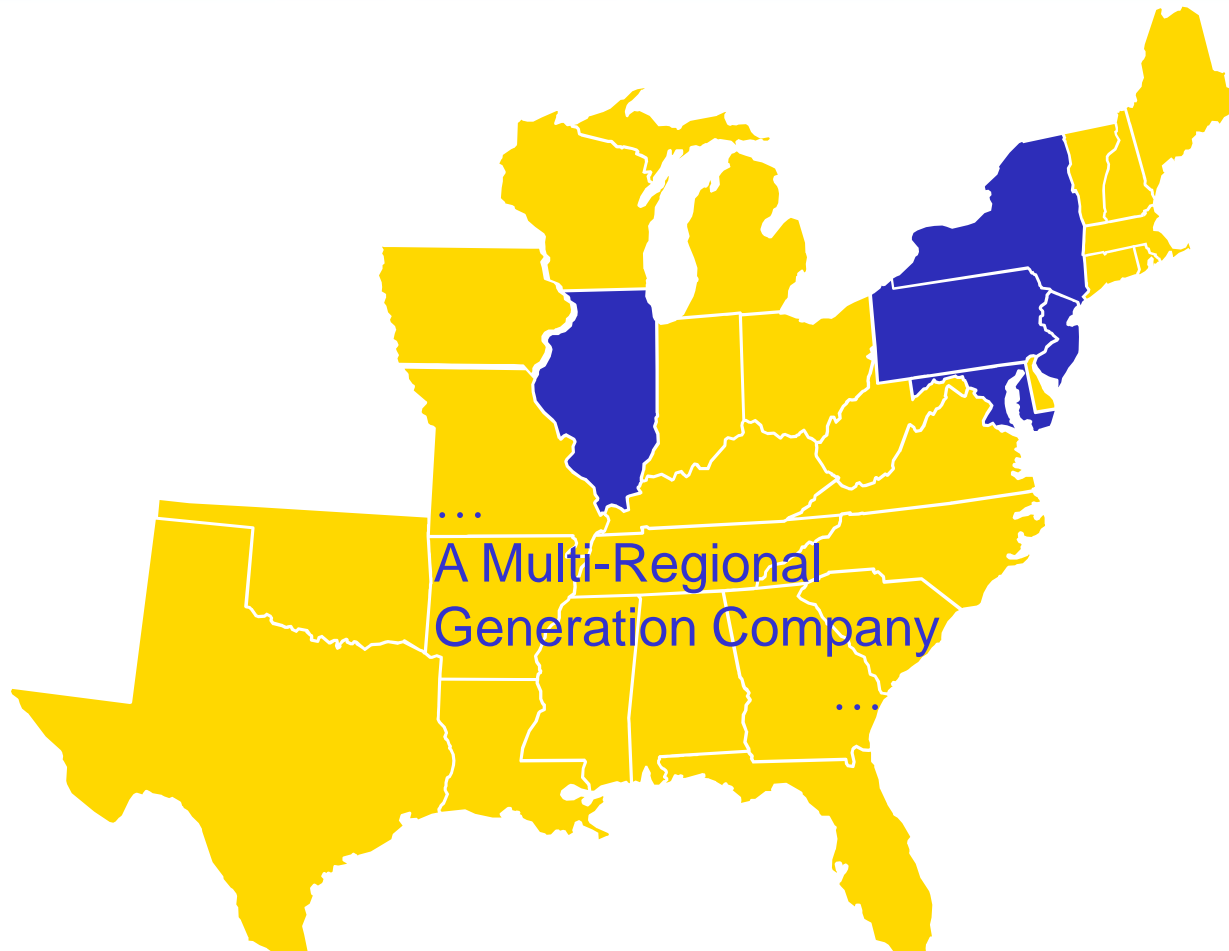




The Role of Oversight in Power Uprate Projects for Nuclear Power Plants

**ASQ Meeting
November 2013**

David Peiffer
Lead Nuclear Oversight
Power Uprate Projects



22 nuclear units in 5 states
The largest nuclear fleet in the USA
3rd largest nuclear fleet worldwide

The process of increasing the maximum power level at which a commercial nuclear power plant may operate is called a power uprate.

NRC regulates licensing of the maximum power level at which a commercial nuclear power plant may operate. This power level is used, with other data, in many of the licensing analyses that demonstrate the safety of the plant.

NRC controls any change to a license, and the licensee may only change after NRC approves the licensee's application.

- ✓ Measurement Uncertainty Recapture
- ✓ Stretch
- ✓ Extended

From 1978 through 2013
The NRC approved 148 uprates
Total Mwe 6862

Less than 2 percent increase is achieved by implementing enhanced techniques for calculating reactor power.

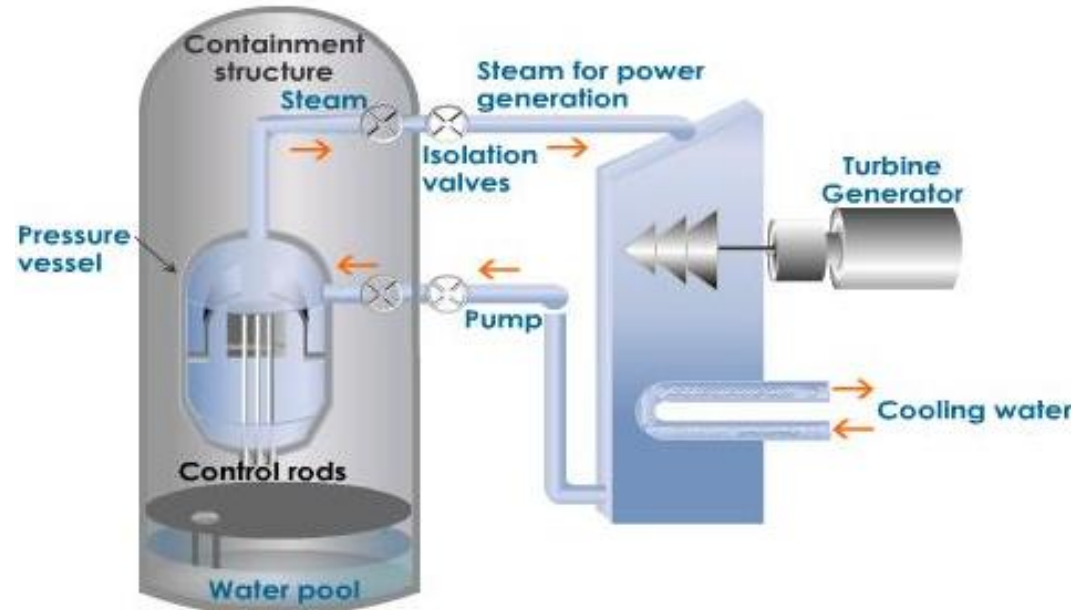
More precise measurements reduce the degree of uncertainty in the power level.

$$Q = (h_{steam} - h_{feed})W_{feed}$$

$$Q = \text{Reactor Power}$$

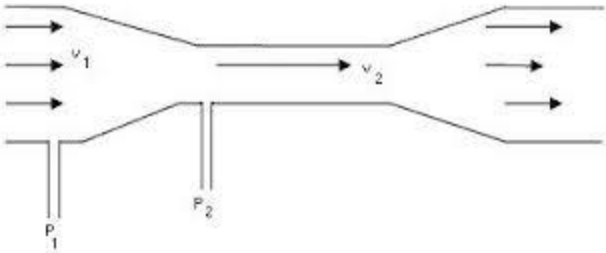
$h = \text{enthalpy (BTU/lb)}$

$W = \text{flow rate (lb/hr)}$

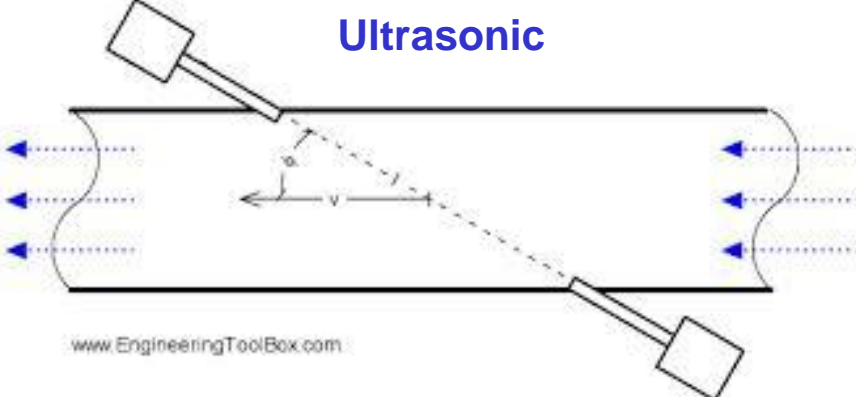


**Improved accuracy of flow measurement
lowers uncertainty by 1 -2 %**

Venturi

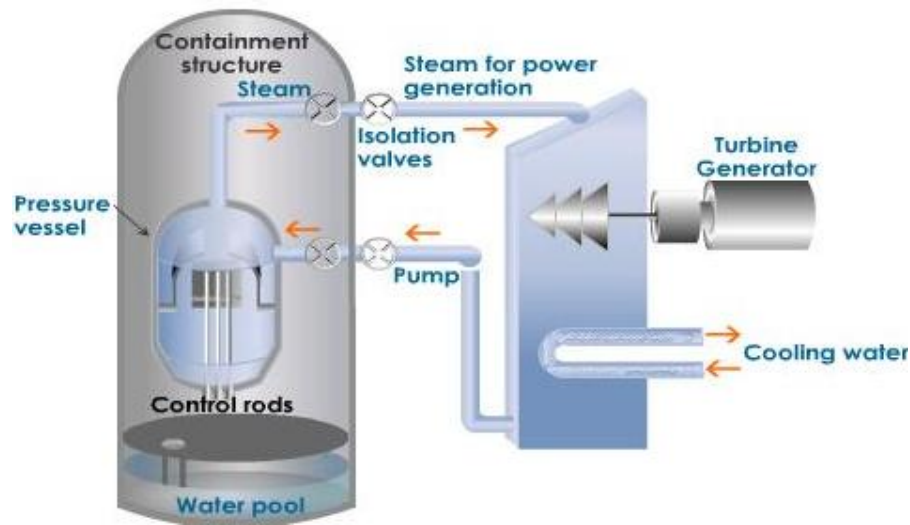


Ultrasonic



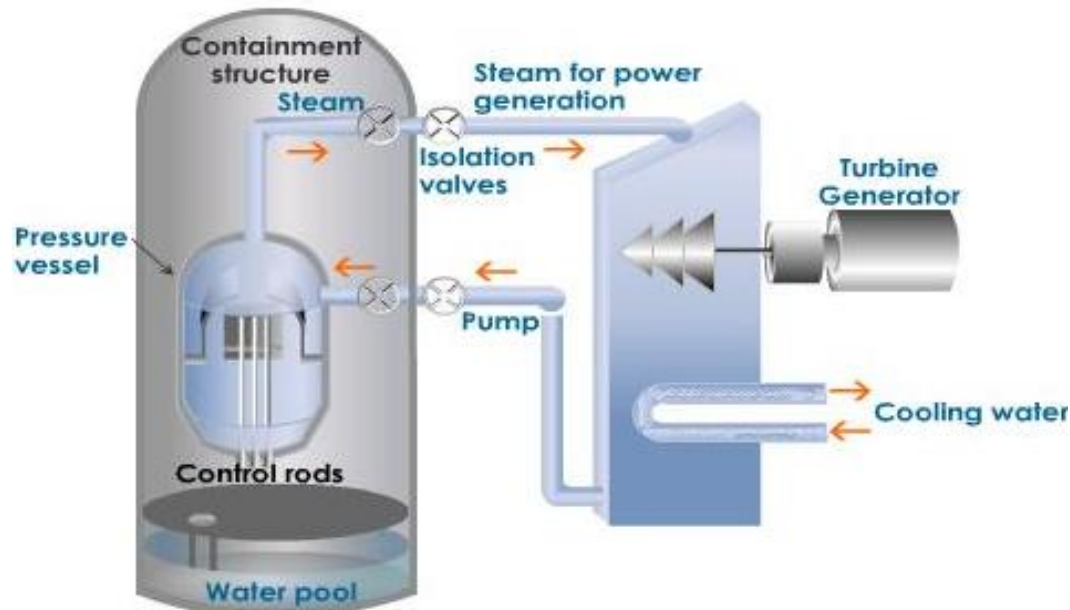
Typically up to 7 percent and are within the design capacity of the plant depending on the operating margins included in the design of each particular plant.

Stretch power uprates usually involve changes to instrumentation setpoints but do not involve major plant modifications.



Increases as high as 20 percent.

These upgrades require significant modifications to major balance-of-plant equipment such as the turbines, pumps and motors, main generators, and/or transformers.



- I. Organization
- II. Quality Assurance Program
- III. Design Control
- IV. Procurement Document Control
- VI. Document Control
- VII. Control of Purchased Material, Equipment, and Services
- VIII. Identification and Control of Materials, Parts, and Components
- IX. Control of Special Processes
- X. Inspection
- XI. Test Control
- XII. Control of Measuring and Test Equipment
- XIII. Handling, Storage and Shipping
- XIV. Inspection, Test, and Operating Status
- XV. Nonconforming Materials, Parts, or Components
- XVI. Corrective Action
- XVII. Quality Assurance Records
- XVIII. Audits

- ✓ **General Electric Power Systems** – main generator rewinds for 11 units
- ✓ **Alstom** – low pressure turbine retrofits for 6 units
- ✓ **Cameron** – Ultrasonic flow measurement devices for 12 units
- ✓ **Welding Services Inc.** – Ultrasonic flow measurement installation for 7 units
- ✓ **Westinghouse** – strain gauges for 6 units
- ✓ **Shaw** – installation services at all units
- ✓ **GE–Hitachi Nuclear** – MUR analysis for 4 units
- ✓ **Westinghouse Electric** – MUR analysis for 4 units
- ✓ **Sargent & Lundy, LLC** – engineering for 10 units
- ✓ **URS/Washington Group** – design changes for 7 units
- ✓ **Energy Solutions, LLC** – disposal services for 6 units
- ✓ **Delta-Unibus** – Electrical bus duct engineering, fabrication and installation for 4 units

Oversight and Surveillance in
countries of supply or manufacturing

USA

Japan

Germany

Poland

France

England

Switzerland

Mexico

Italy

Brazil

Austria

India

Canada

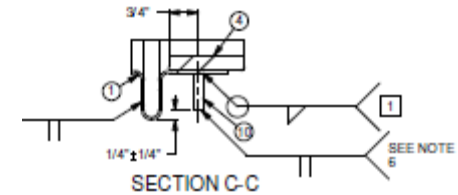
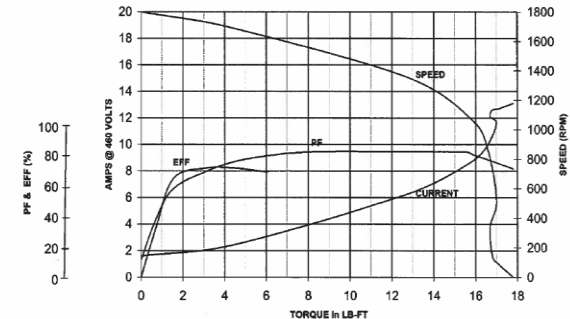
China

- ✓ Clearly define quality, technical and inspection requirements in contract documents
- ✓ Establish Nuclear Oversight as the lead organization for inspections
- ✓ Utilize detailed plans tied to design and fabrication schedules
- ✓ Scale up level of inspection when problems occur
- ✓ Incorporate lessons learned over duration of project
- ✓ Anticipate problems

- ✓ The owner must specify requirements and expectations.
 - Contracts must contain technical requirements and materials and services agreements with suppliers.
 - Audits of suppliers and sub-suppliers – Approved Supplier Lists

- ✓ As the owner, we must approve the design and manufacturing processes.
 - Design documents and procedures require critical & timely reviews.
 - Suppliers require more than expected oversight in their shops to ensure quality.

- ✓ Compare actual manufacturing practices to industry standards that are specified to ensure quality.
(ASME, ASTM, IEEE, NEI, Etc.)

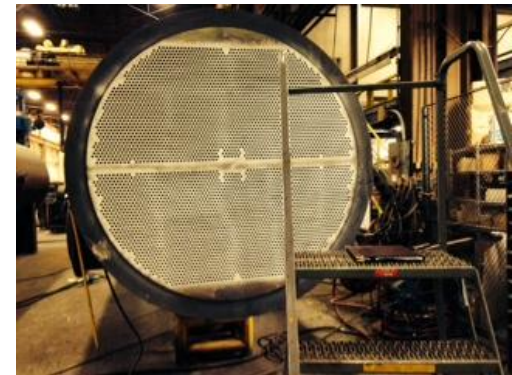
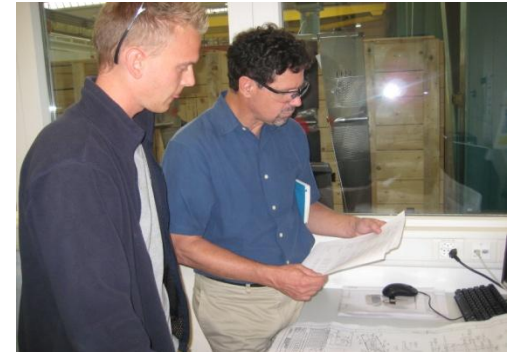


✓ Inspector qualifications

- Engineering degree in the discipline
- ASNT SNT-TC-1A for non-destructive testing of materials

✓ Ensure clear expectations for reporting quality problems and that all non-conformances are reported to the owner for review.

✓ Foreign material removal is difficult after the parts are assembled. Ensure that manufacturers keep the materials clean during in-process and final manufacturing processes.



- ✓ Find quality issues as early as possible. Extensive supply chains require inspection of upstream suppliers.
- ✓ Establish methods for validating machine tool setup – machining errors have caused significant re-work and schedule delays in some projects.
- ✓ Handling and Transportation – Potential for Physical Damage



- ✓ Validating dimensions
 - Quality and accuracy of measuring and test equipment.

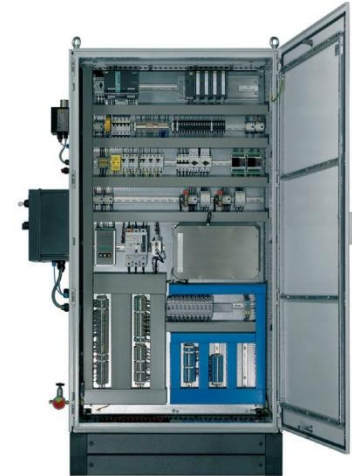
- ✓ Validating test performance meets the design criteria –
 - testing must be performed consistently in conformance to the specified standards.

- ✓ Labeling
 - Identification, Control, & Traceability of materials and parts must be precise. Loss of parts identity resulted in questionable quality, rework, and schedule delays



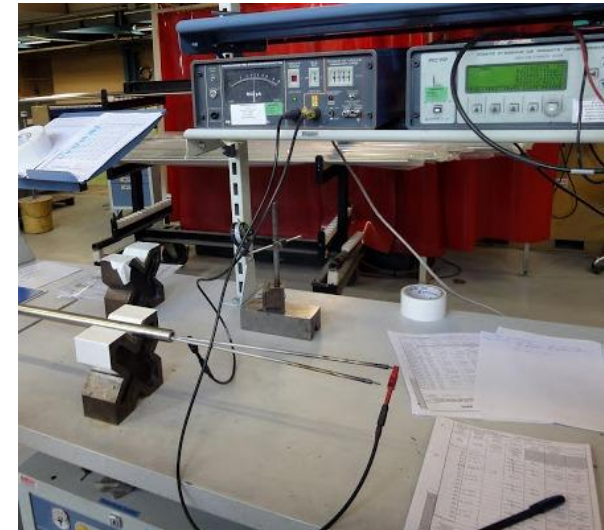
✓ Digital equipment upgrades require special considerations

- Digital Technology Software Quality Assurance
- Cyber Security



✓ Measuring and Test Equipment Calibration

- Laboratory Test Equipment (Material Composition, Electrical Properties, Strength Properties)
- Field Measuring Equipment (Ultrasonic Test Instrumentation, Electrical Properties, Dimensional, etc.)



- ✓ Ease of Installation – achieve the planned installation schedule
- ✓ Startup Without Performance Issues
- ✓ Operate With Consistent Reliability
- ✓ Greater Than 93 Percent Capacity Factor