National Hydro Association

Ensuring Peak Hydro Facility Performance and Reliability – How NHA's Operational Excellence Initiative Can Help?

2013 Annual Conference
Session 3C
Washington, D.C.
April 22, 2013

Operational Excellence Program

Session Participants

Moderator

David Zayas, Manager, National Hydropower Association

Panelists

- Bill Bunker, Area Manager, Pacific Gas & Electric
- Kerry McCalman, Manager, Bureau of Reclamation
- Jim Miller, Consultant, Signal Energy Consultants, LLC

Operational Excellence Program

Background

- Operational Excellence (OpEx) Task Force was formed in May 2011
- OpEx aligns and supports NHA's mission and it's strategic goal # 5 -

Provide resources to help members achieve a high level of operational excellence at existing and planned hydroelectric projects.

- Motivation - Raise Industry Standard of Performance / Avoid Defining event.
- Benchmarking Best Practices and Lessons Learned

Operational Excellence Program - Background

Research Results

- Conducted research on numerous organizations within and outside the hydro industry, including electric power industry
- Research revealed that quality hydropower information exists but it is fragmented and difficult to navigate and there is no central aggregation point of existing data or for submittal and sharing of operations and maintenance information.
  - In February 2012 Task Force members gained insight into the Institute of Nuclear Power Operations (INPO) Event Analysis (EA) program .
  - In April 2012 a meeting was held with NERC staff about their EA program

Operational Excellence Program - Background

Other Industry Forums – Snapshot

- **Department of Homeland Security – CIP Information Sharing Task Force** – "…develop a written report outlining benefits and potential risks associated with sharing Dams Sector safety and security information with sector and cross-sector stakeholders."

- **NERC Electric Reliability Organization Event Analysis Program** – "…promote the reliability of the bulk power system in North America… through a structured and consistent approach to performing event analyses…"

- **Chevron Operational Excellence** – "We aim to be admired for world-class performance through disciplined application of our Operational Excellence Management System."

Operational Excellence Program - Background

Other Industry Forums – Snapshot, Continued…

- **NYC DEP – OpX** "… an opportunity for DEP to take employee ideas and best practices from water utilities across the globe to continue to achieve the agency's goal of being the safest, most productive, cost-effective, and transparent water utility in the nation."

- **INPO** – "…provide a systematic means of sharing operating experience information among nuclear power plants; improve nuclear power plant safety and reliability; learn from the operating experience of the world community of nuclear plants; identify precursor events…"

- **National Electric Coil – Generator Technical Forum** – "to facilitate connection of technical information, enabling equal access to industry specific content for all industry professionals.

Operational Excellence Program - Background

Central Tenants

- Voluntary sharing of hydro industry events
- Stewardship – promoting safety (employee, public, and dam), being a good neighbor, and responsive to environmental issues.
- Industry-wide involvement, including the federal government.

Operational Excellence Program – Current Activities

Two Track Development

- Development of a library of hydropower references and resources.
- Event Report (ER) system & Pilot Program (10 NHA Members)
  - Event Report (ER) input is developed by the reporting organization by its originator
  - ER form would be reviewed by a central coordinator and revisions made through the originator
  - The central coordinator would post ER document to share site using existing NHA's software with notification to participating organizations
  - Searchable database of past ERs

Operational Excellence Program – Current Activities

Program Transition

Hydraulic Power Committee - OpEx Subcommittee Mission & Goals:

Mission:
Instill a culture of operational excellence at existing and future hydro facilities that encourages the aggressive critical self-review and analysis of operations, maintenance, safety, and environmental events, and the sharing thereof.

Goals:

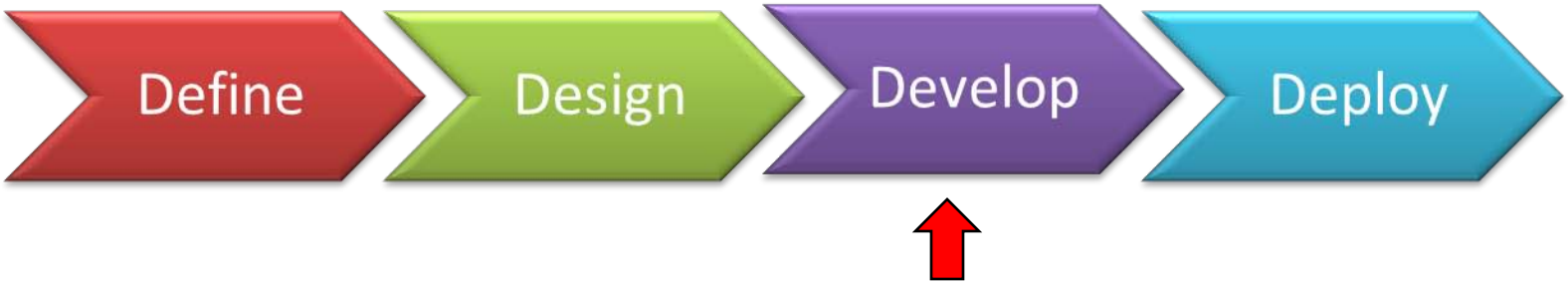
1) Be the recognized industry leader in providing a systematic means and forum for sharing hydropower operating experiences, best practices, and lessons learned among the industry in a timely manner;

2) Raise the hydropower industry's standard of performance by learning from the operating experiences from others and provide training and educational opportunities thereof;

3) Prevent the occurrence and recurrence of similar events, and avoid defining events.

Operational Excellence Program – Current Activities

Program Development



Task No.	Task Description
1.1	Establish Event Report web site for report storage and retrieval
1.2	Issue Event Report Procedure Manual
1.3	Develop Best Practice Library
1.4	Communication Program to Industry & Develop Branding

RECLAMATION

Managing Water in the West

The Importance of Unexpected Event Reporting

U.S. Department of the Interior
Bureau of Reclamation

BACKGROUND

- WHY does Reclamation need this program?
  - Reduce recurring outages
  - Learn from our mistakes
  - Meet Regulatory Requirements
    - NERC requires evaluation of any event that involves protection systems. Lightning triggered events, events that involves a lockout relay operation and events that cause units to drop offline.
  - Documented sabotage reporting process

RECLAMATION

Reclamation's FIST 6-3 Unexpected Event Reporting

The New Program

- **Reclamation wide process for analyzing events**
- **All reportable events are documented**
- **Defines Investigation Team role and commissioning**
- **Tracks developing and implementing corrective actions**

RECLAMATION

FIST 6-3

The New Program (Con't)

- Reporting all events on a new form.
  - Provides consistent information presentation
  - Helps to event track status within each office and region
- All reportable events are reviewed for system-wide issues
  - Key issues and trends are identified
    - Power plant staff are identifying and eliminating recurring events
    - Several systemic problems identified

RECLAMATION

FIST 6-3

The New Program (Con't)

- **Investigation Team role and commissioning**
  - **Provides Investigation guidance**
  - **Provides Charter Template**
- **Developing and implementing Corrective Actions**
  - **Provides tools and guidance for preventing recurring events**
- **Comprehensive assessment of all events for WECC Misoperations reporting.**
  - **Provides process to be sure no event is missed.**
  - **Gives periodic updates**
- **Tracks events which may be sabotage events.**
  - **Provides tools and guidance for sabotage events**

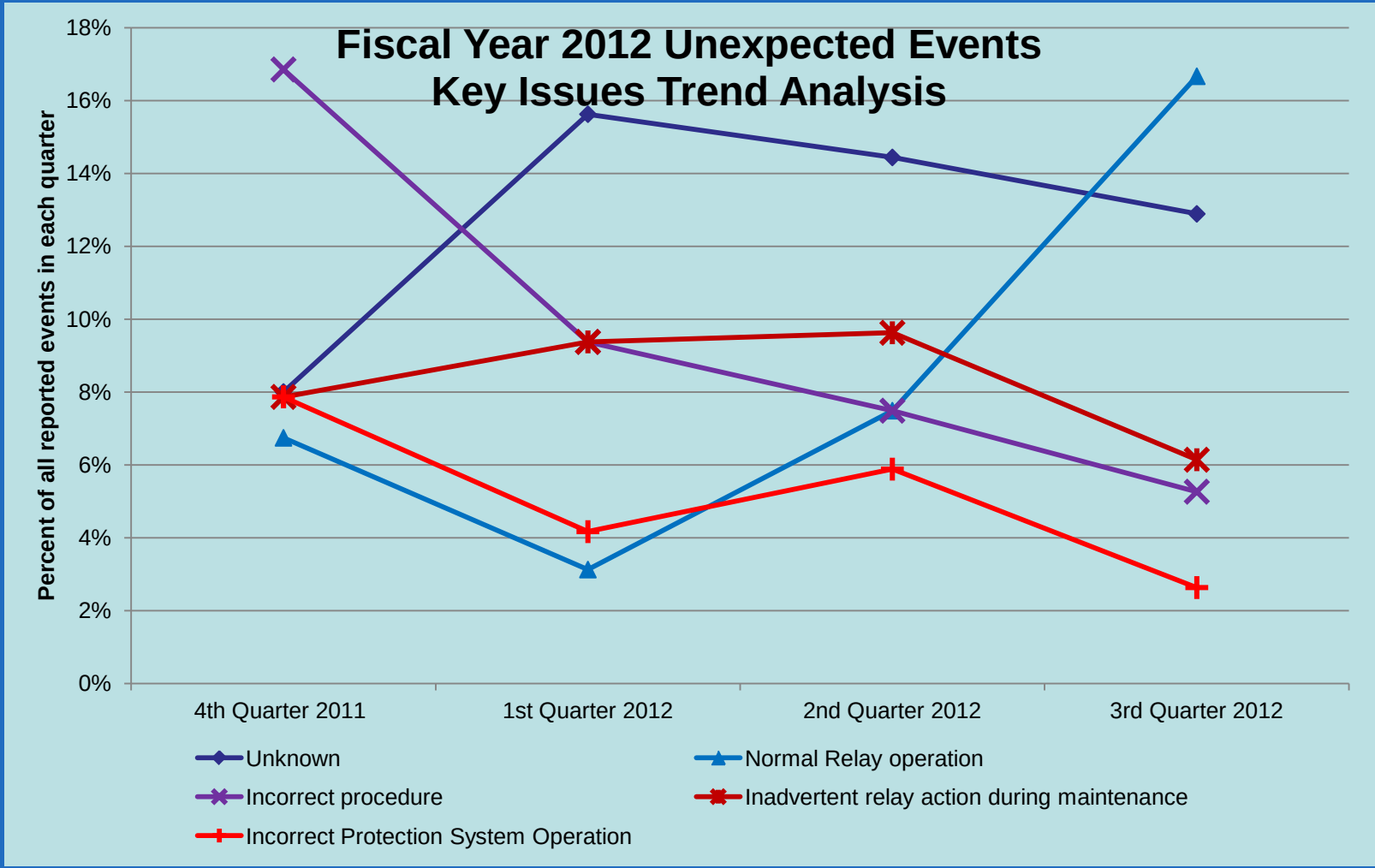
RECLAMATION

FIST 6-3

The Results

- The success of the program is based on evaluating each event
- Recent events demonstrate this fact
- Powerplant 115kV circuit tripped three times by the same relay
- The first two times lightning “in the area” was blamed
  - No analysis of the protection system operation was performed
- The third time investigation was performed
- Evaluation revealed incorrect CT wiring

FIST 6-3 The Results



RECLAMATION

FIST 6-3

The Results

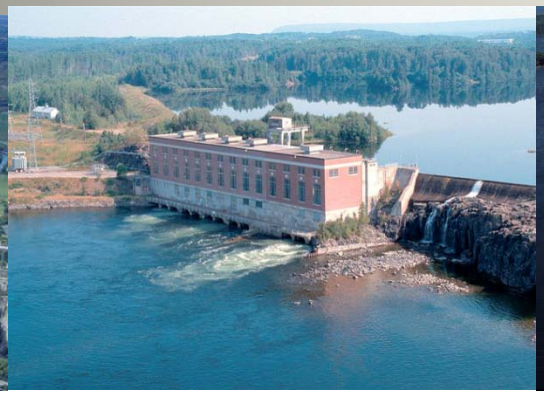
- **After one year the number of protection system operations evaluated is increasing as determined by the “Normal Operation” line**
- **The “Incorrect Procedure” and “Inadvertent relay action during maintenance” are trending down but are still need attention**
- **“Incorrect Protection System Operation” is trending down overall attesting to the success of evaluation**

FIST 6-3 Unexpected Event Reporting

The Benefits

- **Finds systemic organizational issues**
- **Reduces recurring equipment problems**
- **Aids in Regulatory Compliance**
- **Reduces the amount of smoke from your powerplant**

RECLAMATION



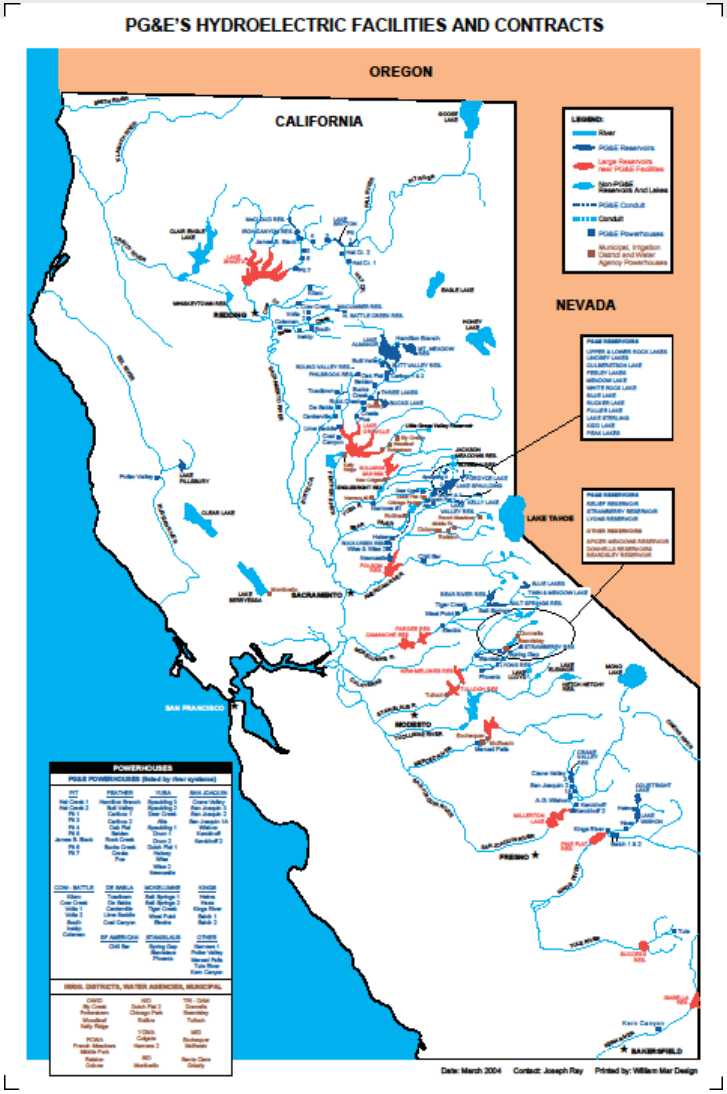
Best Practice Benchmarking And NHA's OpEx

Bill Bunker
Pacific Gas & Electric Company

PG&E Hydro Generation Overview

High up in the Sierra Nevada mountains, the water from 140,000 acres of watershed lands and 16 river basins feeds about 100 reservoirs and flows through 68 powerhouses for PG&E. This is the largest privately owned network of hydroelectric facilities in the United States and is a key part of PG&E's overall clean-power portfolio.

- **109 generating units at 68 powerhouses**
- **3,896 MW of capacity**
- **98 reservoirs**
- **171 dams**
- **400 miles of canals, tunnels & flumes**



Key Challenge: Aging Infrastructure

PG&E Hydro System

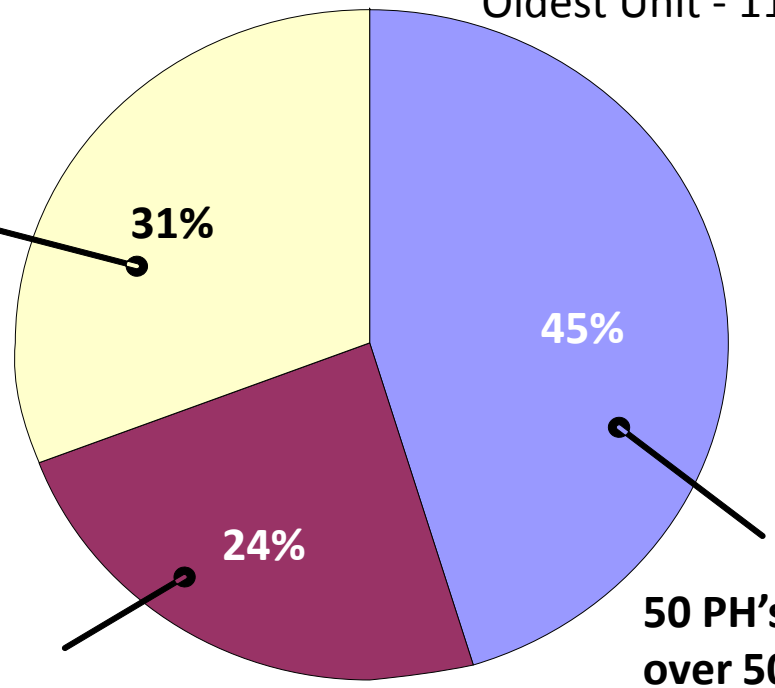
% of System Capacity by Age

Average System Age 72

Newest Unit - 24 Year Old

Oldest Unit - 111 Years Old

Helms PS
1212 MW's
27 Years



PH's < 50 Years Old
914 MW's
19 PH's - 22 Units

50 PH's (767 MW's) over 50 Years Old; 10 over 100 Years Old

Types of Benchmarking

- Internal, used to ensure consistency within and organization.
- Competitive, primarily to ensure performance is at least on par with competing and similar organizations.
- Strategic, used when identifying and analyzing world-class performance. Often includes looking at targets outside the company's own industry.

PG&E Internal Benchmarking

Safety Near Miss Reports

- As they occur, shared throughout Power Generation
- Recent lesson learned: Lack of a clearance limit for the drain end of a pressurized system.

Incident Report Analysis

- All forced outage events logged in database.
- Annual Pareto analysis done with root cause analysis and action plan – shared throughout Hydro.

PG&E Competitive Benchmarking

- BC Hydro Benchmarking Trip
  - Availability
  - Clearance Procedures
  - Control Center Operations
  - Hydrography / Water Planning
- Learnings converted to an action plan
  - Asset Management program
  - Instrumentation and Controls modernization opportunity
  - Use of OSI Pi

Op Ex Event Reporting at PG&E

1. All reports are shared among Hydro Managers upon NHA Distribution
2. Managers review and distribute throughout their organizations
3. Particularly relevant events are then discussed at the next Weekly Managers Call
   - Crane Ops: Winds are capable of generating larger than anticipated forces on our structures and equipment.
   - Develop and implement Foreign Material Exclusion (FME) procedure for unit outages, and review FME procedure with plant and contract employees.

PG&E's Experience with OpEx

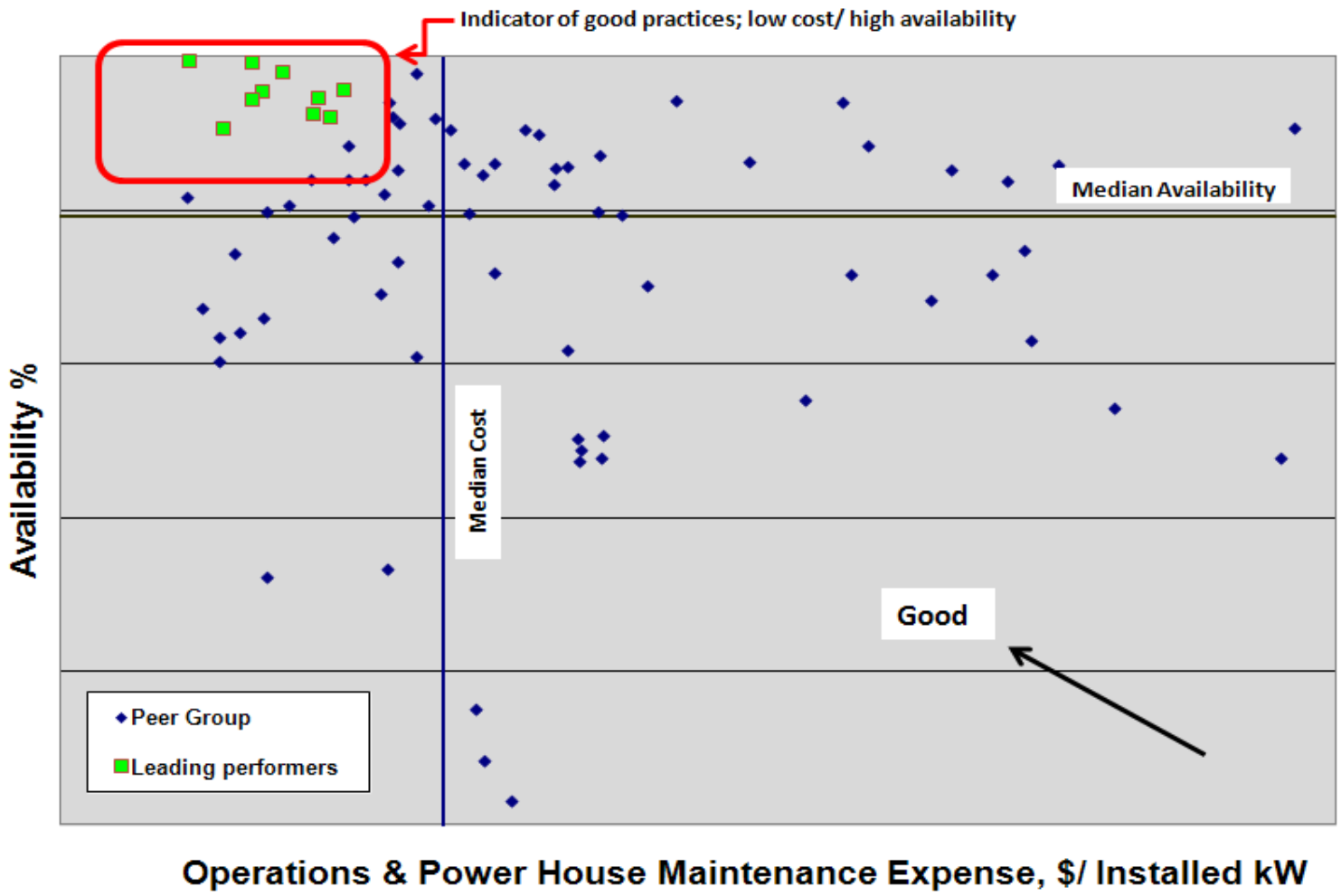
From the perspective of PG&E Hydro Managers, OpEx event reporting is progressing well:

- "Submittals I have seen are of high quality and high value."
- "Another Hydro generator learned from our brush rigging report and implemented preventive actions in his company."
- "The recent submittal on a control room fire was high value because PG&E has been reviewing fire system recommendations from our property loss folks, and reviewing the details from the event will help us make business decisions on whether to proceed.
- **"One area that is probably lacking is the volume of submittals. OpEx is so important for our industry, it sure would be nice to see more!"**

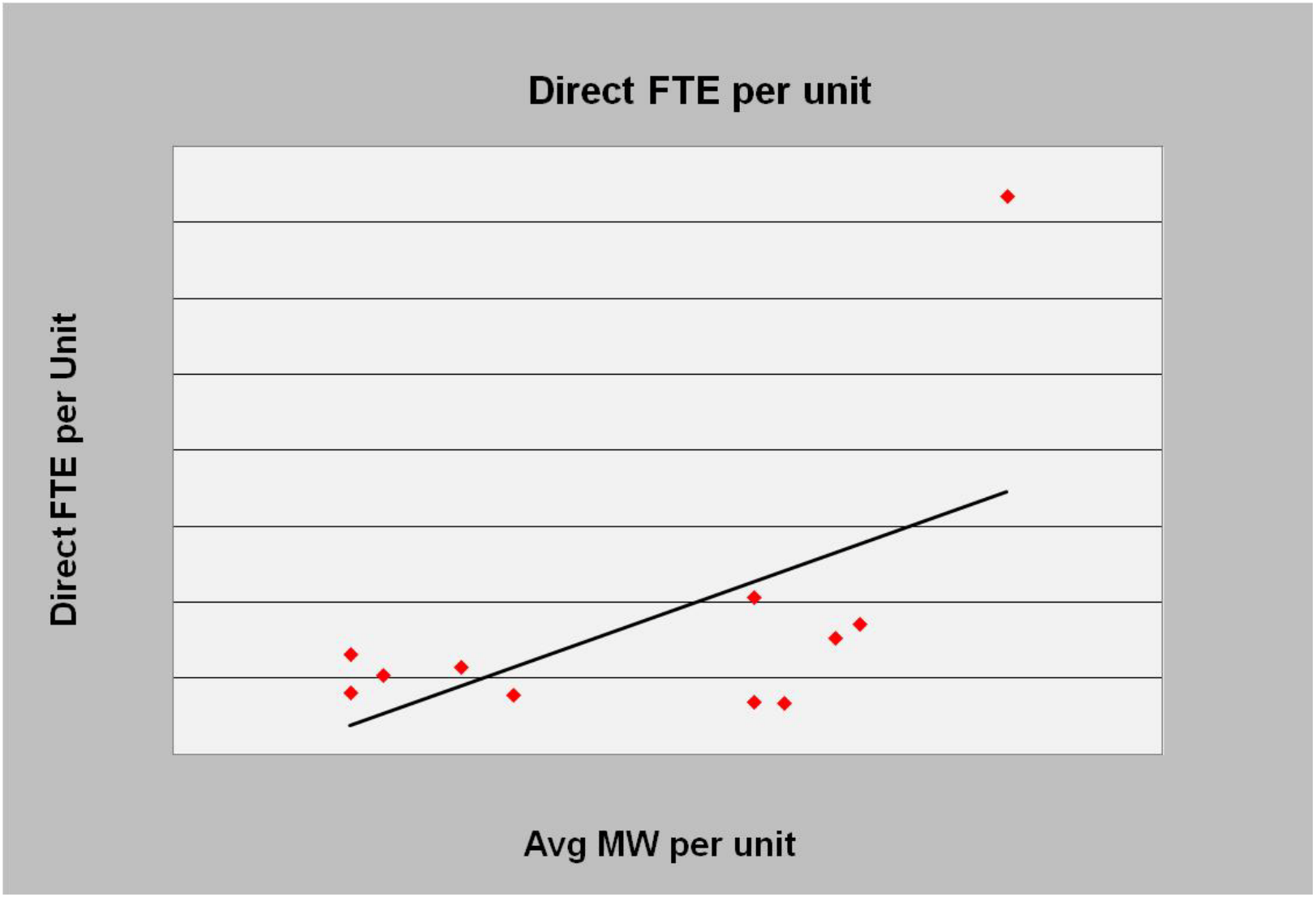
EUCG Hydroelectric Productivity Committee

- EUCG's HPC is a low-cost, member-driven forum for cost and performance benchmarking and best practices sharing.
- Objective: To assist member companies in achieving excellence by providing timely, relevant and accurate benchmarking information on cost, performance and best practices.
  - *311 hydro plants, conventional and pumped storage, ranging in size from 0.4 to 2,780 MW, 1 to 36 units per plant*
  - Thoroughly vetted data to assure apples-to-apples comparison

Identifying Cost and Performance Leaders



Staffing Level Analyses



Other EUCG Products

- Best Practices Sharing
  - During EUCG semi-annual meetings, top performers discuss practices that drive database results
  - Audience is primarily analysts, business and maintenance managers
  - General Forums allow discussion and sharing between nuclear and fossil generators as well.

- Hydro Management Symposium
  - In addition to EUCG meetings, the HPC sponsors workshops for peer exchange of operations and maintenance practices
  - Also uses database results to inform discussions
  - Content is more technical in nature
  - Audience is primarily generation managers and plant personnel
  - Held every two years or on demand

National Hydro Association

Operational Excellence

Event Report Process Illustration

Event

Event Report

OE Database

Functional Areas:

- **Safety**
- **Operations**
- **Maintenance**
- **Environmental**

Hydro Industry

Event Report Notifications by Category

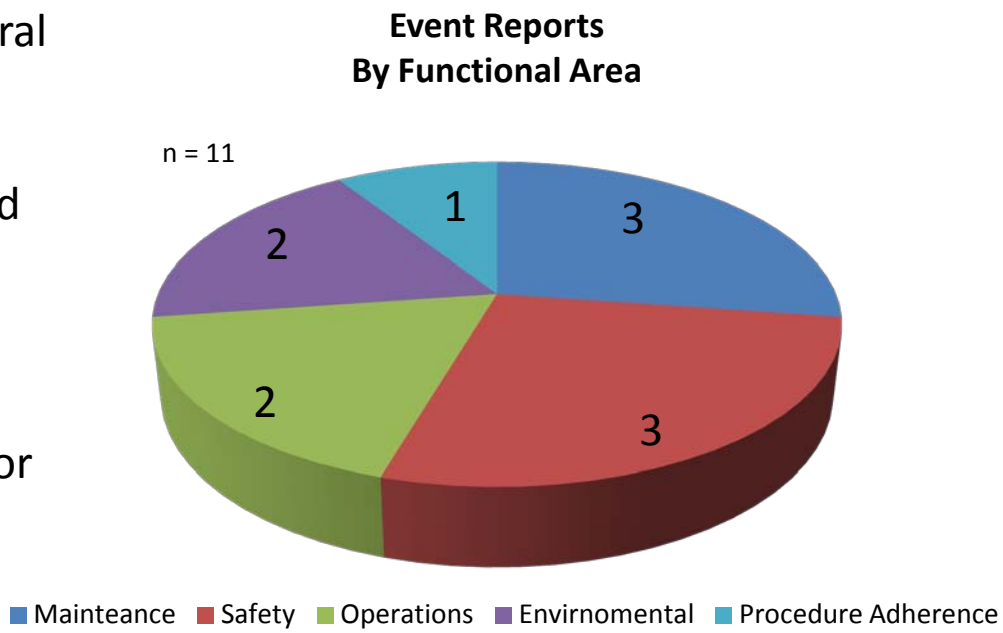
Hydro Industry

Search by Event Type, Equipment, etc.

Sample ER
[Oil Release]
[Brush Ring Failure]

Pilot Phase Event Reports - Results

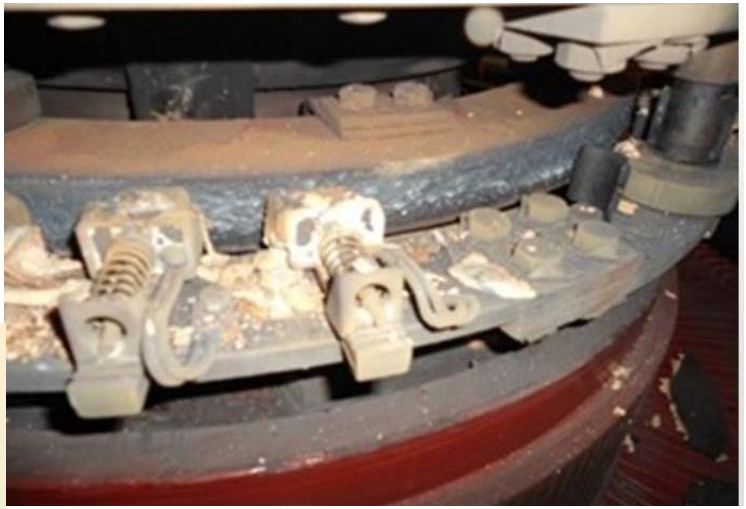
- 11 Event Reports from 6 Utilities including 4 reports from the Federal sector
- 1 report contained lessons learned and recommendations from an employee injury.
- 6 reports describe forced outage or equipment failure events



Pilot Phase Event Reports - Results – Part II

To prevent a repeat event the ERs contain

- 43 Corrective Actions
- 20 Lessons Learned
- 17 Recommendations



Lesson Learned - Example

"The investigation concluded that this event could have been prevented by performing preventative maintenance as per industry standards and manufacturers recommendations. With an adequate procedure and the necessary personnel training this incident would have been prevented."

From one of the 2013 Event Reports

Or

Impact of Event:

- 10 hour forced outage
- Fire/smoke damage
- Unplanned staffing of plant 24/7
- $269K to clean up and repair control room, staff plant 24/7 for 7 weeks, lost power revenue

Operational Excellence Program – Current Activities

Outward Communications – NHA Website

Members Area

MEMBERS AREA
- Committees & Councils
- Member Resources
- Member News
- Hydro Industry Forum
- Past Awards
- Past Events

> Members Area > Operational Excellence

Operational Excellence

BACKGROUND

In July of 2011, the NHA's Board of Directors approved Strategic Goal #5 – *Provide resources to help members achieve a high level of operational excellence at existing and planned hydroelectric projects*. To achieve Goal 5, the Board approved the formation of a new NHA initiative and task force, the Operational Excellence Task Force ("Task Force"), comprised of industry members and charged with defining, developing and implementing an Operational Excellence ("OE") program that was responsive to Goal 5.

Employee, public and dam safety is a major focus for facility owners, but as equipment wears and maintenance schedules increase and components are replaced or refurbished, operational reliability is also an increasing concern for many hydropower owners and operators. The sharing of operations, safety (employee, public and dam), environmental and maintenance ("OSEM") issues and concerns, and their solutions, is one way the hydro industry can respond to these increasing concerns and continue to operate in a safe, reliable and efficient manner. The average age of a dam and the associated hydroelectric facility in North America is 54 years old. Until recently however, the hydropower industry lacked a dedicated program that allowed for the sharing and retrieval of OSEM information.

THE INITIATIVE

The Task Force identified the need for a new industry forum where OSEM information could be shared through a central database. To achieve this new industry forum the Task Force envisioned a sophisticated Event Reporting ("ER") system where hydro events could be submitted for review and re-distributed to the industry as action alerts, but also serve as a hydro depository/library that would collect, store, and aggregate this information in a central location.

More information about OE and the ER system is available in the Procedures Manual and Guidebook. You may also contact NHA's Manager of Regulatory Affairs and Technical Services **Dave Zayas**.

Operational Excellence Resources

Please check back regularly of resources will be updated periodically.

Hydropower Resources

Please check back regularly of resources will be updated periodically.

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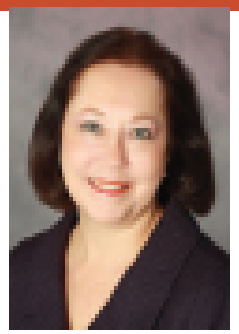
Operational Excellence Program – Current Activities

Marketing & Promotion -Power Engineering Magazine Article

NHA SPECIAL SECTION

The Hydropower Industry's Pursuit of Excellence



BY LINDA CHURCH CIOCCI, EXECUTIVE DIRECTOR, AND DAVID ZAYAS, MANAGER OF REGULATORY AFFAIRS AND TECHNICAL SERVICES, NATIONAL HYDROPOWER ASSOCIATION

What if you could prevent an event or accident at your facility before it happened, and what is that worth? What if you had information in advance that alerted you to a potential issue and you were able to avoid an employee accident or lost time, a forced outage, or a multi-million dollar equipment repair?

NHA'S OPERATIONAL EXCELLENCE PROGRAM & TASK FORCE

In 2012, NHA created the Operational Excellence Task Force (Task Force) composed of industry members and charged with identifying the resources needed to achieve a high level of operational excellence at existing and planned hydropow-

Raise the hydropower industry's standard of performance by learning from the operating experiences from others and provide training and educational opportunities thereof.

Prevent the occurrence and recurrence of similar events, and avoid defining events.

By developing a better understand-

Invitation to Participate

Expectations:

1. Active Participation Required: Share event information from your facilities with other OpEx participants through the NHA central coordinators. The utilization of the ER template aids in analysis and trending.
2. Share NHA OpEx event reports within your organization so the industry can benefit from the lessons learned, corrective actions and recommendations. The sharing of ER information can prevent a reoccurrence.

Time to catch the train!

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