **Description:** Develop automated data feeds to and automated execution of the Planned Outage Coordination Studies. Develop automated data feeds for the Near-term Reliability Cases and automated execution of those cases.
- **Objectives:**
 - Consistent and systematic study capability
 - More comprehensive study of time windows
 - Improved ability to manage outage coordination plan
 - Enable continuous reliability assessment for the current day and next day
- **Business Benefits:**
 - More efficient study base case topology set up process
 - Earlier identification of potential reliability issues
 - More efficient use of resources
 - Reduced risk of human error

Constraint Management Improvements

- **Description:** This project will ensure schedule curtailments are performed equitably and efficiently and also roll in the RAS Arming Automation project currently underway. Determining the Dynamic Transfer Capabilities and subsequently the Rate of Change constraints nearer to real-time will likely be the heavy lift in this project but will also roll in existing efforts aimed at this process.
- **Objectives:**
 - Improve the overall constraint management
 - Improve reliability and access
- **Business Benefits:**
 - Improved capability to manage transmission constraints
 - Improved efficiency and effectiveness

Physical and Organizational Operations Changes

- **Description:** Implement operational efficiencies and improvements in reliability that can be achieved through organizational changes. The first step will be to assess potential gains from additional training or certification, increased redundancy between control centers and enhanced coordination between real-time functions
- **Objectives:**
 - Control center capability and efficiency improvements
 - Redundant operations at both control centers
- **Business Benefits:**
 - Better cross-training of operators
 - Improved communications amongst operators
 - Improved consistency and coordination

Control Center Data and Visualization

- **Description:** Provide various dispatch improvements to improve operations awareness, coordination and capabilities. Scope potentially includes new displays of projection/forecast information, better overall integration of available data, incorporation of public data that is helpful for Situational Awareness, establish consistency in the displays and applications at control centers, upgrade to video and audio capabilities, and implementation and training of Dispatchers to use the SCADA system for transmission equipment tag-out functions.
- **Objectives:**
 - Enhance data availability, visualization and situational awareness
- **Business Benefits:**
 - Better coordination between operators
 - Improved forward looking situational awareness
 - Better visibility to market conditions
 - Elimination of some manual processes

Price Forecasting and Zonal Inventory Management

- **Description:** Develop improved capability to determine the opportunity cost of BPA resources (or zonal collections of resources) with granularity reflective of locations that can drive price variances and make corresponding updates to impacted systems, internal processes and policies.
- **Objectives:**
 - Improve ability and efficiency in computing hydro opportunity costs
 - Maximize the secondary market value of the FCRPS
 - Capability to participate in evolving markets
- **Business Benefits:**
 - Increased net secondary revenues
 - Improved understanding of pricing drivers
 - Greater agility in pursuing additional markets

Data Analytics

- **Description:** Develop systematic and robust analytical tools and capabilities to enable analysts and others to efficiently provide better and more timely support to business information needs.
- **Objectives:**
 - Improved ability to answer business questions through analytical capabilities
 - Automation of regular reports and faster data analysis
 - Greater adoption of data-driven decision making
- **Business Benefits:**
 - Improved insight into operational and commercial business
 - More efficient and timely business decision support
 - Accelerated capability to analyze data
 - Improved business efficiency

Merchant Scheduling & Settlements Expansion

- **Description:** Extend the systems developed in the recent MSS project to address the need for the processes around schedule (e-Tag) submission, as well as centralization of settlements processes throughout Power Services.
- **Objectives:**
 - Integrated settlements system
 - Capability of tracking of settlements statements to their source
- **Business Benefits:**
 - Consolidated scheduling practices
 - Consolidated settlements practices
 - Improved ability to interact with neighboring utilities

Future Grid Modernization Projects for Potential EIM Participation

Bonneville has begun to study and determine how and under what conditions Bonneville could join the Western EIM. The following projects planned for FY20 and beyond are contingent on a possible decision in the future to join the Western EIM. If BPA chooses not to join, we anticipate these projects will no longer be pursued.

EIM Bids and Base Schedule Submission

- **Description:** Develop bid submission capability informed by operational needs, market requirements, price modeling and hydro management economic optimization. Develop schedule submission capability including the capability to assess and respond to the BA's resource sufficiency requirements and initiate appropriate responses to pending insufficiencies.
- **Objectives:**
 - Capability to submit bid curves to the EIM
 - Capability to meet the market requirements and timelines
 - Capability to meet obligations concurrent with market opportunities
 - Existing obligations and market activities are not compromised
- **Business Benefits:**
 - Maximize opportunity cost
 - Maximize value of resource flexibility

AGC EIM Readiness

- **Description:** Develop the ability to receive and process EIM market awards, process them to represent specific generation dispatches and integrate those dispatches into BPA's AGC system. Project will leverage the enhanced coordination of data between BPA's generation scheduling functions, the AGC changes included in the AGC Modernization project as well as EIM Bid and Base Schedule project.
- **Objectives:**
 - Efficient receipt of dispatch targets that include market awards
 - Ability for generators to move consistent with market and operations expectations
 - Maintain or enhance reliability operations capability
 - Minimize imbalance risk
- **Business Benefits:**
 - Efficient integration of market awards into AGC
 - Minimize imbalance costs

Outage Submission to Market Operator

- **Description:** Develop and implement interfaces to supply planned transmission and generation outages from BPA's outage management system(s) to the CAISO's OMS as well as the business capability and systems changes to use outage cards to implement market restrictions reflective of various operational limitations.
- **Objective:**
 - Ability to efficiently provide the outage and associated rating changes to market
 - Ability to meet data and timing requirements
 - Ability to effectively implement operational constraints
- **Business Benefits:**
 - Minimize imbalance exposure
 - Operational constraints are honored

EIM Real-Time Operations

- **Description:** There are many operations functions that occur in or near the real-time horizon both in transmission operations and hydro operations. This project implements changes to systems, processes and practices to carryout the interactions necessary to participate in the EIM market. This includes actions involving the EIM Balancing Authority Area Operations Portal, Automatic Dispatch System and Outage Management System tools as well as management of ETSRs and associated limits, generator distribution factors as well as the enhancement of visualization displays to provide good visibility into Resource performance.
- **Objectives:**
 - Real-time operators are able to manage the EIM functions
 - Existing real-time obligations are not compromised
- **Business Benefits:**
 - Efficient market operations including appropriate limits and control actions
 - Enhanced operational visibility
 - Improved constraint management

EIM Settlements

- **Description:** Develop and implement shadow settlement systems to provide predictability and support for the administration of EIM market charges received from the CAISO, stakeholder outreach for other utilities within the BPA Balancing Authority that will be affected as well as all BPA transmission Customers, meter data validation and submission to CAISO and the development of business processes to support dispute processes.
- **Objectives:**
 - Ability to manage EIM settlements with the CAISO
 - Ability to manage EIM settlements with BPA load and generation customers
- **Business Benefits:**
 - Predictable and understandable settlements
 - Fair and transparent pass-through of EIM settlements
 - Bid and pricing knowledge to benefit future market offers

Policy Updates for EIM

- **Description:** This project will not only include the many specific policy decisions needed to guide the way in which BPA participates in the EIM market but also includes a transmission tariff change related to imbalance and also changes to corresponding business practices.
- **Objectives:**
 - Policies are created that reflective of BPA business and the market design
 - Policy changes are made in a systematic and timely manner
 - Policy changes are well coordinated, clear and well documented
- **Business Benefits:**
 - Ability to effectively participate in the EIM market

EIM Training Program

- **Description:** Develop and provide systematic structured EIM training program oriented around both broad knowledge growth regarding how the EIM works as well as job-specific EIM training and certification in key areas. This program should be established in a way that is maintained, durable over time and easily repeatable as EIM staffing and roles change.
- **Objectives:**
 - Repetitive and durable program
 - Staff understand how EIM works and how BPA is participating in the EIM
 - Staff are able to accurately and efficiently carry out EIM roles
- **Business Benefits:**
 - Broad internal market knowledge base
 - Market opportunity is maximized and risk is minimized

FINANCIAL DISCLOSURE

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