

— NERC Monitoring and Situational Awareness Conference —

Bonneville Power Administration

Loss of EMS: Focus on Prevention



October 3, 2017



Today's Topics

- Agency Overview;
- Preventing Loss of EMS:
 - Redundancy;
 - 24x7 Support;
 - Preparation;
 - Lessons Learned; and
 - In-House Expertise.
- Measures of Success; and
- Questions?

Agency Overview

- Bonneville Power Administration (BPA) is a federal agency established in 1937;
- BPA is self-funded and recovers all Agency costs through rates for wholesale power sales and transmission services;
- BPA's service territory spans 15,000 transmission miles in the Pacific Northwest and consists of Oregon, Washington, Idaho, and parts of California, Montana, Nevada, and Utah; and
- BPA is registered with NERC for the following functions:
 - BA, TOP, TO, TP, TSP, PC, PSE, and RP.

Agency Overview, *continued*

- Assures resource adequacy to meet the Pacific Northwest region's firm power requirements;
- Markets, but does not own, wholesale power from federal dams and acquired from non-federal generation;
- Builds, owns, operates and maintains a high-voltage transmission system to integrate and deliver power from federal and non-federal generation to regional customers in the Pacific Northwest and between the Northwest and the Southwest; and
- Protects and enhances fish and wildlife in the Columbia River basin.

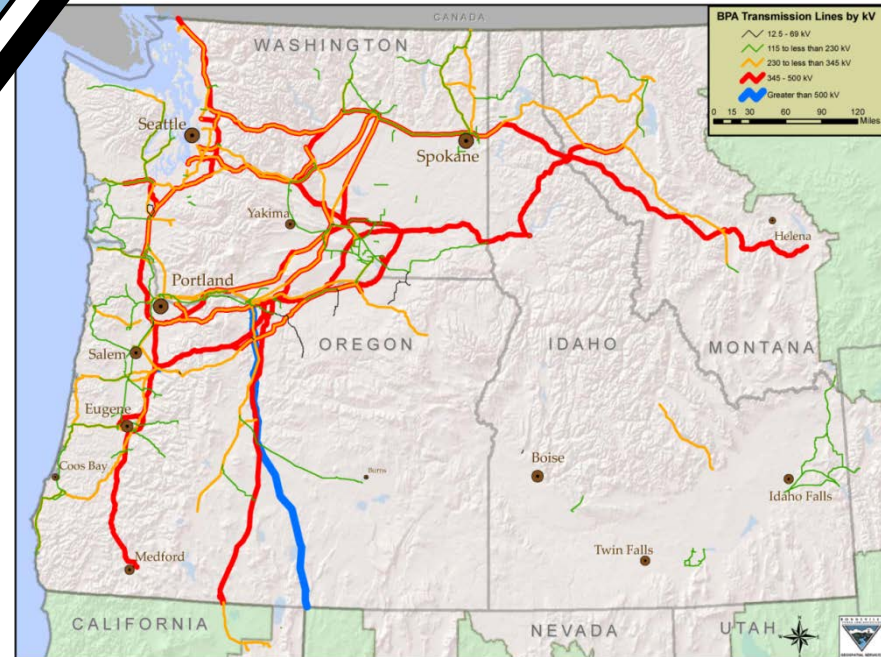
BPA Statistics

BPA Statistics	Amount
Balancing Authority (BA) Installed Generation	32,108 MW
2016-17 BA Peak Load	10,943 MW
Average Load 2016	6,142 MW
Total Exports 2016	85,922,555 MWh
Total Imports 2016	30,970,545 MWh
Total Wholesale Power Customers	142
Transmission Customers	~511

Agency Overview

Power Services

Transmission Services

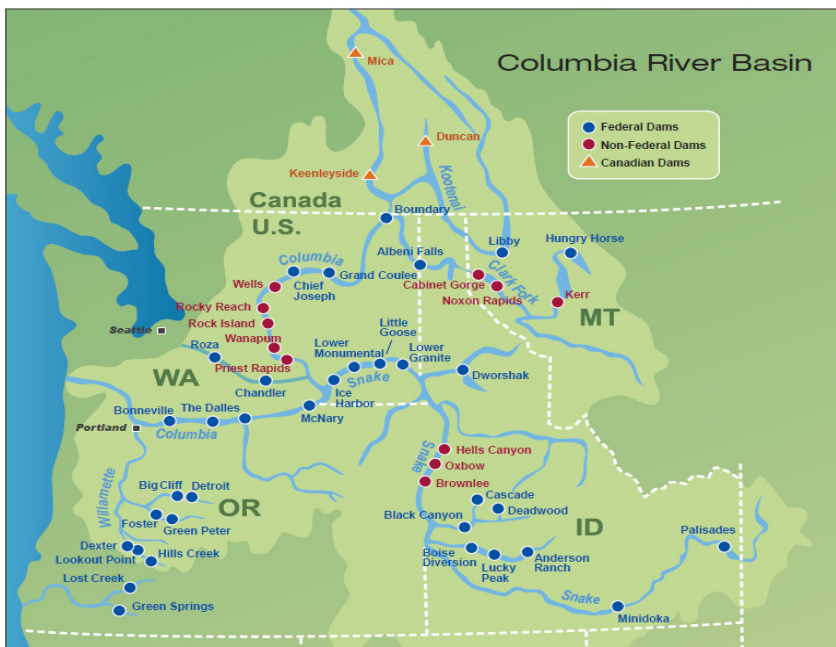


Agency Overview

Power Services

BPA markets electric power from 31 federal dams, the Columbia Generating Station Nuclear Plant, and several small non-federal power plants:

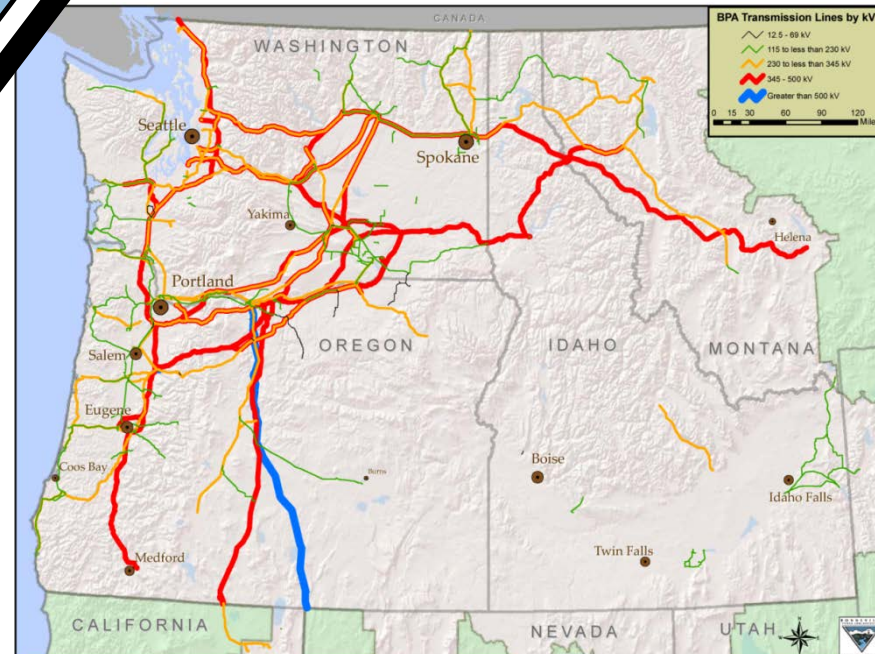
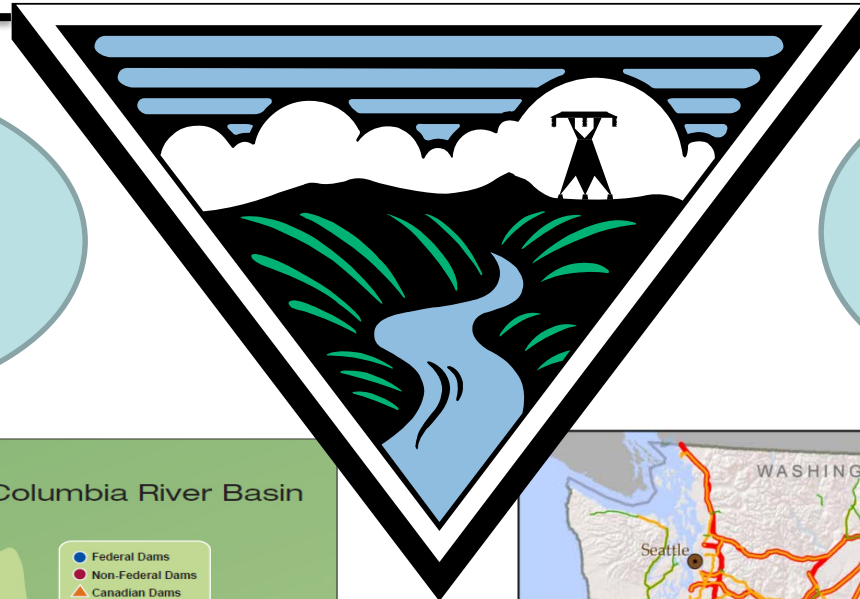
- ❑ About 80 percent of the power BPA sells is hydroelectric; and
- ❑ BPA accounts for about 28 percent of the electric power consumed within the region.



Agency Overview

Power Services

Transmission Services



Agency Overview

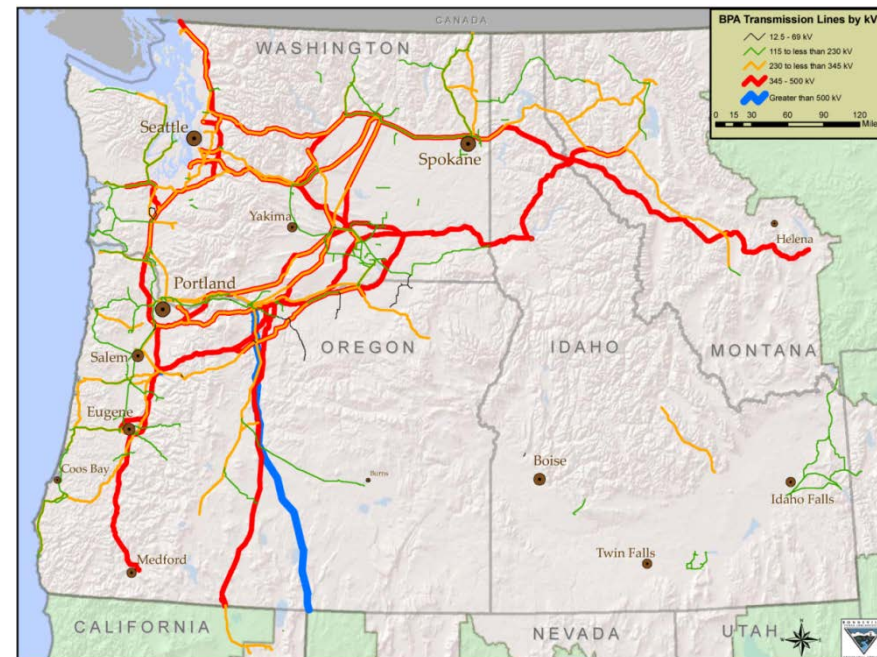
Transmission System

Operating voltage	Circuit miles
1,100 kV	1
1,000 kV	264 ^{8/}
500 kV	4,869
345 kV	570
287 kV	229
230 kV	5,328
161 kV	119
138 kV	56
115 kV	3,520
below 115 kV	282
Total^{9/}	15,238

8/ BPA's portion of the PNW/PSW direct-current intertie. The total length of this line from The Dalles, Oregon, to Los Angeles is 846 miles.
 9/ Total circuit miles as of Feb. 2, 2017.

BPA's transmission system contains more than 15,000 miles of high voltage lines.

About 75 percent of the high-voltage grid in the Pacific Northwest.



Transmission Services – Control Centers

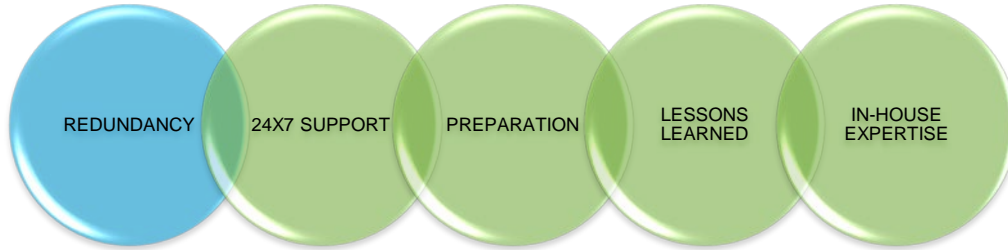
BPA's two control centers, one in Vancouver and one in Spokane, are connected via BPA-owned and operated, fully redundant, telecommunication systems comprised of both fiber optic and radio systems, with the same BPA-owned communication systems also used to communicate to most remote sites.

Both centers are staffed and operating on a 24/7 basis.



Preventing the Loss of EMS





Prevention Through **REDUNDANCY**

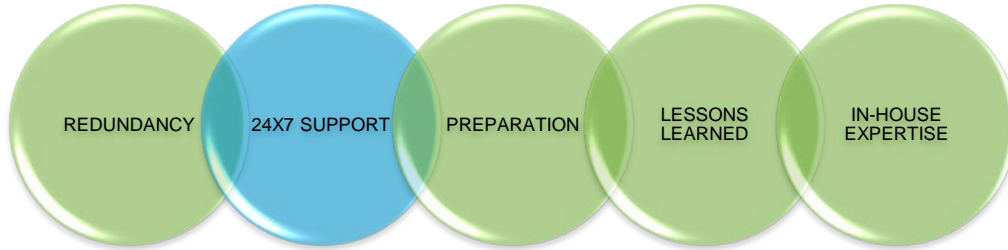
Two independent Control Centers: Operating in parallel 24x7, including:

- Independent EMS redundant at each Control Center;
- Parallel RTU communications to each Control Center;
- Authentication Servers redundant at each Control Center;
- Operators and support staff at each Control Center;
- Independent time sources at each Control Center; and
- Interconnection via BPA-owned and operated, fully redundant, telecommunication systems.

Database and code deployments: Are carefully sequenced to ensure errors aren't replicated to the other control center;

Normal operations: Each control center has access to all transmission data, most through independent communications, but responds to only that portion currently under their jurisdiction; and

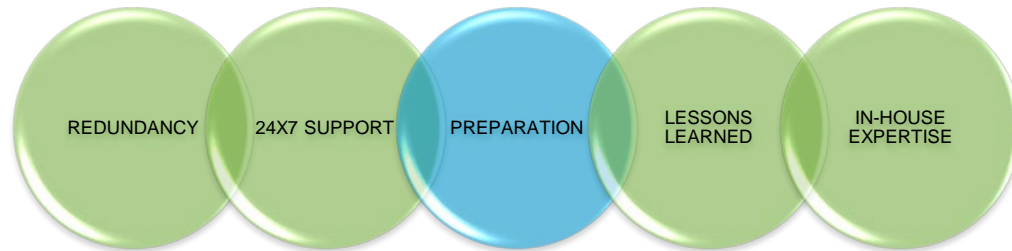
Emergency operations: Jurisdictions can be reassigned between control centers based on communication connectivity or a single control center can assume jurisdiction of the entire BPA footprint.



Prevention Through **24x7 SUPPORT**

Network and System Operation Center (NSOC): Provides continuous 24x7 network and system monitoring, incident response, IT support, remedial action, and incident coordination. Other activities include:

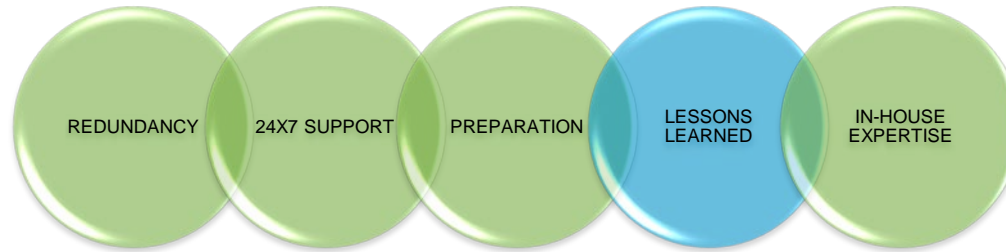
- Identifies functional and security problems as a result of alerts processed by monitoring tools, customer complaints, or other actionable information;
- Provides single point-of-contact for work affecting the control center computers, software, networks, and building systems;
- Performs on-site system response, mitigation, and recovery;
- Provides immediate IT/OT response, support, and maintenance;
- Supports the coordination of work in the DCC/MCC data centers to ensure no concurrent outages of critical systems; and
- Provides damage assessments and begin system recovery immediately after a critical failure.



Prevention Through **PREPARATION**

Full redundancy testing: BPA performs full redundancy testing twice per month to verify redundant operations and maintain proficiency in switching between control centers. Key activities also include:

- Annual EOP-008 Loss of Functionality Exercise: Tests in both directions by physically severing all communications between the two Control Centers for a minimum of two hours;
- Ramping up its participation in GridEx IV (for 2017, BPA will be an active participant, rather than an observer); and
- Active involvement with WECC and NERC EMSWG to stay abreast of issues and best practices.



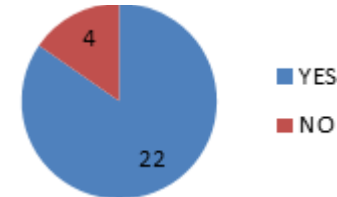
Prevention Through **LESSONS LEARNED**

Lessons Learned review process: All published Lessons Learned require review and follow-up:

- SME determines if action is required to address identified risk; and
- Required actions are logged and prioritized for resolution.

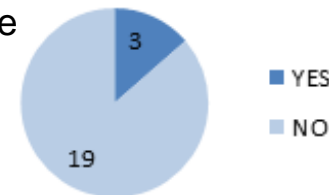
BPA’s internal response to 26 EMS Lessons Learned:

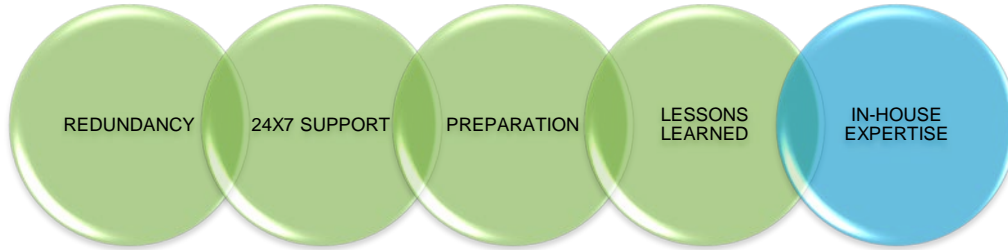
- 22 YES (Applicable to BPA); and
- 4 NO (Not Applicable).



Of the 22 EMS Lessons Learned that were applicable to BPA :

- 86%: Risk already mitigated at BPA; and
- 14%: Required an Action Plan to address (two addressed by adding 24x7 Reliability Engineers and the remaining one required a system change).





Prevention Through **IN-HOUSE EXPERTISE**

BPA has worked with the same EMS vendor since the 1980s: BPA has developed significant in-house expertise allowing all real-time issues to be resolved without external support:

- Technical training: This internal expertise is perpetuated through technical training provided by the vendor and peer-to-peer training within the organization; and
- Redundant Control Centers: Having redundant EMS at redundant Control Centers allows internal EMS staff more time to thoroughly investigate and address issues at the impacted site.

Measures of Success

- **No reportable outages:** In the seven years since NERC's Event Analysis Process (EAP) was launched, BPA has had no reportable SCADA or AGC outages.

If BPA had not had the redundant control center, two incidents (since our upgrade in May 2015) likely would have been reportable outages:

- Field work resulted in DCC losing communication from numerous RTUs and redundant communication to MCC was not impacted. Site transfer performed allowing all critical DCC functions to be performed using the MCC EMS; and
 - DCC frontends failed when old SCADA servers were retired because the watchdog function was still trying to ping the old servers. Site transfer again enabled continued operation using MCC EMS.
- **EMS Availability:** BPA has had virtually no EMS interruptions since our most recent upgrades:
 - **SCADA** (Upgraded May 2015): DCC SCADA Availability of 99.992% and MCC SCADA Availability of 99.995%; At no time were both unavailable simultaneously; and
 - **AGC** (Upgraded November 2016): Only one of the AGC systems is designated as the "controlling" AGC at a given time. Controlling AGC Availability of 99.9999%.

Questions?



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