Northwest **Power** and **Conservation** Council



October 2, 2018

**MEMORANDUM**

**TO:** **Council Members**

**FROM:** **Elizabeth Osborne**

**SUBJECT:** **Briefing by Representatives from Chelan County Public Utility District**

## BACKGROUND:

Presenters: Kirk Hudson, Managing Director of Generation and Transmission
Bill Christman, Chief Engineer, Dam Safety and Natural Resources

Summary: Mr. Hudson will brief the Council on the Hydropower Research Institute, initiated by Chelan PUD and incorporated in the summer of 2018. Mr. Christman will present on innovations in dam safety.

Background: Chelan County Public Utility District, headquartered in Wenatchee, was established in 1936 and began providing electric service in 1947. The PUD owns and operates three hydroelectric generating projects – Rocky Reach, Rock Island, and Lake Chelan dams – along with a small amount of solar power, with a total generating capacity of over 2000 MW. The power generated serves over 50,000 retail electric customers and is sold to other utilities in the Pacific Northwest.

More Info: See attached description of the Hydropower Research Institute

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# The Hydropower Research Institute

*Optimizing Hydropower through Digital Transformation*

The Hydropower Research Institute (HRI) is a new data-driven collaborative designed to empower hydropower owners to optimize their projects and remain competitive in a changing electric system. The HRI's mission is to ensure hydropower continues to be the premier electricity-generating resource through digital transformation and technology development.

The HRI will aggregate hydropower operational data, assist hydropower owners in the digital transformation, and facilitate research and development of new technology for hydropower facilities and equipment Its primary purpose is to use this information to reduce operating costs, avoid forced outages and minimize maintenance time. Chelan County Public Utility District initiated the HRI after identifying a need for improved use of operational data and sensor technology in the hydropower industry. Chelan PUD and Southern Company have contributed to the HRI as founding members. Other generators, vendors, manufacturers and researchers are invited to become contributors and subscribers in 2019.

## Data Analytics, Predictive Analysis and Sensor Technologies

Today, hydropower owners and operators evaluate aging equipment based on "placed in service dates" supplemented by condition assessments. In contrast, active monitoring while units are still in service – *before* age and condition become a major factor – can improve industry's understanding of the equipment aging process.

Most hydropower owners and operators already generate, collect, and store operational data using a variety of instruments and sensors. However, raw data from one project has little value for identifying and fixing problems before they become emergencies. A large data set provides more insight into equipment life cycle, stressors and behavior prior to failure. Combining data into aggregated and anonymous datasets allows asset owners to build greater operational intelligence in the hydropower community. The HRI's vendor-neutral platform will allow utilities and manufacturers to convert undervalued data into a critically important tool by facilitating data analytics across their respective fleets and even across all users. The HRI platform will also use an existing cloud provider to reduce complexity (i.e. scalability, security, tools) and development risk for all participants. This will improve asset performance prediction and assist owners and operators with data-driven decision-making.

Ultimately, improved predictive capabilities will enable hydropower owners and operators to efficiently plan major interventions and replacements prior to equipment failure, improving overall fleet availability. Analysis of the aggregated data set can also inform industry demand for research. For example, some sensor technologies developed for other industries may have applications for hydropower. Through a robust research, demonstration and deployment program, the HRI can reduce the risk associated with applying these and other new technologies to hydropower and bringing them to market.

## Technology Leadership

The HRI is physically located in Wenatchee, Washington on the Columbia River. While HRI data services will be available from anywhere in the world via the cloud, the Columbia River is a natural place to perform research, demonstrate and deploy new hydropower technologies, and collaborate with experts in the hydropower industry. Ultimately, hydropower owners and operators across the nation will benefit from the HRI and electric customers will benefit from technologies that reduce the long-term costs of hydroelectric generation.

## Funding

The HRI will operate on a non-profit basis. Additional asset owners can join the HRI by paying an annual membership fee and contributing operational data. Fees for additional asset owners to join the HRI will be based on operating cost estimates. Finally, manufacturers, vendors, academics and researchers can subscribe to the HRI to receive access to data sets by member permission (for individual member data) or by specific-use license for access to the aggregated data set. Costs for subscribers will be based on license requirements.

While its members and subscribers will fund the operation of HRI, the organization may seek other funding sources. The HRI will actively monitor opportunities to leverage its existing funding to help members with the digital transformation and to respond to emerging hydropower research needs. This may include collaborating with federal or state government programs or private research efforts.

## Next Steps

The HRI was incorporated in July 2018, and is on schedule have an aggregated data set available by the end of 2018. The HRI will be ready to begin accepting data contributors and subscribers in 2019. However, if you organization is interested in becoming a contributor, steps can be taken now to ensure your data is ready for the HRI platform. For more information on how to join the HRI, please contact the HRI at info@hridata.org or (509) 866-4HRI.

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# The Hydropower Research Institute

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**Northwest Power and Conservation Council**

**October 10, 2018**

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## Hydropower's Challenge

- **Compete in the future with all other electrical generation sources.**
- **We can affect operations cost, reliability, availability and quality.**
  - We cannot affect market price
- **Digital transformation* is a means to reducing operations cost and improving reliability, availability and quality.**
  - Making hydropower a more attractive product for the market

***Leveraging digital information and technology to change the way we do things***

9/19/2018

HRI

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# What is the Hydropower Research Institute?

- **A data-driven collaborative formed and governed by hydropower owners.**
  - Designed to empower hydropower owners to remain competitive in a changing electric system and market.
- **Focused on enabling hydropower owners to drive business value of digital transformation by:**
  - Aggregating operational data
  - Identifying technology development needs
  - Providing a collaborative forum to share tools and addressing culture change required to digitally transform hydropower

10/3/2018

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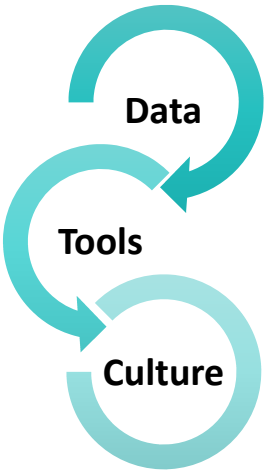
# Business Value = (data * tools)$^{culture}$




- **<u>Data</u> is the required asset for digital transformation –** ***the HRI increases the value of data by improving accessibility to your and other contributors shared data.***
- **<u>Tools</u> are essential to help interact with and understand data –** ***the HRI is a vendor-neutral platform and provides a forum to identify the need for new tools and technology.***
- **<u>Culture</u> is the most important aspect of realizing the benefits of digital transformation –** ***the HRI provides a collaborative forum to embrace necessary operational changes.***

10/3/2018

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## How can you participate in the HRI?

### Members

- Hydropower asset owner that contributed start-up capital.
- Board Director seat
- Responsible for Governance and Management
- Contributes data and has access to aggregated data
- Engages on collaborative efforts
- Engages through HRI Management and Technical Steering Committee

### Subscribers

- Non-hydropower asset owner
- Pays for licensed access to aggregated data
- Engages on collaborative research efforts

### Contributors

- Hydropower asset owner that contributes annual fee
- Contributes data and has access to aggregated data
- Engages on collaborative efforts
- Influences technical direction through HRI Steering Committee



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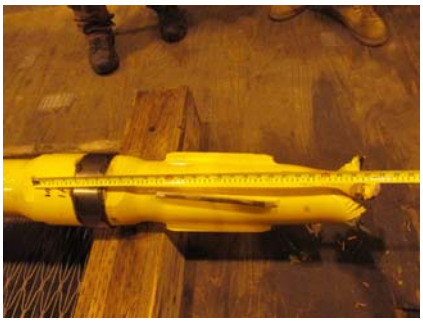
## Example HRI Use Case Kaplan Shaft Failure

### >Chelan Objectives

- Determine if degradation of kaplan shaft can be predicted.
- If so, operationalize a predictive method to use on sister unit.

### >Bad news

- Chelan only had one similar unit which provided insufficient data to use predictive analysis.
- No easy way to determine who had data from similar units other than the ones that failed.
- No easy way to obtain data once similar units identified.



### >Good news

- Data from similar kaplan pipe failures was available.

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# Where are we now?

- **Building data aggregation platform**
  - Design guided by technical steering committee
    - Kirk Hudson, Chelan PUD
    - Lisa Martindale, Alabama Power/Southern Company
    - Daniel Rabon, USACE Hydropower Business Line
- **On-boarding nine hydropower plants from across the U.S.**
  - Initial aggregated data set available by start of 2019
  - Ultimately, aggregated data set from Chelan PUD, Southern Company and USACE will represent operational data from 110 hydropower plants
- **Ready to accept new contributors and work with subscribers Q1 2019**



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# Security, Privacy, Market Concerns

- **Data Transfers:** The HRI will use a secure transfer mechanism for both receiving and transmitting data.
  - Data can be encrypted during transport and while at rest
- **Storage:** Data will be stored using AWS (Amazon Web Services) which includes the security features built by Amazon as well as mirroring so there is no fear of losing your data.
- **Transformation & Anonymity:** The staff responsible for data transformation will be contractually bound by non-disclosure agreements.
  - Data transferred to the HRI may go to Member-specific locations and only after it is transformed and anonymized moved into the shared, HRI area
  - Transformed data may use the same field names across the HRI so field names will not indicate owner information
- **Privacy:** The HRI will not sell or reveal owner information. Per the structure of the HRI, data may be shared with subscribers for a fee.
  - HRI data will be anonymized by owner although it will include the manufacturer of the component and other important characteristics to allow comparisons
  - Members may also take steps to anonymize data prior to sharing it with the HRI

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## Contact Info

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**HRIdata.org**


HRI

# Chelan County
# Public Utility District
Wenatchee, WA

## Seismic Evaluation for Hydropower & Associated Facilities
October 2018

Bill Christman
bill.christman@chelanpud.org

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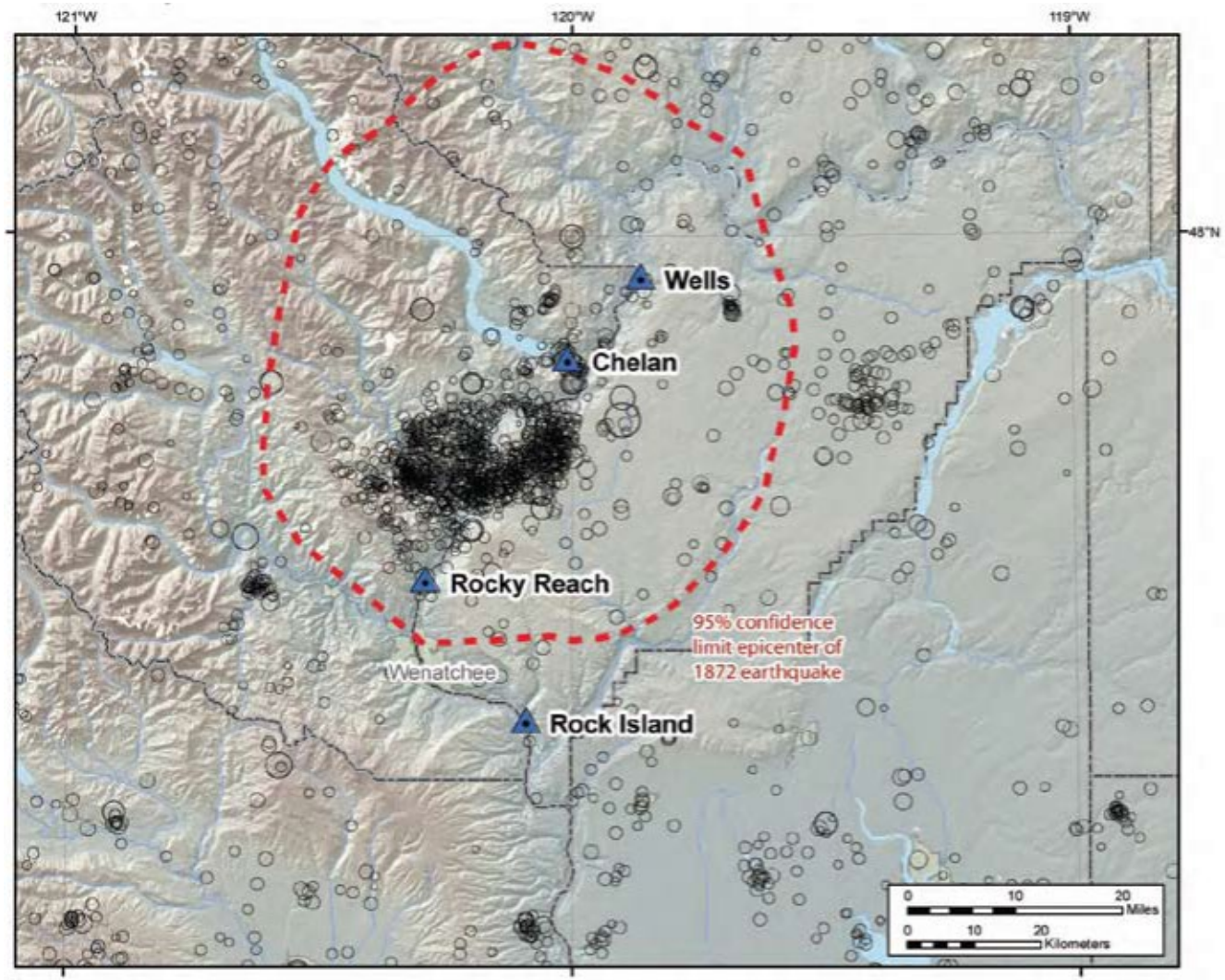
# Mid-Columbia Region's seismic setting:


**Major points:**

- NCW was, until about 2006, thought to be a very low seismic risk (background seismicity at most)
- We collaborated with the FERC and other stakeholders to perform a PSHA.
- The PSHA was performed with <u>all</u> of the "informed community" input (including what they knew they knew, and what they thought they might not know).
- This effort occurred over a more than 2-year span which produced a very well understood outcome and comprehensively supports our intent to responsibly discharge our duty-of-care to the public.
- Gray lines represent known faults (red lines are highways, blue line is Columbia River).

# Mid-Columbia Region's seismic setting con't:




**Major points:**

- This region contains a seismic source that is not well-represented at the surface.
- The dashed red line shows the 95% confidence limit epicenter of the "1872 earthquake"
- In using the PSHA approach, or in other words a risk-informed process, we believe our outcome is more stable (less chance of changing in the future).

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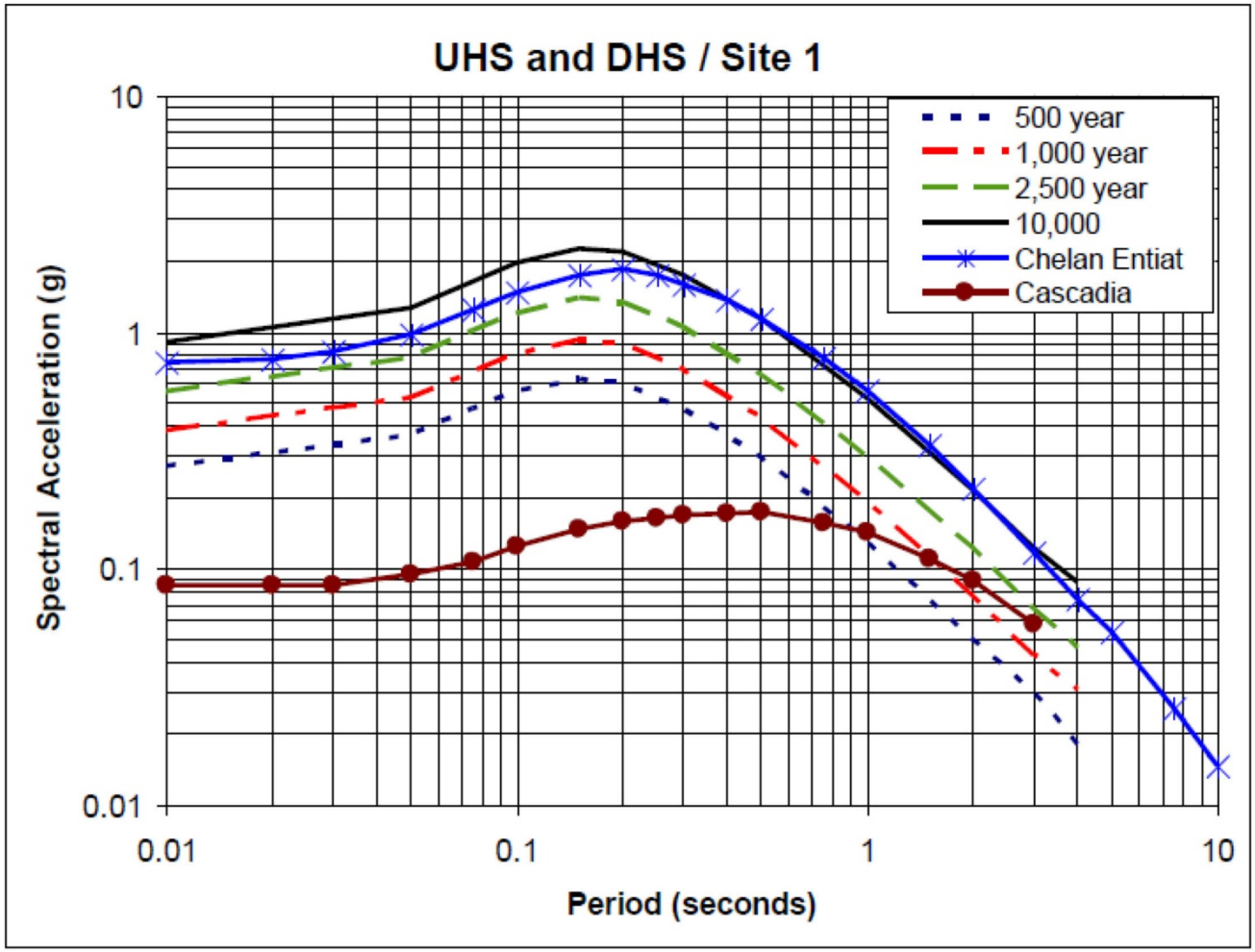
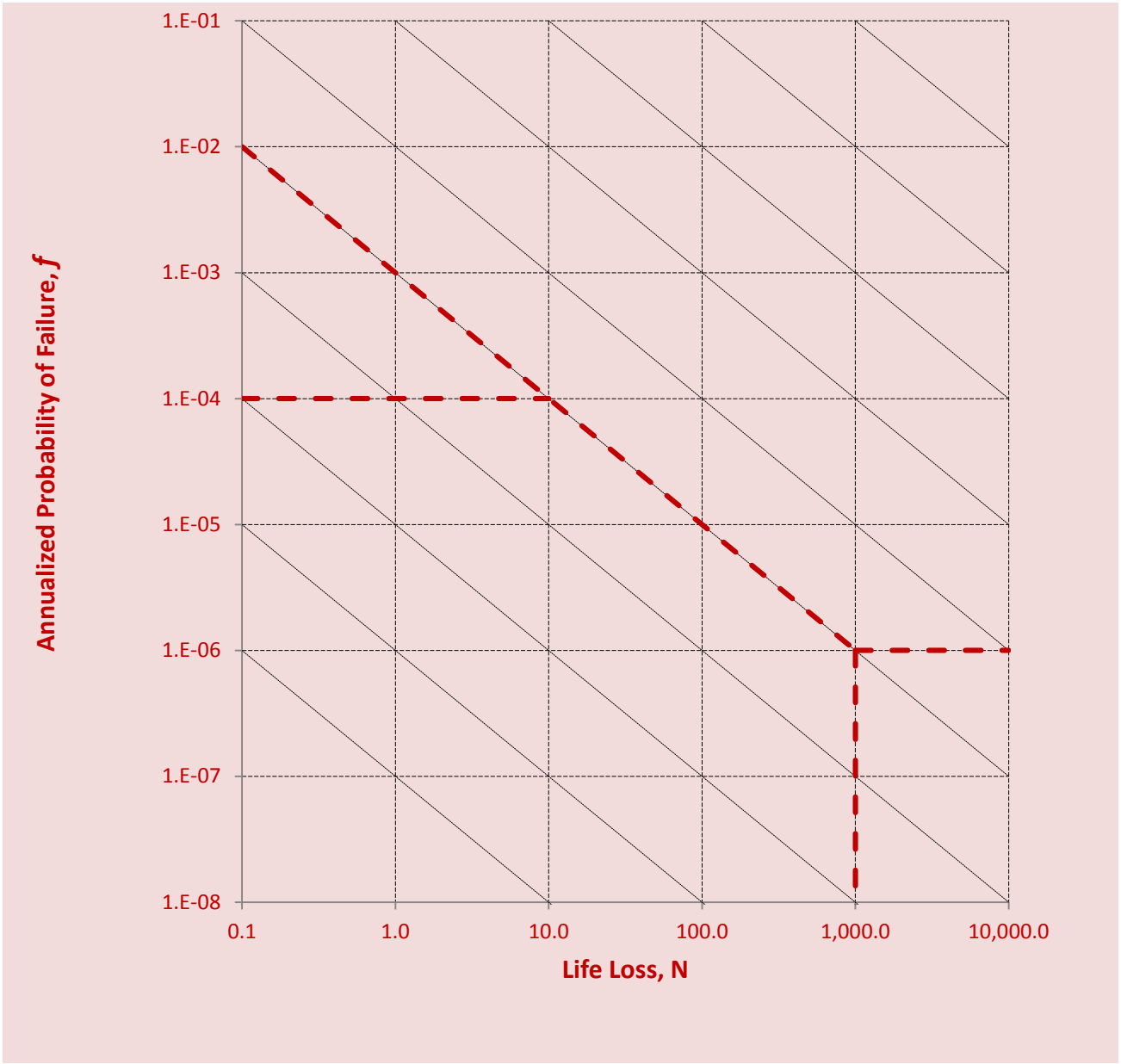
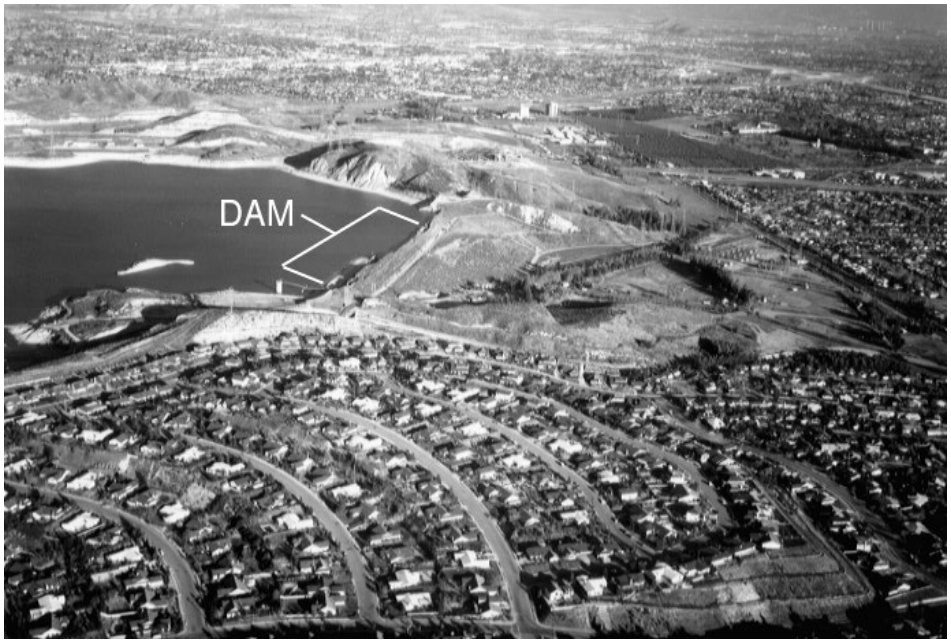
# Comparison of Deterministic and Probabilistic Ground Motions





# The “potential consequences” component of risk-assessment:


Rocky Reach Dam, WA
Low downstream hazard




Lower San-Fernando Dam, LA
High downstream hazard

# Rock Island Hydroelectric Project

Low Downstream Hazard

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# Chelan Powerhouse and Switchyard

Low Hazard

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We have evaluated our water retaining structures for the 10,000 year ground motion as a **first step** in the risk-assessment process. We have also evaluated the water retaining structures for the Maximum Credible Earthquake. We haven't finalized the analysis for appurtenent structures (e.g. transformers and switchyards).

An ongoing second step in our risk-assessment looks at things that would be important for maintaining control of the hydro-project(s); areas where Project robustness can likely benefit the most – some examples are shown on the following pages and include:

Control Room Resiliency and Enhanced Operator Response Training

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Ensuring Essential Hydroelectric Control Systems Remain Functional (i.e. tying things down)

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Office, Warehouse, and Equipment Center Resiliency

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# Rock Island

Spillway/Hydraulic Water Passage Reliability “After the Event”

# Rock Island Hydro Project

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# Chelan Dam & intake structure

Penstock Isolation Valve Resiliency “After the Event”

## Summary

- Chelan PUD's 3 Hydroelectric Project's water retaining structures are resilient for rare seismic loads; and,
- Other Risk-Informed-Decision-Making is ongoing because…
- Our projects are subject to a variety of risks (e.g. effects of aging, changes in anticipated flood flows, security breaches)

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