Westinghouse Methodology Impacts from the Removal of the RCCA from Core Location D-6

Brian Guthrie, Transient Analysis

Danielle Schmitt, Nuclear Design

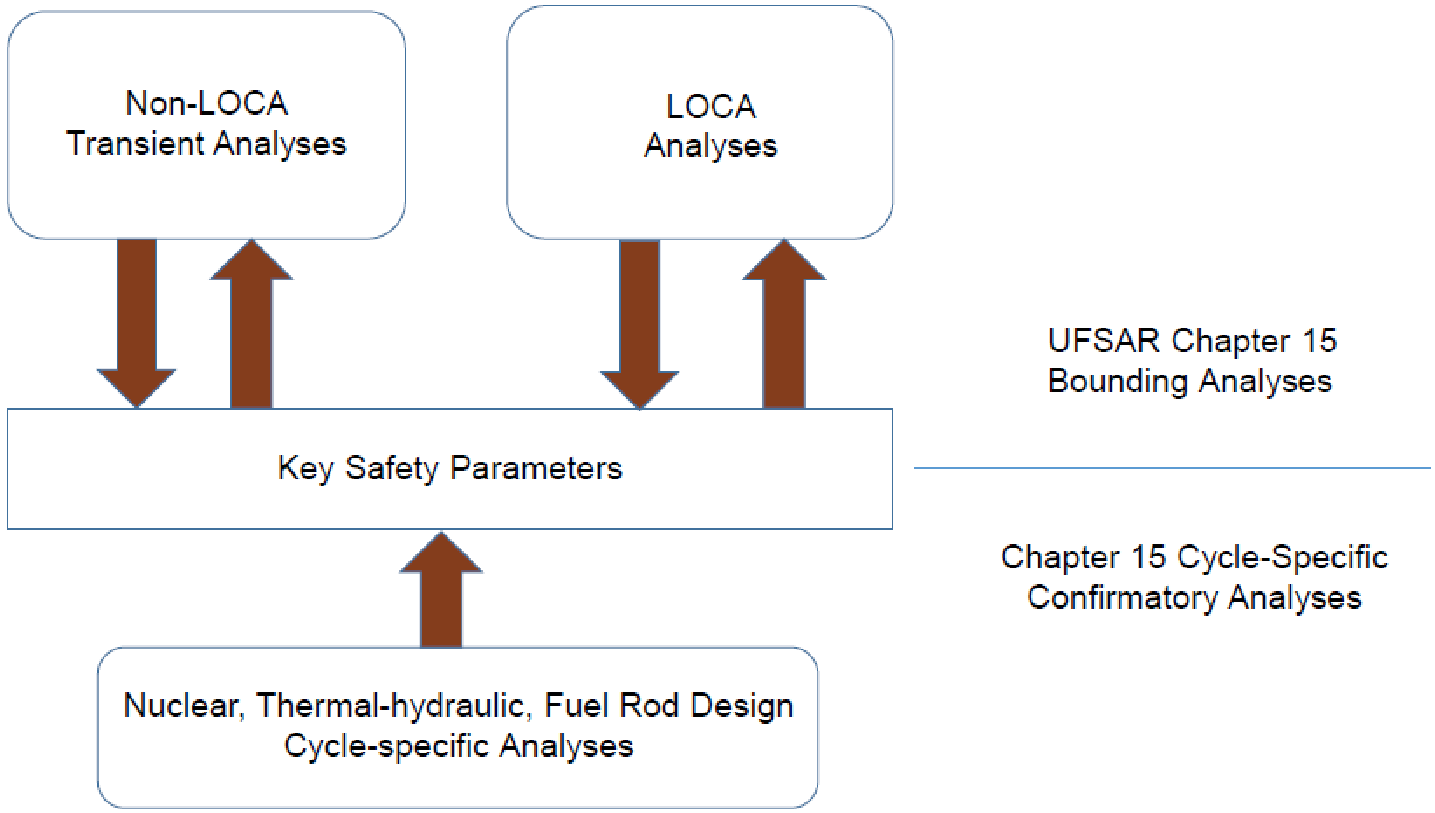
Overview of Reload Method (WCAP-9272-P-A)

- The STP engineering design change process is used to implement the removal of RCCA D-6
- Impacts of the change on UFSAR Chapter 6 and Chapter 15 analyses have been evaluated through a detailed review of the AORs and the reload design process (WCAP-9272-P-A).
- As detailed in Table 7 of NOC-AE-16003351, the existing key safety parameters continue to apply (and are confirmed on a cycle specific basis) and no other aspects of the AORs are impacted.

WCAP-9272 methodology is still applicable when control rod pattern is changed

Westinghouse

Overview of Reload Method (WCAP-9272-P-A)



Westinghouse

Overview of Reload Method (WCAP-9272-P-A)

- WCAP-9272-P-A Process
- The AORs are established using conservative inputs that are expected to bound future cycles.
- The key safety parameters that could be impacted by a reload become the Reload Safety Analysis Checklist (RSAC) which is issued every cycle by the Safety Analysis groups to Nuclear and Thermal Hydraulic Design for confirmation
- Any RSAC limit that is not met for a given cycle is provided to the impacted Safety Analysis group for evaluation
- Evaluation or re-analysis of the AOR is performed to address the RSAC exception and the results are reported in the cycle specific Reload Evaluation.

WCAP-9272 methodology is still applicable when control rod pattern is changed

Westinghouse

Safety Analysis Accidents

- Example – HZP Steamline Break
- RETRAN-02 uses a point kinetics neutronics model and does not directly model a control rod pattern
- Limiting case is generated using assumed physics characteristics.
- Nuclear Design implicitly confirms acceptability of the physics characteristics by comparing ANC calculated parameters to RETRAN-02 calculated parameters.
- An unacceptable mismatch requires evaluation or reanalysis of the event using adjusted physics parameters.
- This approach is consistent with the analysis methodology for the HZP steamline break core response described in WCAP-9226-P-A, Revision 1; the reload methodology for this event is described in WCAP-9272-P-A; and the qualification of RETRAN-02 for use in analyzing HZP steamline break core response is described in WCAP-14882-P-A.

No UFSAR safety analysis calculations explicitly model control rod patterns.

Westinghouse

Cycle-Specific Core Design Analysis

- Each cycle the reload core is modeled by Nuclear Design in detail (fuel pattern, control rod pattern, burnable absorbers, etc.)
- This detailed model is used to calculate cycle-specific values for comparison to the RSAC key safety parameters
- Key safety parameters assumed in the AOR include values that are impacted by RCCAs such as shutdown margin, total rod worth, and trip reactivity
- Key safety parameters assumed in the AOR do not include the number of RCCAs, RCCA configuration, or a symmetric RCCA pattern

Nuclear Design calculations explicitly model control rod pattern.

Westinghouse

Cycle-Specific Core Design Analysis

- Nuclear Design performs the cycle-specific analysis using:
  - ANC [WCAP-10965-P-A]
  - APOLLO [WCAP-13524-P-A]
  - PARAGON/NEXUS [WCAP-16045-P-A, Addendum 1-A]

- These codes were rigorously benchmarked and qualified for a variety of reactor types, fuel types, and burnable poisons

- These codes are capable of modeling an asymmetric core:
  - Highest worth rod stuck out of the core (N-1) is a conservatism assumption for many RSAC calculations
  - Asymmetric core temperature distribution with an N-1 condition is modeled for the Steamline Break accident
  - N-2, N-3, etc are calculated for use in plant Operations

Nuclear Design codes are capable of modeling the removal of RCCA D-6.

Conclusions

- Plant changes are handled by STP engineering design change process
- As a part of the engineering design change process, Westinghouse and the STP Nuclear Fuel and Analysis group performed an impact review of the respective AORs including the continued applicability of WCAP-9272-P-A
- WCAP-9272-P-A methodology is still applicable when control rod pattern is changed
- No UFSAR safety analysis calculations explicitly model control rod patterns
- Nuclear Design codes are capable of modeling the removal of RCCA D-6