CEATI INTERNATIONAL

Centre for Energy Advancement through Technological Innovation

National Hydropower Association Conference – April 2013

Session 7C: New Dam Safety Initiatives and Priorities

What is CEATI International?

- A **user-driven** multinational technology solutions exchange and development program for utilities

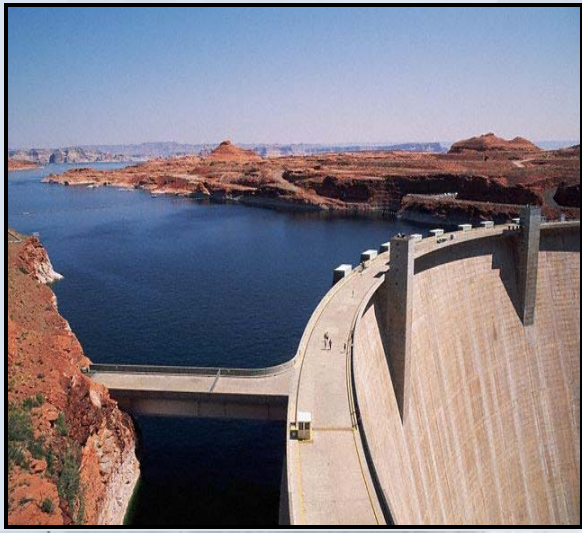
- CEATI facilitates inter-utility information exchange, informal benchmarking, and technology transfer opportunities

- Projects are developed based on issues raised by participating organizations. They are typically highly leveraged and result in practical deliverables that impact daily operations and strategic planning.

CEATI's Conventional Hydro Program

- Plant Reliability/ O&M
- Dam Safety
- Operations and Planning

- Asset Management
- Penstock Assessment



Over 60 Participating Utilities

Utility Participation Map

CEATI INTERNATIONAL

For more information regarding our Interest Groups, Events and Publications, visit **www.ceati.com**

Updated January 1, 2013

US Utility Participation

CEATI INTERNATIONAL

Grant County PUBLIC UTILITY DISTRICT
CHELAN COUNTY PUBLIC UTILITY DISTRICT
Douglas County
TACOMA POWER
TRI-STATE Generation and Transmission Association, Inc.
PUGET SOUND ENERGY
AVISTA
EWEB
BONNEVILLE POWER ADMINISTRATION
PGE
IDAHO POWER
PACIFICORP
SMUD SACRAMENTO MUNICIPAL UTILITY DISTRICT
PG&E
APS
SDGE A Sempra Energy utility
ppl
minnesota power
Xcel Energy RESPONSIBLE BY NATURE
ITC
NORTH AMERICAN HYDRO
WPS
AEP AMERICAN ELECTRIC POWER
Exelon
Ameren
TVA
FirstEnergy
Duke Energy
SOUTHERN COMPANY
Entergy
GeorgiaTransmission
FPL
conEdison
Northeast Utilities
New York Power Authority
nationalgrid
FirstLight Power Resources
ENERGIA NOVA
Central Hudson
PSEG

National Organizations

National Rural Electric Cooperative Association

US Army Corps of Engineers

US Department of the Interior Bureau of Reclamation

Federal Energy Regulatory Commission

For more information regarding our Interest Groups, Events and Publications, visit www.ceati.com

Updated January 1, 2013

Dam Safety Interest Group (DSIG)

Topics & Issues

- Dam Safety Program Management & Organization
- Dam Safety Training
- Safety & Design Standards
- Instrumentation & Monitoring
- Information Analysis & Management
- Performance Assessments
- Risk Management

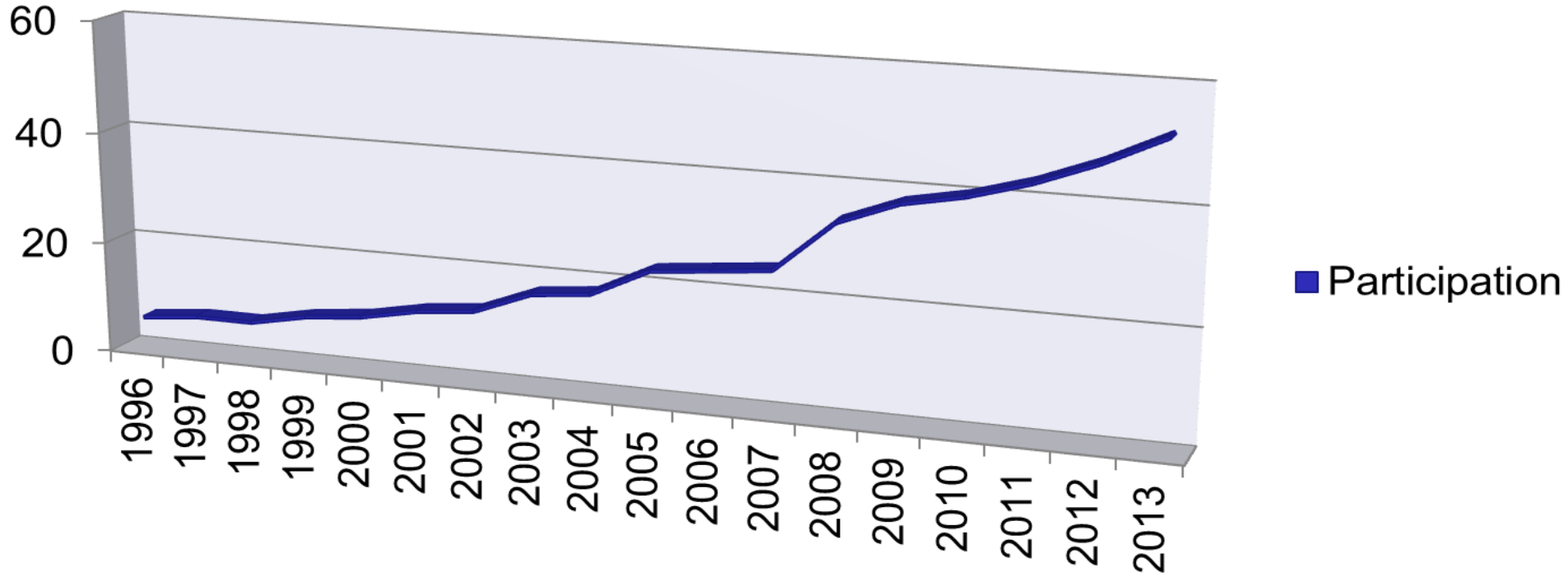
Special Initiatives:

- *FERC Licensees Working Group*
- *Penstocks Task Force*

Dam Safety Interest Group (DSIG)

Introduction

- Present Participation includes 52 Owners from around the World.



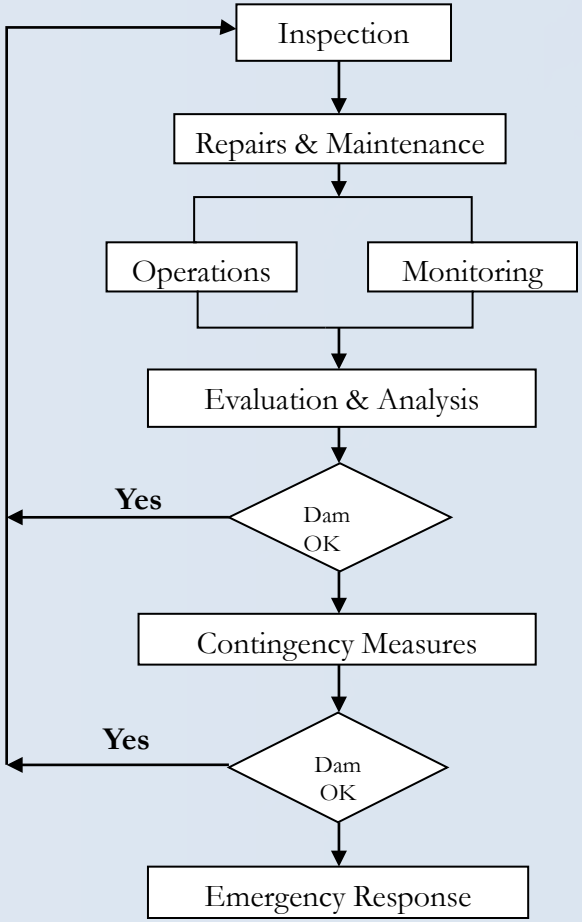
FERC Licensees Working Group

- **First session held on March 11, 2013 in conjunction with Spring 2013 DSIG meeting in Las Vegas, NV.**
- **Topics discussed included:**
  - Owners Dam Safety Program
  - Evolution towards a Risk Informed Decision Making Philosophy
  - Enhancements to EAPs (operations plan during high inflow event)

Forum for collaboration and interactive dialogue between:

- *FERC's Division of Dam Safety and Inspections*
- *Over 30 participating FERC licensees*

Dam Safety Performance Monitoring and Data Analysis Management - Best Practices



Contractor: Paul C. Rizzo and Associates

Supported by: 23 sponsoring utilities

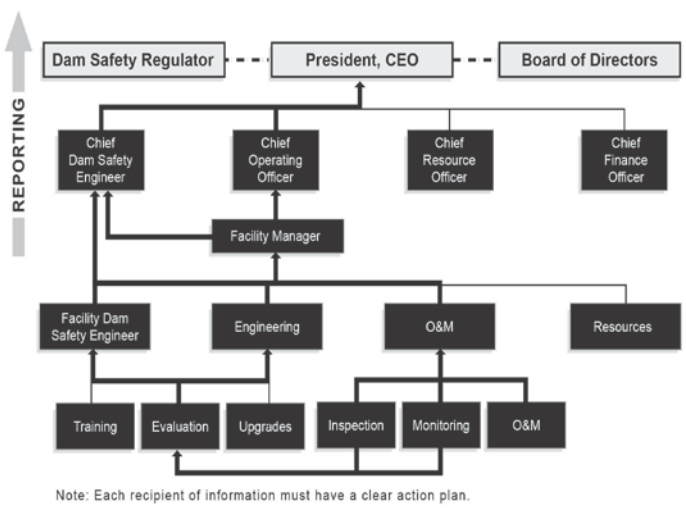
Objectives:

Document management best practice that incorporates:

- Surveillance and monitoring
- Instrumentation needs and maintenance
- Data collection, analysis, and storage
- Responsibilities of management and key personnel
- Coordination and communications

Figure 4-2 Procedural Guidance for Dam Safety Programs

Dam Safety Performance Monitoring and Data Analysis Management - Best Practices



Section 1 - Introduction & Overview

Section 2 – Why Monitor Performance?

Section 3 – Understanding How Dams Fail

Section 4 – Key Elements of a Successful Dam Safety Monitoring Program

Section 5 – Model Surveillance, Monitoring, and Analysis Program

Section 6 - Guidelines for Designing, Installing and Maintaining Performance Monitoring Systems

Dam Safety Performance Monitoring and Data Analysis Management - Best Practices

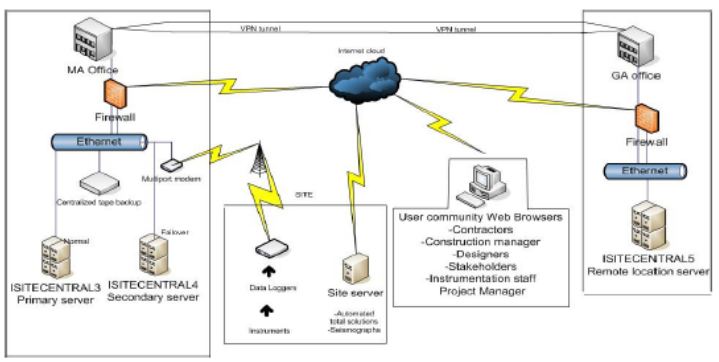


Figure 5-20 Schematic of Advanced Automated Data Acquisition System

Section 7 – Guidelines for Summarizing Data

Section 8 – Typical Monitoring Programs

Section 9 – Organizational Structure & Responsibilities

Section 10 – Conclusions & Final Remarks

Appendices

- Bibliography on instrumentation in dams
- Purpose and use of instrument devices
- Case histories
- Typical PFMs for various dam types

Grouted Post-Tensioned Rock Anchor Assessment Program

Condit Dam

Contractor: Paul C. Rizzo and Associates

Supported by: 14 sponsoring utilities

Objectives:

- Obtain real data through removal of anchors at dams slated for decommissioning or having redundant anchors – 3 sites.
- Understand performance of anchors under actual site conditions – forensic study report.
- Gain a better understanding of the aging processes on grout protected anchors.

Grouted Post-Tensioned Rock Anchor Assessment Program

Multi-stranded post tensioned anchors, Elwha Dam, WA.

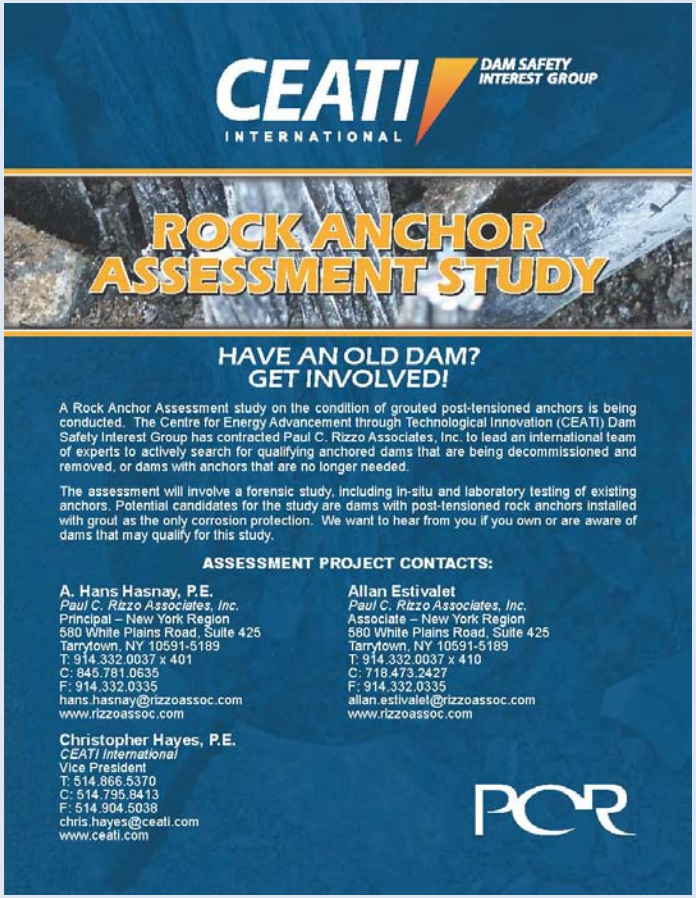
Elwha Dam Removal

- Portions of dam removed in 2011
- Multi-strand anchors
- RIZZO sent engineer to inspect anchors and collect samples.

Condit Dam Removal

- Dam removed during summer of 2012
- Button head anchors
- PacificCorp contracted with RIZZO to inspect anchors and collect samples.

Grouted Post-Tensioned Rock Anchor Assessment Program


CEATI INTERNATIONAL
DAM SAFETY INTEREST GROUP

ROCK ANCHOR ASSESSMENT STUDY

HAVE AN OLD DAM?
GET INVOLVED!

A Rock Anchor Assessment study on the condition of grouted post-tensioned anchors is being conducted. The Centre for Energy Advancement through Technological Innovation (CEATI) Dam Safety Interest Group has contracted Paul C. Rizzo Associates, Inc. to lead an international team of experts to actively search for qualifying anchored dams that are being decommissioned and removed, or dams with anchors that are no longer needed.

The assessment will involve a forensic study, including in-situ and laboratory testing of existing anchors. Potential candidates for the study are dams with post-tensioned rock anchors installed with grout as the only corrosion protection. We want to hear from you if you own or are aware of dams that may qualify for this study.

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PCR

Current status

- RIZZO implementing outreach program within the dam community
- RIZZO identified potential test sites:
  - John H. Bankhead Lock and Dam, Alabama: USACE
  - Mayfield Powerhouse, Washington Tacoma Power
  - Pointe du Bois Dam, Manitoba, Canada
    Manitoba Hydro
  - Zardedas Dam
    Algeria

Using Maturity Matrices to Evaluate Dam Safety Programs

Contractor: Damwatch Services Ltd.

Supported by: 17 sponsoring utilities

Objectives:

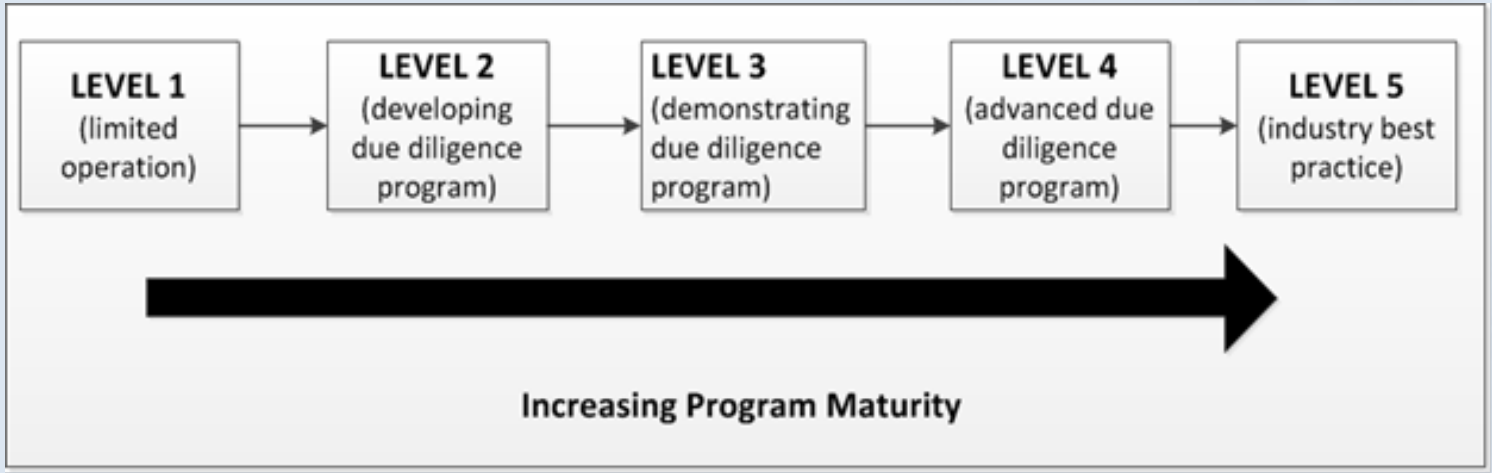
Develop a system using Maturity Matrices which will allow an owner to:

- benchmark themselves among their peers to a level relevant to their dam portfolio
- self-assess their dam safety program for continuous improvement.

Using Maturity Matrices to Evaluate Dam Safety Programs

Maturity Matrices:

- Utilise key performance measures to assess maturity of the dam safety program's components
- Examples of acceptable practice to what is considered industry leading practice.



Penstock Maintenance and Inspection Guide

Key components:

- evaluating the condition of in-service penstocks and
- surveillance & monitoring of in-service penstocks
- methodology for risk assessment of in-service penstocks
- failure causes and mechanisms of penstocks and associated equipment
- decision making process and technical criteria related to the repair or replacement of penstocks

Penstock Maintenance and Inspection Guide

Industry Documentation to be referenced:

- Guidelines for Evaluating Aging Penstocks; Task Committee on Guidelines for Aging Penstocks, Energy Division, ASCE;
- Guidelines for Inspection and Monitoring of In-Service Penstocks; ASCE Task Committee;

Penstock Maintenance and Inspection Guide

Status:

- RFP issued to the industry in January, 2013
- 2 proposals received by February 28, 2013
- Proposal currently under evaluation by working group

Penstock Task Force:

- Over 38 participating utilities from both the DSIG and HPLIG
- Chair: Charlie Ahlgren of Pacific Gas & Electric

hydroAMP – hydro Asset Management Program

What do you need to know before you can prepare an asset plan?

- Inventory of your assets
- Their condition
  - If you have many, a consistent method is important
- Cost of keeping your assets operational
- Consequences of failure

What is hydroAMP?

- **Provides a consistent methodology for assessing equipment condition**
  - ❖ hydroAMP is designed to support Asset Management Programs

- **It is a condition assessment tool not built for preventative or predictive maintenance**

hydroAMP Steering Committee:

- BPA
- Hydro-Quebec
- Seattle City Light
- US Army Corps of Engineers
- US Bureau of Reclamation.

hydroAMP Guides

1. Batteries
2. Circuit Breakers
3. Compressed Air Systems
4. Cranes
5. Emergency Closure Gates and Valves
6. Exciters – revised 2011
7. Generators – revised in August 2012
8. Governors
9. Surge Arrestors
10. Transformers
11. Turbines
12. ***Penstocks - new***
13. ***Balance of Plant - new***

hydroAMP Two Tier Condition Assessment

Tier 1

- **Based on tests, measurements, and inspections that are typically performed during routine O&M activities.**
- **Assessment results in a “Condition Index” with a scale of 1-10; higher is better.**
- **Mid to low range values may signal the need for Tier 2 evaluation.**

hydroAMP Two Tier Condition Assessment

Tier 2

- **In-depth, non-routine tests or inspections that may be invasive and/or require specialized equipment and expertise not normally found at the project.**
- **Results are used to adjust the Condition Index score (either up or down).**
- **When performed, adds confidence to the assessment results and conclusions.**

hydroAMP Balance of Plant Guide

The **Balance of Plant** guide covers o**ver 70 equipment types** including the following:

- Plant, Spillway, and/or Unit Control System – analog
- Plant, Spillway, and/or Unit Control System – digital
- Spillway Gates
- Spillway Gate Operating Equipment

hydroAMP Balance of Plant Guide

Tier 1 Balance of Plant Condition Summary				
No.	**Condition Indicator**	**Score × Weighting Factor = Total Score**		
1	Age *(Score must be 0, 1, 2 or 3)*		1.0	
2	Maintenance History *(Score must be 0, 1, 2, or 3)*		0.667	
3	Operations Performance *(Score must be 0, 1, 2, or 3)*		1.0	
4	Physical Characteristics *(Score must be 0, 1, 2, or 3)*		0.667	
5	"____Other____" *(Score must be 0, 1, 2, or 3)*		TBD*	
Tier 1 Emergency Closure System Condition Index (Sum of individual Total Scores) *(Condition Index should be between 0 and 10)*				

Tier 1 Data Quality Indicator *(Value must be 0, 4, 7 or 10)*	

hydroAMP Balance of Plant Guide

Balance of Plant Condition Indicator 1 - Age:

< 50% of Design Life	3
≥ 50% and < 100% of Design Life	2
≥ 100% and < 125% of Design Life	1
≥ 125% of Design Life	0

Balance of Plant Condition Indicator 2 – Maintenance History:

Normal preventative maintenance	3
Rare corrective maintenance	2
Increasing corrective maintenance, more frequent or longer outages	1
Frequent repairs, labor intensive, spare parts are not available	0

hydroAMP Balance of Plant Guide

Balance of Plant Condition Indicator 3 – Operational Performance:

Performance is normal and meets original design criteria	3
Performance is adequate, and meet original design criteria but is less efficient or effective than when originally installed	2
Performance is significantly affected or design is inadequate for current function	1
Performance is inadequate or the device is not operational	0

hydroAMP Balance of Plant Guide

Balance of Plant Condition Indicator 4 – Physical Characteristics :

No physical deterioration is observed	3
Physical deterioration is more than cosmetic, but has not yet compromised physical/structural integrity	2
Physical deterioration is significant though equipment is still functional	1
Physical deterioration has yielded low confidence in physical or structural integrity	0

Balance of Plant Condition Indicator 5 - Other:

None	3
Minor	2
Significant	1
Major	0

Dam Safety Interest Group (DSIG)

Other Initiatives

- Comparison of Flood Hazard Estimation Methods for Dam Safety - Phase 1
- Investigating the Structural Safety of Cracked Concrete Dams
- Dam Safety Training for Plant Operators
- Activation Guidelines for Dam Safety EAPs
- Emergency Management: Development of Standardized Inundation Maps Produced using GIS

Dam Safety Interest Group (DSIG)

2012 Meetings and Workshops

- Model Dam Safety Program and Performance Measures – March 2012
- Penstock Symposium – March 2012
- Seismic Hazard and Risk Assessment Workshop for Dams – May 2012
- Penstock Working Group – June 2012
- Planning for Extreme Events: A Water Management & Dam Safety Perspective – October 2012
- Evaluating Liquefaction and its effects on Dams – November 2012

Dam Safety Interest Group (DSIG)

2013 Meetings and Workshops

- DSIG General Meeting and Industry Workshop: Mitigating the Impacts of Aging Infrastructure – March 11-13, 2012 in Las Vegas
- Activation Guidelines for Dam Safety EAP – June 2013 in Toronto
- Emergency Management: Development of Standardized Inundation Maps Produced using GIS – June 2013 in Toronto
- Using Maturity Matrices to Evaluate Dam Safety Programs – Workshop – October 23, 2013 in Vancouver
- DSIG Fall General Meeting – October 24-25, 2013 in Vancouver

Thank You!

Should you have questions about CEATI, our programs or aspects discussed in this presentation please feel free to contact me.

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