Uprating Programs

Background

Nuclear power plant upratings are a timely and cost-effective way to provide incremental electric generation. Westinghouse has successfully implemented more than 114 plant upratings, providing more than 4,300 MWe of additional power generation.

Westinghouse currently offers three types of uprating programs:

1. Measurement uncertainty recapture (MUR) power uprate: $1\% \leq X \leq 2\%$
   - *Taking advantage of improved power measurements to lower the power calorimetric uncertainty.*
2. Stretch power uprate (SPU): $2\% \leq X \leq 7\%$
   - *Raising power to within the design capacity of the plant.*
3. Extended power uprate (EPU): $X > 7\%$
   - *May require significant modifications to major balance-of-plant (BOP) equipment (e.g., high-pressure turbines, condensate pumps and motors, main generators and/or transformers).*

Description

The scope of work in an uprating program generally covers five major areas: uprate decision process, project development and management, engineering analysis, regulatory approval and licensing, and implementation. Westinghouse has the experience and capability to provide support in each of these areas.

Westinghouse will work with a utility to develop the strategy and process required to make important uprate decisions.

Westinghouse recommends a three-phase process for power uprates, one that has resulted in a high success rate for achieving upratings at plants throughout the world.

This process is summarized next, with each phase structured to develop specific information that will support decision-making and outline the basis for the uprate project. However, there is considerable flexibility in the way an uprating is conducted; the program structure can be readily modified to accommodate an individual plant's needs. Systematic work planning optimizes the uprating and also allows for integration with other asset management programs at a utility, such as equipment efficiency upgrades, license renewal and life extension, and fuel cycle management. Westinghouse has the experience to maximize the integration of an uprate into the strategy and long-term planning of a utility, and can assist in utility-specific, cost-benefit analyses. (See illustration on page 2.)

The first phase involves establishing the overall program strategy. For this phase, Westinghouse generally recommends an expert panel review in which the utility, Westinghouse, the turbine vendor and the BOP designer meet. The purpose is to identify target power levels as well as potential barriers and limits to achieving these power levels. During this phase, solution paths and rough estimates of costs associated with removing these barriers are determined.

Following the expert panel review, a utility can elect to proceed with the work required to support uprating implementation or, as phase two, a more detailed feasibility study can be performed. This study uses the output of the expert panel review to examine in more detail those limiting accident analyses, systems and components, with the goal of demonstrating that continued safe and reliable operation is feasible at uprated conditions. Uprated operating conditions – e.g., reactor coolant system (RCS) average temperature, power level, RCS flow and steam pressure – are defined and used as a basis for the feasibility analysis. Scoping calculations and sensitivity studies are developed, with the help of existing analyses and experience gained from plants operating under similar conditions.

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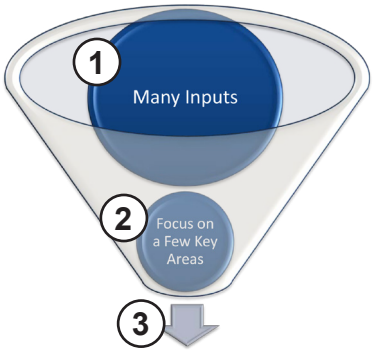
1. Joint Expert Panel
   - Determine recommended target uprated power level; identify limiting plant features and regulatory approval issues; provide preliminary schedule and budgetary estimates
2. Feasibility Study
   - Using expert panel results, perform "scoping" calculations to better identify and understand selected pinch points
   - Recommend margin usage and trade-offs, fuel design, operating parameters and regulatory approach
   - Refine work scope and cost required to implement uprate
3. Technical Work Scope and Implementation
   - Perform uprate program and obtain regulatory approval to operate at uprated thermal power



This three-phase uprating process follows the concepts identified in NEI-08-10 and has resulted in a high success rate for achieving upratings at plants throughout the world

Westinghouse's three-phase process for uprates

If necessary, plant-specific analyses of the postulated accidents, systems and components can be performed as part of the feasibility study to confirm that safety and operational margins are maintained at uprated power conditions. These analyses and evaluations demonstrate the adequacy of the reactor core design, reactor control and protection systems set points, emergency core cooling system, and emergency feedwater system at uprated conditions. Analyses performed to support the uprating can use enhanced analytical techniques to provide added margin, identify necessary plant modifications and determine if any limitations need to be imposed.

In the third phase, implementation, the comprehensive analytical work is complete and documented for the plant systems, components and accident analyses using approved and tested methodologies. Other enhancements to plant operation, such as optimization of control system set points or revised fuel peaking factors, are incorporated into the analyses.

Westinghouse also provides licensing services for the uprating, which include drafting the Licensing Amendment Request in accordance with the guidance documents provided by the U.S. Nuclear Regulatory Commission, as well as all required updates to the Updated Final Safety Analysis Report, technical specifications, and other licensing and setpoint documents.

Westinghouse has extensive experience and a high success record in supporting utilities in the licensing process through responding to Requests for Additional Information and jointly attending meetings with the regulator.

Benefits

An increase in the nuclear steam supply system not only garners additional revenue from increased power generation, but it also updates the design and licensing basis of a plant in many areas by utilizing enhanced analytical methods and upgrading equipment.
An uprate can also provide cost savings and synergies with other asset management programs and can help fund future programs. An uprating provides a cost-effective opportunity to assess and use design and analysis margins in a beneficial way.

Experience

- MURs completed
  - 34 American pressurized water reactors (PWRs), five European PWRs and two Asian PWRs
- SPUs completed
  - 42 American PWRs, two European PWRs and four Asian PWRs
- EPUs completed
  - 13 American PWRs and 10 European PWRs

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