LOCA Safety Analysis Services

Background

A loss-of-coolant accident (LOCA) is an inadvertent loss of inventory from the primary side of the reactor coolant system (RCS).

Description

Westinghouse can perform analyses and evaluations covering the following LOCA-related areas:

1OCFR50, Appendix K Small-Break LOCA Analysis

Appendix K small-break LOCA (SBLOCA) analysis is the thermal-hydraulic analysis detailing breaks under 1 foot, 2 inches in length. Appendix K conforms to 10CFR50.46 acceptance criteria, which are based upon the limiting conditions and assumptions outlined in 10CFR50, Appendix K.Westinghouse is proficient in the use of the NOTRUMP evaluation model, which is approved for use on Westinghouse nuclear steam supply system (NSSS) designs. The model includes the NOTRUMP thermal-hydraulic code and the SBLOCA fuel rod heat-up code.Westinghouse is also proficient in the use of the Combustion Engineering (CE) Nuclear Power LLC SBLOCA evaluation model, which is approved for use on CE-NSSS designs. The SBLOCA comprises the CEFLASH-4AS thermal-hydraulic code and the STRIKIN-II and PARCH fuel rod codes.

Best-Estimate Large-Break LOCA Analysis

Following revised 10CFR50, Appendix K approval in 1998, best-estimate thermal-hydraulic methods have been used to calculate the response to a postulated LOCA. Through a cooperative with the EPRI (Electric Power Research Institute) Westinghouse developed,

Analysis Capabilities

Westinghouse is capable of modifying the GOTHIC software to perform analyses for special applications. For example, to perform the containment DBA analyses for the Westinghouse validated and obtained U.S. Nuclear Regulatory Commission (NRC) approval of the only existing bestestimate large-break LOCA (BELBLOCA) methodology, which is based upon the Westinghouse version of the COBRA/TRAC code – WCOBRA/TRAC. The methodology, which Westinghouse has perfected, is approved for use in performing BELBLOCA analyses for two-loop plenum injection (UPI), and three-loop and four-loop pressurized water reactors (PWRs). The benefit of using this methodology is that it not only aligns with the 10CFR50.46 acceptance criteria, but it also will improve plant economies and operational experience when implemented.

BESBLOCA Analysis

Westinghouse is currently completing the development and validation of models and correlations needed to extend the best-estimate WCOBRA/TRAC methodology to address SBLOCA processes. The code uncertainty, in regard to its ability to model small-break phenomena, is also being quantified. This extension of the best-estimate methodology to SBLOCA analysis is expected to generate a significant reduction in predicted peak clad temperature, which can be used to support increases in rated power or to relax operational restrictions.

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LOCA Long-term Cooling Analysis

LOCA analysis is performed to demonstrate conformance with the 10CFR50.46 acceptance criteria that a cites coolable geometry and long-term cooling must be maintained after a LOCA to enable adequate removal of decay heat. Westinghouse routinely performs three separate analyses for Westinghouse NSSS designs to confirm the following:

- Post-LOCA subcriticality analysis - Maintenance of core subcriticality after transfer to sump recirculation
- Boric acid precipitation control analysis - Switchover to hot-leg or simultaneous hot-leg and cold-leg recirculation prior to precipitation of boric acid in the core
- Decay heat removal analysis - Sufficient emergency core cooling system (ECCS) performance when the system is realigned for cold-leg recirculation and also for switchover to hot-leg or simultaneous hotleg and cold-leg recirculation

In addition,Westinghouse is proficient in the use of the long-term cooling evaluation model that is used for CE-NSSS designs, which demonstrates conformance to the long-term cooling acceptance criteria.

LOCA Hydraulic Forces Analysis

Such analysis generates LOCA hydraulic forces for use as input to structural qualification analyses performed to demonstrate compliance with 10CFR50, Appendix A, GDC-4.Westinghouse calculates reactor coolant system (RCS) thermal-hydraulic transient data by using the MULTIFLEX code, which, through application of either an NRC-approved beam model or an NRCaccepted advanced beam model, can account for some fluid-structure interaction. MULTIFLEX output is post-processed using a variety of tools (LATFORC, FORCE2, THRUST, NSAPLOT) to generate LOCA forces for the specific areas of interest. LOCA forces are computed specifically to support vessel, loop and steam generator qualification, including such various subcomponents such as control rod guide tubes, steam generator vertical divider plates and reactor vessel baffle-former plates.

Safety Analyses and Evaluations

Westinghouse performs LOCA evaluations/ analyses to support numerous products, including fuel reloads, plant upratings, Thot reductions and replacement steam generator programs, as well as other plant changes and nonconforming conditions.

Technology transfer is also available for the codes listed above, including pre-processors and post-processors, as well as for licensed methods and training.

Experience

Westinghouse has more than 35 personnel actively involved in LOCA analysis. The group maintains an extensive experience base in the LOCA area, including a core group of engineers with more than 15 years of experience.

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