

## SESSION 8: Operating Plans and Institutional Knowledge

<b>Panel Members:</b>	<b>Bill Christman</b> <b>Walter Davis</b> <b>James Thrasher</b>	<b>Chelan Co. PUD No. 1</b> <b>Seattle City Light</b> <b>American Electric Power</b>
<b>Moderator:</b>	<b>Gus Tjoumas</b>	<b>FERC</b>

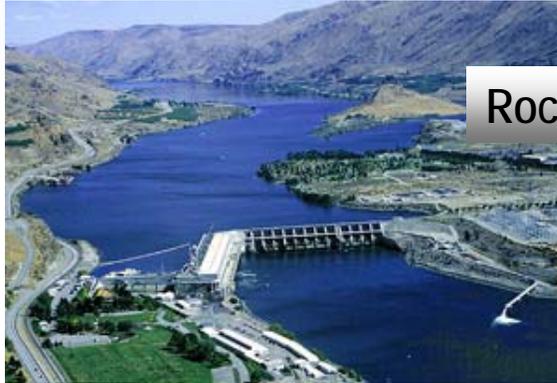


# ***How to Retain Critical Knowledge***

Bill Christman, P.E. — Chelan County PUD

# How to Retain Critical Knowledge

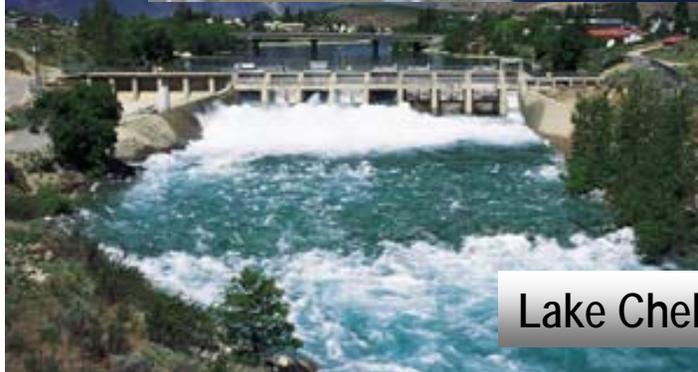
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Rocky Reach



Rock Island



Lake Chelan

## *Chelan County Public Utility District*

- 3 Dams
- 2000 MW of Generating Capacity
- Second largest non-Federal hydroelectric producer in the U.S.

# How to Retain Critical Knowledge

Bill Christman, P.E. — Chelan County PUD

*Capturing knowledge before  
it walks out the door.*



# How to Retain Critical Knowledge

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## *Why does this matter?*

### An industry-wide issue

- 50% to lose 50% in 5 years
  - 50% of utilities are faced with 50% or more of their workforce retiring in the next five years
- 90% have a problem...30% have a plan
  - Of 21 energy companies interviewed, over 90% report attrition as an important or emerging issue...Over 30% report having a plan to address the issue
- Ample anecdotal evidence
  - Including explicit plans to recruit replacements from other utilities

# How to Retain Critical Knowledge

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## *Knowledge Retention Process*

- Identify critical skills and knowledge at risk
- Assess consequences of losing that knowledge
- Capture the knowledge
- Evaluate strategies to transfer critical knowledge



# How to Retain Critical Knowledge

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## *Gap Analysis: Attrition Forecast*

- Focus on required critical skills and where those skills reside
- Identify a way to prioritize critical skills and assess those in danger of being lost through attrition
- Two and five year forward look at organizational impact

NOTE: Often the least well understood tasks, because of difficulty or lack of standardization are most at risk from attrition by a few specialists in that area.

# How to Retain Critical Knowledge

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## *What are we doing?*

### 1. Workforce assessment

(April 2004)

- 614 full-time employees
- 156 (25%) eligible to retire



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## *What are we doing?*

2. Identify knowledge or skills that could be lost
  - Necessary for reliable and/or safe hydro operations
  - Not uniformly common knowledge
  - Currently undocumented



# How to Retain Critical Knowledge

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## *What are we doing?*

3. Capture and deliver that knowledge
  - Operational and Maintenance Instructions (OMI's)
  - Standard Operating Procedures (SOP's)
  - Job Plan and work notes database (Maximo)

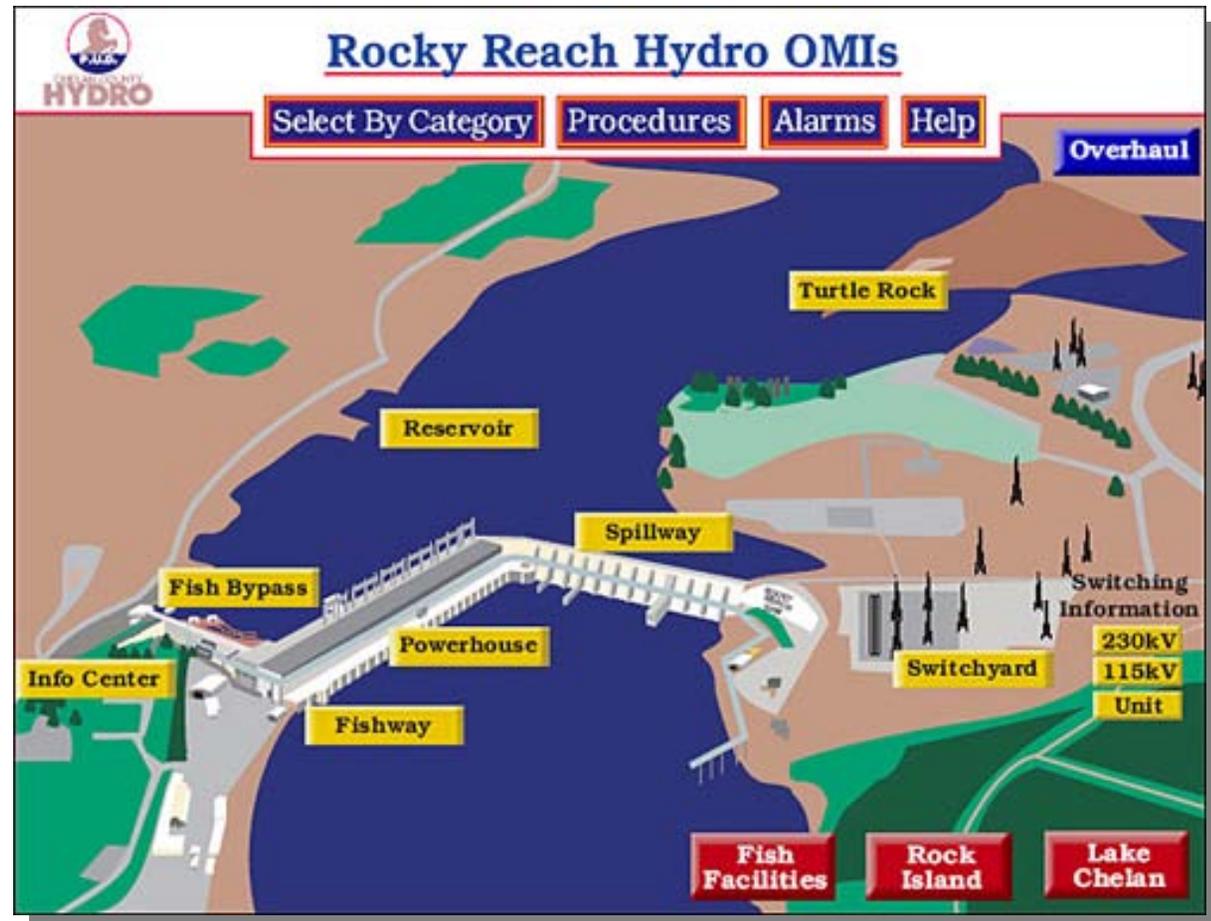


# How to Retain Critical Knowledge

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*Operational and  
Maintenance  
Instructions*

*Web-based*

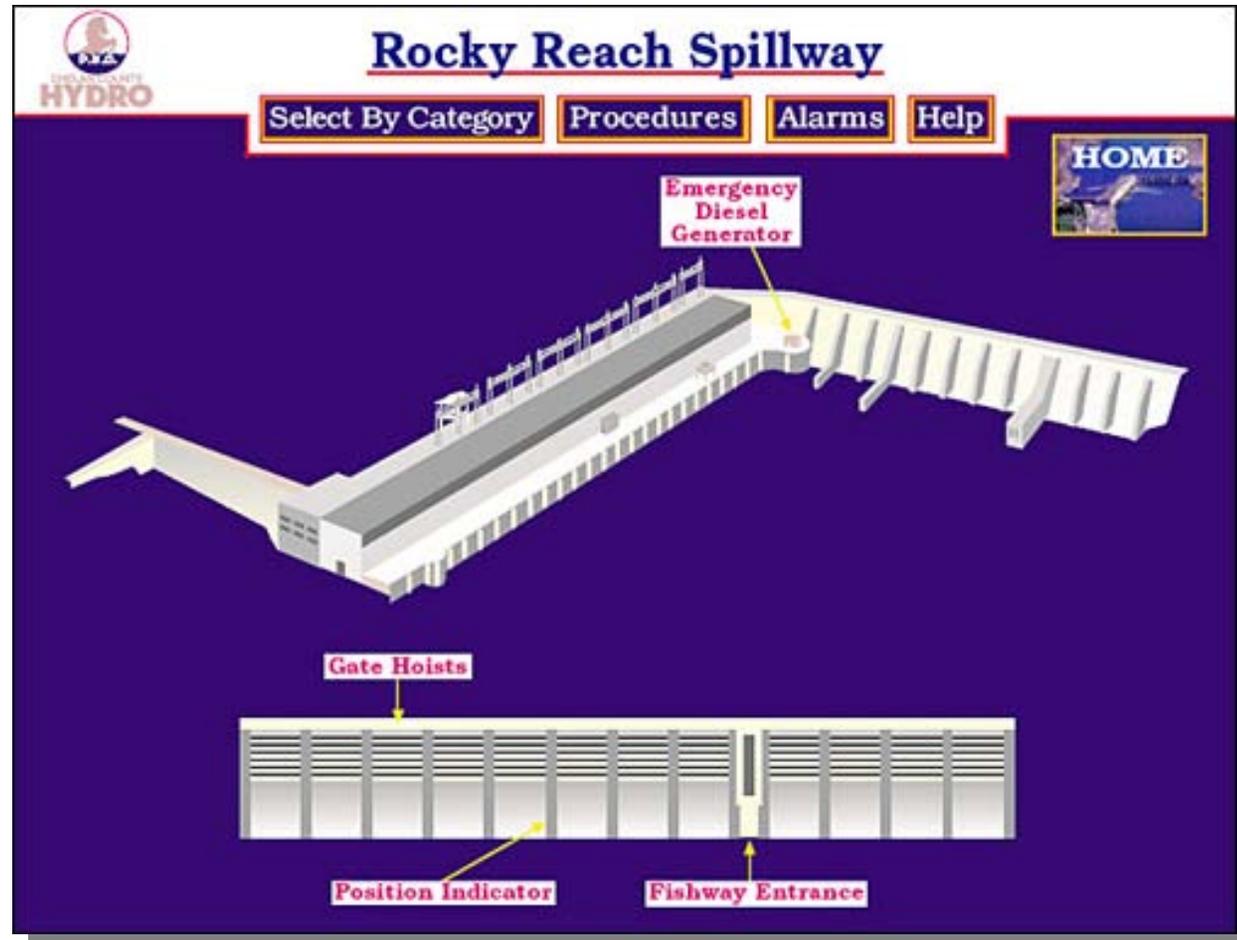


# How to Retain Critical Knowledge

Bill Christman, P.E. — Chelan County PUD

*Operational and  
Maintenance  
Instructions*

*Web-based*



# How to Retain Critical Knowledge

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*Operational and  
Maintenance  
Instructions*

*Web-based*

Components - Gates and Hoists		<a href="#">Home</a>
		<a href="#">Help</a>
		<a href="#">Overview</a>
		<a href="#">Components</a>
		<a href="#">Dissection</a>
		<a href="#">Alarms</a>
		<a href="#">Maintenance</a>
		<a href="#">Reference</a>
		
		<a href="#">ROCKY REACH</a>
		<a href="#">CO2 02</a>
		<a href="#">Gates and Hoists</a>
		<a href="#">July 15th, 1999</a>
		<a href="#">Screen 3 of 8</a>
		<a href="#">ALARMS</a>
		<a href="#">SOPs</a>
		<a href="#">See Also:</a>

Components - Gates and Hoists	
<b>Main Unit Components</b>	<p>The 12 spillway gates are a radial type with curved upstream skin plates attached to a structural steel frame and is operated by an individual fixed gate hoist mounted directly above the gate on steel framing which spans between the spillway piers. Guide rollers attached to the sides of each gate operate on curved steel bearing plates embedded in the concrete piers and serve to keep the gate centered in the spillway opening.</p>
<b>Note:</b> This material was extracted from the plant manual. Some of the data may be out of date. An OMI for this subject will be developed later.	<p>Each radial gate is supported by two gate arms located at the outer extremities of the gate and extending in a downstream direction normal to the plane of the gate. Each gate arm terminates in a Lubrite bushed trunnion which delivers the water load to a large welded steel trunnion girder supported on the downstream face of the adjacent spillway pier and anchored by 12, 6" diam. steel bars, on each side, extending into the concrete about 41 ft. to an anchor frame.</p> <p>Rubber J-seals are provided at the bottom and sides of each gate to minimize leakage past the gate when in the closed position. The side seals bear against corrosion resistant curved steel plates embedded in the vertical faces of the concrete piers. The bottom seal bears against a steel sill beam at el. 649.56'. The rubber seals are in one continuous length and held securely in position by bolted steel clamp bars.</p> <p>Two gate lifting brackets are provided at the lower sides of the upstream face of each radial gate and eight 1 1/4 in. diam wire rope hoist cables are attached to each bracket, using wire rope bridge anchors.</p>
<a href="#">Continued on next screen</a>	

# How to Retain Critical Knowledge

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## *Standard Operating Procedures*

The screenshot shows a web browser window displaying a document titled "Tainter Gate Cable Tensioning". The browser's address bar shows "Local intranet". The document is structured as follows:

- Contents:** A sidebar menu on the left lists various procedures, with "Tainter Gate Cable Tensioning" highlighted.
- Title:** "Tainter Gate Cable Tensioning"
- Metadata:** "SOP/RR/Maintenance", "Creation Date:", "Revision Date:", and "Approved by:".
- Description:** A paragraph explaining the process: "The cable tensioning is a process which is performed after the gate is approximately level and lifting in square relevant to the pier. At this point it is a good idea to raise then lower the gate to its highest point to straighten the cables on the lays before continuing."
- Tools:** A section titled "The tools required to perform this job are:" followed by a bulleted list:
  - hydraulic tensioning indicator
  - 18" pipe wrench
  - 2-5/16" deep and standard socket (socket should be in the toolbox)
  - 2-5/16" combination wrench
  - 3/4" or 1" drive ratchet
- Procedure:** A paragraph detailing the steps: "To begin the process, determine the repeatable distance of raise for each set of reads. This can be done by taking a physical measurement or by time of lift and set down. Take one set of reads, (a total of 16 cables), to use as a base line and continue to utilize the same distance of raise and hydraulic pressure (#1200 - #1500 PSI) until all adjustments are complete. After the baseline, find the average and determine the high and low value of +/- %5 of the average. The adjustment of individual cables can be done by tightening or loosening each cable after setting the gate down and allowing the cables to go slack. Repeat this procedure until all measurements are within the +/- %5. This +/- %5 applies to the comparison of individual cables on each side and the comparison side to side"
- Conclusion:** A final paragraph: "Cable tensioning can be done with as few as 2 people but preferably 4 people, this makes the job go faster and more accurate. Care must be taken to watch all corners of the gate for racking and gouging and any problem must be taken care of promptly. If problems do occur then it is preferred that a new baseline be established and the process start over."

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## *Job Plan Work Notes Database*

1410005  
2:39:38PM

### Job Plan Information

Job Number: 2017

Description: CHHD - HEADWORKS ANNUAL/INTER-GATE - INSPECT/LUBE

Page 1  
of 4

Route To:

#### Job Steps

Description	Duration
<b>00 JOB BRIEFING</b> WAC 296-45-135 Job briefing.  The employer shall ensure that the leadworker conducts a job briefing with the employees involved before they start each job. The briefing shall cover at least the following subjects: Hazards associated with the job, work procedures involved, special precautions, energy source controls, and personal protective equipment requirements.	0.00
<b>20 GATHER TOOLS AND MATERIALS</b>	0.00
<b>40 INSPECT THE WIRE ROPE ON SPILL GATE 7 AND LUBRICATE, IF NEEDED</b>	0.00
140330 - LUBRICANT, CHAIN & CABLE, 13 OZ., AEROSOL, X-433	
<b>50 INSPECT THE HOIST CHAINS AND DOCUMENT</b>	0.00
1. Carefully inspect each of the chains on a link by link basis, making note of the areas and the magnitude of the most serious loss of material. If the condition of the paint is such that it would warrant re-coating then address as necessary.  Chain replacement criteria has been established by Bill Christman and will be supplied.  2. Assure that the chains do not have any unnecessary rotation in the length of the chain. This will assure equal tension is shared by both chains when hoisting a gate.	
<b>60 INSPECT THE CONDITION OF THE GATE SIDE SEALS AND BOTTOM SEALS</b>	0.00
Look for splits, cracks, abrasions or missing seal material and document gate number, location and dimensions.	
<b>70 INSPECT THE CONDITION OF THE SPILL GATE SILL PLATES</b>	0.00
Make note of any abnormalities such as erosion, abrasions, marking or pitting. Document gate number, location and	

# How to Retain Critical Knowledge

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## *Summary*

- Commit leadership and resources to the initiative
- Devise a plan
- Obtain the tools
- Obtain workforce commitment
- Prioritize
- Get started



# How to Retain Critical Knowledge

Bill Christman, P.E. — Chelan County PUD

## *Questions?*

If you want to know more, contact me:

Bill Christman

Chelan County PUD

509-661-4283

[billc@chelanpud.org](mailto:billc@chelanpud.org)



# Session 8

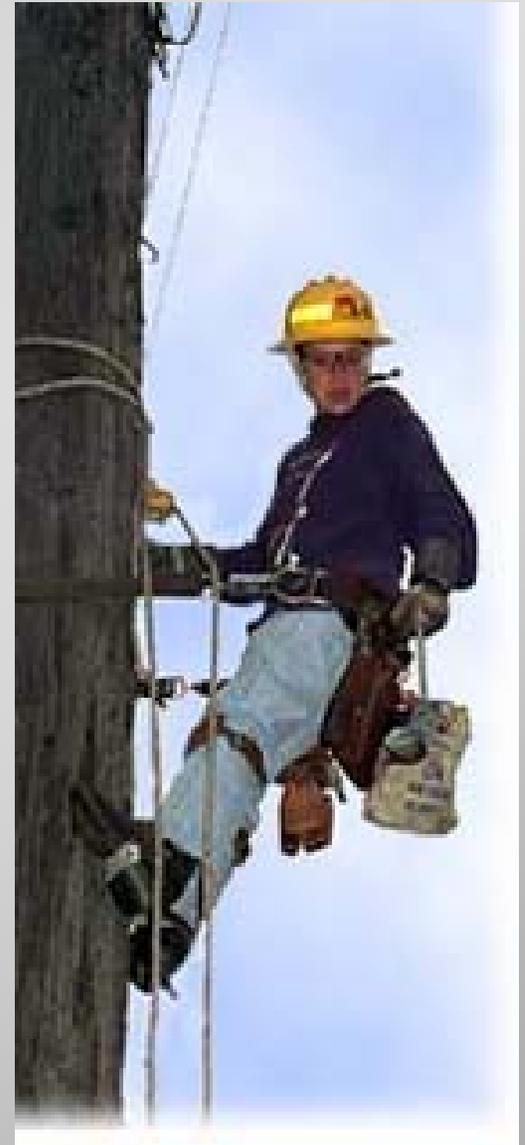
## Operating Plans and Institutional Knowledge

Unifying Dam Safety and Security  
FERC Dam Safety 2005



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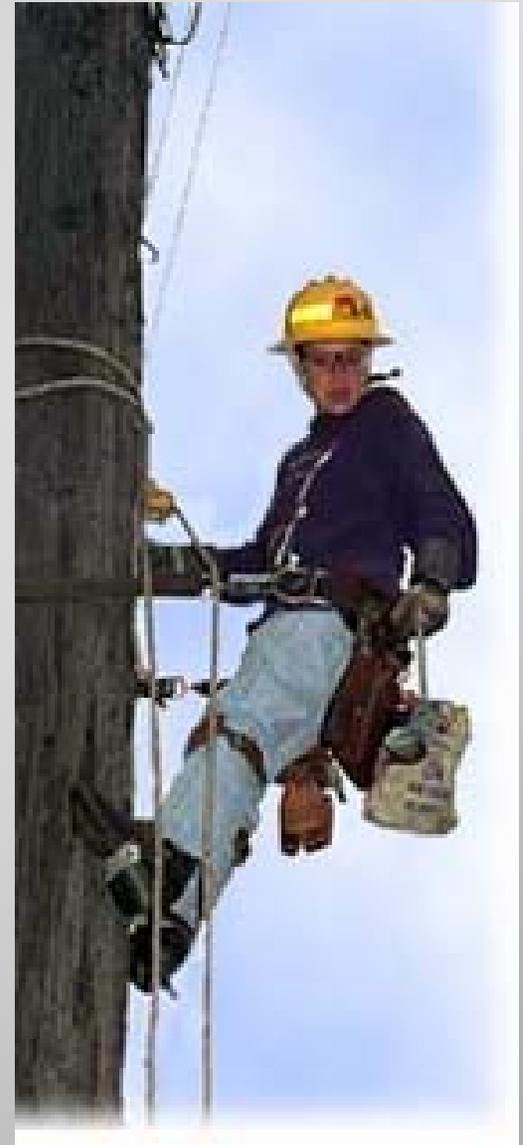
# Apprenticeships



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# Apprenticeships

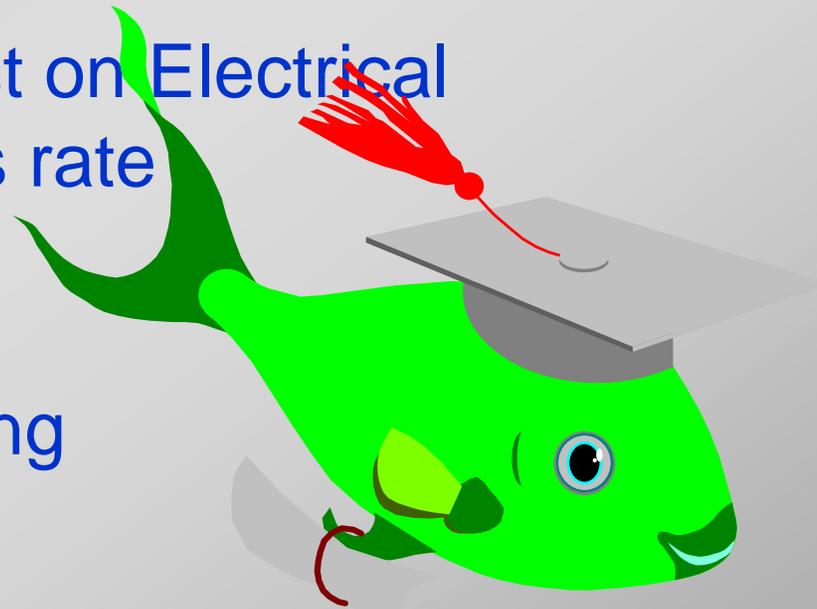
- ◆ The program (over 50 years old) has been in a leadership role for a long time
- ◆ Covers 6 skilled trades, including hydro machinists and electrical constructors
- ◆ Graduates of the program are certified journey workers by Washington State



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# Hydro Operator Recruitment

- ◆ Screen for two year degree in electric vocational trades, or one year hydro operator experience
- ◆ Administer written test on Electrical Knowledge 20% pass rate
- ◆ Interview from Pool
- ◆ 2 part - 2 year Training



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# Hydro Operator Training

- ◆ New operators have two years to complete a 36 unit Hydro Operator Training Course (from Los Angeles Water and Power, Tacoma Power uses the same course. Tacoma requires completion in 1-1/2 years and provides instruction.)
- ◆ Plant familiarization by senior operator - walks through various tasks and manuals
- ◆ Chief Operator conducts checks and evaluations - to documented bench marks



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# Hydro Operator Training

- ◆ Dam safety awareness and inspection component could be strengthened by including documented benchmarks in the formal training program
- ◆ Currently, self taught TADS modules are available for operators, and they are encouraged to pursue this during annual training by Dam Safety Engineer



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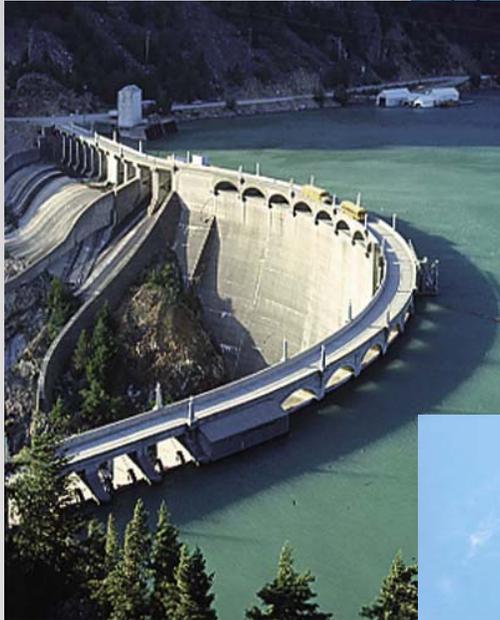
- ◆ **Serve Population of 750,000**
- ◆ **Our Mission is to provide low cost, environmentally sound electricity for the benefit of the citizens of Seattle**
- ◆ **Historic investment in hydroelectric generation has made this possible. Seattle owns 10 Hydro Dams -1870 MW**



**Seattle City Light**

# Our Lines of Business

◆ *Power delivery*



◆ *Power Supply*



◆ *Corporate Services*



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# Improving our Dam Safety Program

- ◆ Best Practices Review - To improve dam safety programs and to elevate the level of dam safety practice.
- ◆ ASDSO Peer Review Team evaluates our Dam Safety Program mission, objectives, policies and procedures.
- ◆ And our compliance with those procedures, and compares them to industry standards.



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# ASDSO Peer Reviewers

- ◆ **William B. Bingham, P.I. Gannett Fleming**
- ◆ **Tomas A. Kelly, P.E. Southern California Edison (Retired)**
- ◆ **George E. Mills, Ohio Department of Natural Resources, Dam Safety Administrator (Retired)**



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# ASDSO PEER REVIEW

- ◆ Panel of 3 reviewed Seattle Light and Water Departments dam safety programs
- ◆ recommendations included need for basic dam/ dam safety training at the sites, TADS may not be enough, unless facilitated, and
- ◆ Develop an internal program to raise the awareness of the importance of the dams and the dam safety program to the City, including senior management



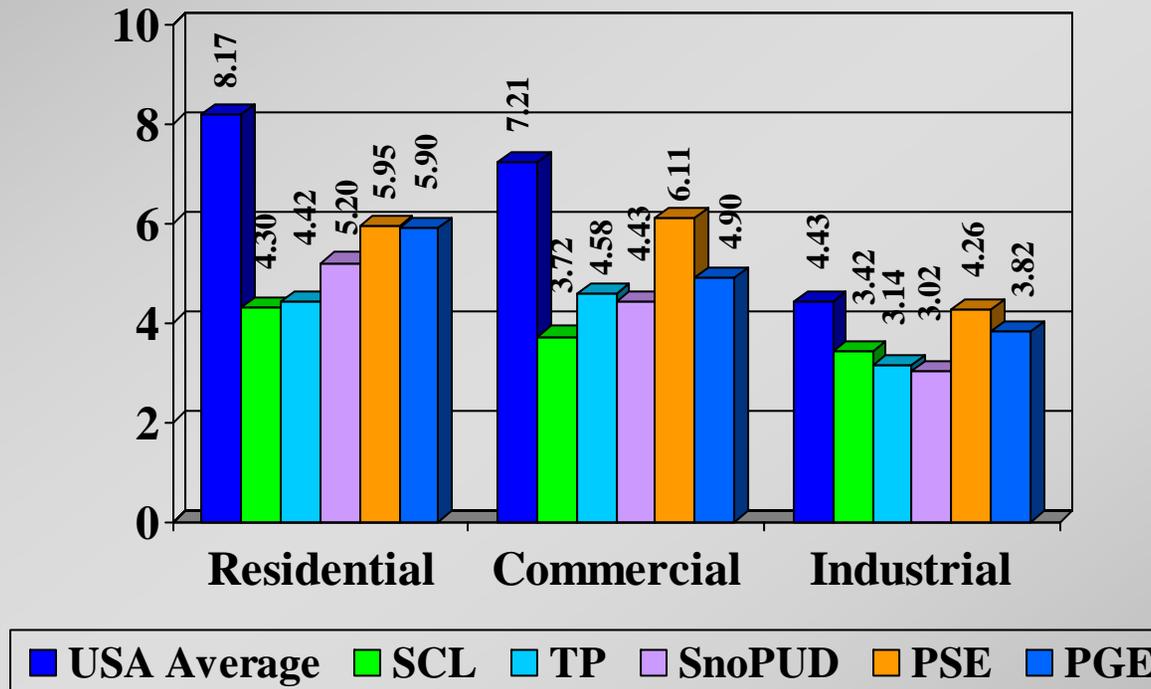
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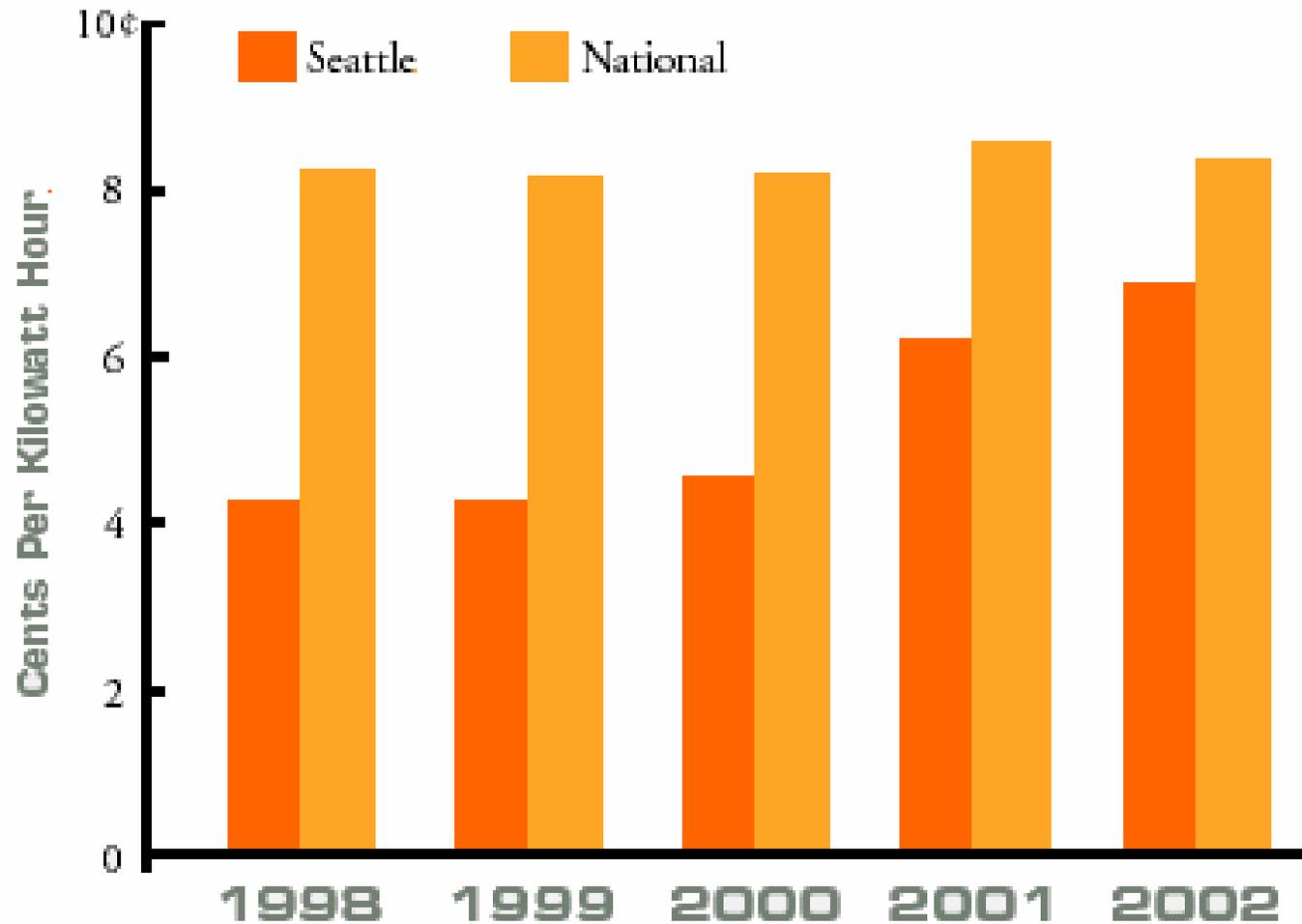
# Preserve our price and cost advantages

## Comparison with Neighboring Utilities, 1999



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## Average Residential Rates



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# Protect the Environment

## Salmon in the Skagit Before and After Flow Plan

- ◆ Through the 1970's, the Skagit Project was run with one goal: supply electricity in the cheapest, most efficient way
- ◆ Accumulating fisheries research led SCL in 1981 to regulate river flows around the needs of Skagit River salmon



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# Business Risk of Dam Ownership

Annualized cost of risk before and after Dam Safety ...

- ◆ Consequences of a major dam failure can wipe out even a large company
- ◆ How are the annualized costs of dam safety risk reduced by monitoring, training, surveillance, O&M manuals?



*Boundary Dam*

*photo courtesy of the City of Seattle,*

[City Light Department \(#\)](#)

(click for a full sized photo)



[http://simscience.org/cracks/advanced/arch\\_char1.html](http://simscience.org/cracks/advanced/arch_char1.html)



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# Washington State Requirements

Dam owners are required to develop and maintain an Operation and Maintenance Manual:

- ◆ **Describes procedures for normal and extreme project operation**
- ◆ **Procedures for monitoring, inspection and long-term maintenance**
- ◆ **Detailed requirements, outline and example in Pub. 92-21 (revised 1995, Guidelines for Developing Dam Operation and Maintenance Manuals)**



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# Washington State Requirements

An O&M Manual should at a minimum contain the following chapters:

- ◆ **SECTION 1 - GENERAL INFORMATION** includes purpose of the manual and general project description and data sheet
- ◆ **SECTION 2 - PROJECT OPERATION** provides details for reservoir and dam equipment operation
- ◆ **SECTION 3 - MAINTENANCE** provides detailed information on periodic maintenance and upkeep



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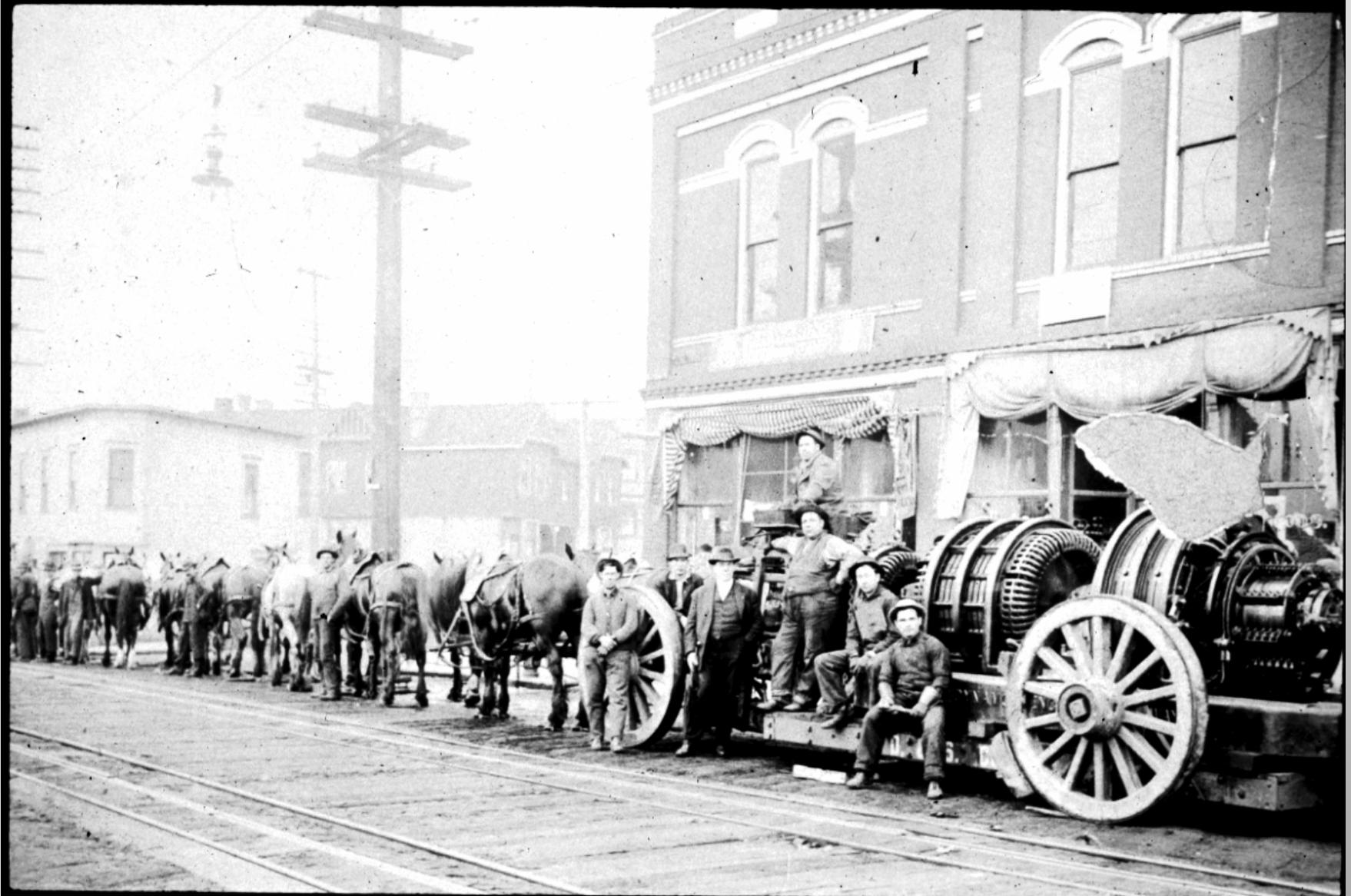
# Washington State Requirements

An O&M Manual should at a minimum contain the following chapters (continued):

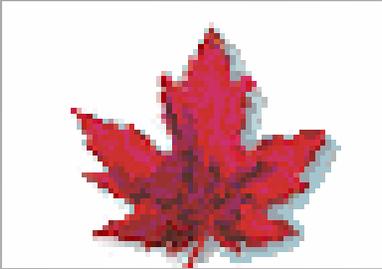
- ◆ **SECTION 4 - INSPECTION** provides procedures and checklists for performing regular periodic inspections
- ◆ **SECTION 5 - INSTRUMENTATION AND MONITORING** summarizes instruments installed and program
- ◆ **SECTION 6 - UPDATING** provides for periodic updating and controlling contents
- ◆ <http://www.ecy.wa.gov/programs/wr/dams/dss.html>



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# CDA Dam Safety Guidelines...

**Requirement: Dam operation, maintenance and surveillance shall be provided so that an acceptable level of dam safety is ensured.**



**A manual (the “OMS Manual”) shall be prepared, documenting operation, maintenance and surveillance for each applicable dam.**

**Includes specific requirements and outline in Sections 3.1 through 3.4.**

<http://www.cda.ca/index.htm>



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# CDA Dam Safety Guidelines...



## 3.4.2 Regular Inspections

**Requirement: Periodic Inspections shall be performed. Instructions and procedures should include:**

- Checklists, frequency, responsibility, reporting , qualifications of inspectors...
- Grant County Public Utility District has a Civil/Structural Inspection and Surveillance Program Manual for its PEC Hydro Project. Dave Moore of GCPUD No. 2 is here.



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# Coordination and Cooperation

- ◆ **Communication across utility**
- ◆ **eliminate silo effects**
- ◆ **become a high powered organization**



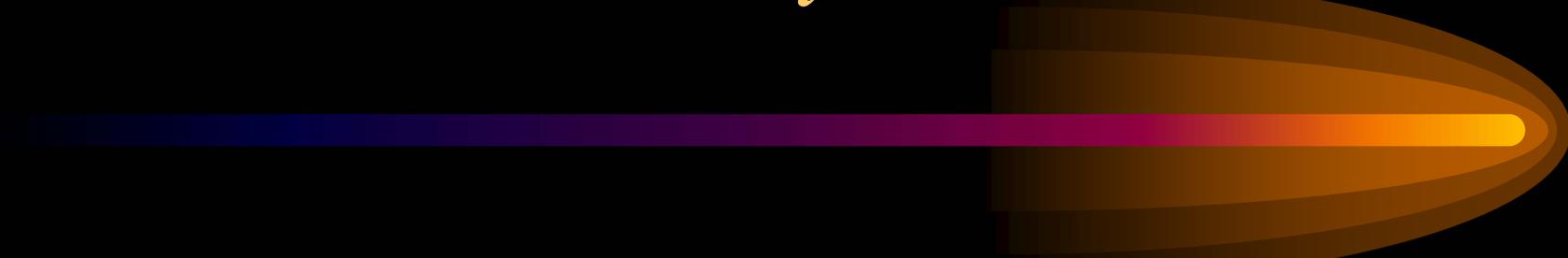
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# *AEP Hydro Generation*

A decorative graphic consisting of a horizontal line with a gradient from dark purple to bright yellow, ending in a large, stylized, teardrop-shaped arrowhead pointing to the right. The arrowhead has a brown-to-gold gradient and a soft shadow effect.

Plan For Workforce Development:  
Knowledge Transfer

# *AEP Has A Generating Capacity of 36,000 MWs*



- 65% Coal
- 25% Gas
- 7% Nuclear
- 3% Hydro/Wind



Name of Plant	Type of Plant	Plant Location
1. Berrien Springs	Hydro	Michigan
2. Buchanan	Hydro	Michigan
3. Buck	Hydro	Virginia
4. Byllesby	Hydro	Virginia
5. Claytor	Hydro	Virginia
6. Constantine	Hydro	Michigan
7. Elkhart	Hydro	Indiana
8. Leesville	Hydro	Virginia
9. London	Hydro	West Virginia
10. Marmet	Hydro	West Virginia
11. Mottville	Hydro	Michigan
12. Niagara	Hydro	Virginia
13. Racine	Hydro	Ohio
14. Reusens	Hydro	Virginia
15. Smith Mountain	Pumped Storage	Virginia
16. Twin Branch	Hydro	Indiana
17. Winfield	Hydro	West Virginia

# *Changing of the Guard*

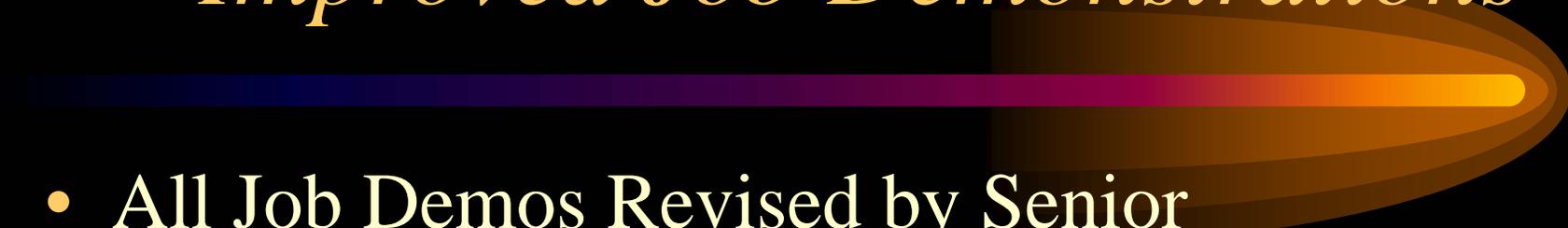


How Do We Capture & Preserve the  
Knowledge of Our Experienced  
Employees?

# *Improve Hiring Standards*

- Two-Year College Degree Requirement
- \*Pass the MASS and POSS tests
- Pass Hydro Knowledge Assessment Test
  
- \*Edison Electric Institute (EEI) selection system for screening candidates

# *Improved Job Demonstrations*



- All Job Demos Revised by Senior Mechanics (Subject Matter Experts (SME))
- Revised Job Demos Validated by SMEs to Match New Job Descriptions

# *Initiate Knowledge Assessments*



- Operations: L&K International
- Maintenance: Technical Manuals
- Ultimate Goal: Provide Objective Data For Promoting Candidates and Hiring New Employees

# *Initiate Written Procedures*



- Use Process Mapping to Create Applicable Flow Charts
- Option Exists to Convert Flow Charts to Written Text



<b>Hydro Operations Position</b>	New Hire	Job Demonstration		Six Month	Knowledge Assessments	Promotion Evaluation
	Orientation	Instruction	Evaluation	Probationary Review		

Notes: The probationary review is not subject to demo completion.

