LTR-NRC-15-62 Attachment

WCAP-10325-P-A Methodology Material Properties as Applied in the Watts Bar Containment Analysis (Non-Proprietary)

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WCAP-10325-P-A Methodology Material Properties as Applied in the Watts Bar Containment Analysis

Agenda

- Issue Statement
- Standard Review Plan
- WCAP-10325-P-A Methodology Background
- WCAP-10325-P-A (SATAN/REFLOOD/EPITOME)
- WCAP-8354-P-A (LOTIC1))
- IG-14-1 Discussion (InfoGram)
- WCAP-10325-P-A Conservatism Rack-up
- Comparison of Methodologies
- Watts Bar Analysis of Record Status
- Standard Review Plan Conformance
- Conclusions

Issue Statement

- The NRC has requested that Watts Bar 1 and 2 provide the results of the containment pressure, temperature, sump temperature responses and net positive suction head (NPSH) analysis using the ASME published volumetric heat capacity for the RCS metal including corrections of the errors reported NSALs.

Standard Review Plan

- The objective is to conservatively calculate the containment pressure response following a LOCA to protect the health and safety of the public
- Standard Review Plan (NUREG-0800) Section 6.2.1.3
  - Section II.A Acceptance Criteria requires that containments are designed with sufficient margin to accommodate the temperature and pressure conditions following a LOCA
  - Section II.B Acceptance Criteria states that additional conservatism should be included to maximize energy release during blowdown and reflood, maximizing stored sensible heat is cited as an example

WCAP-10325-P-A Methodology Background

- WCAP-10325-P-A documents a Loss of Coolant Accident Mass and Energy (LOCA M&E) release methodology
- Built around several conservative assumptions
  - Rapid non-mechanistic release of stored RCS energy
  - Thermal conductors are single node (i.e. not conduction limited)
  - Input parameters are skewed conservatively (e.g. core power, decay heat, initial conditions)

WCAP-10325-P-A (SATAN/REFLOOD/EPITOME)

- WCAP-10325-P-A supports the Standard Review Plan acceptance criteria through the following:
  - Conservatively fast stored energy release model
  - Single node heat slabs (not conduction limited)
  - Key inputs are biased conservatively
    - Fuel stored energy is maximized
    - Decay heat is maximized (ANS-1979+2sigma)
    - RCS volumes are biased high
    - Initial RCS temperatures are biased high
    - Initial RCS pressure is biased high
    - Uncertainty on core power is included

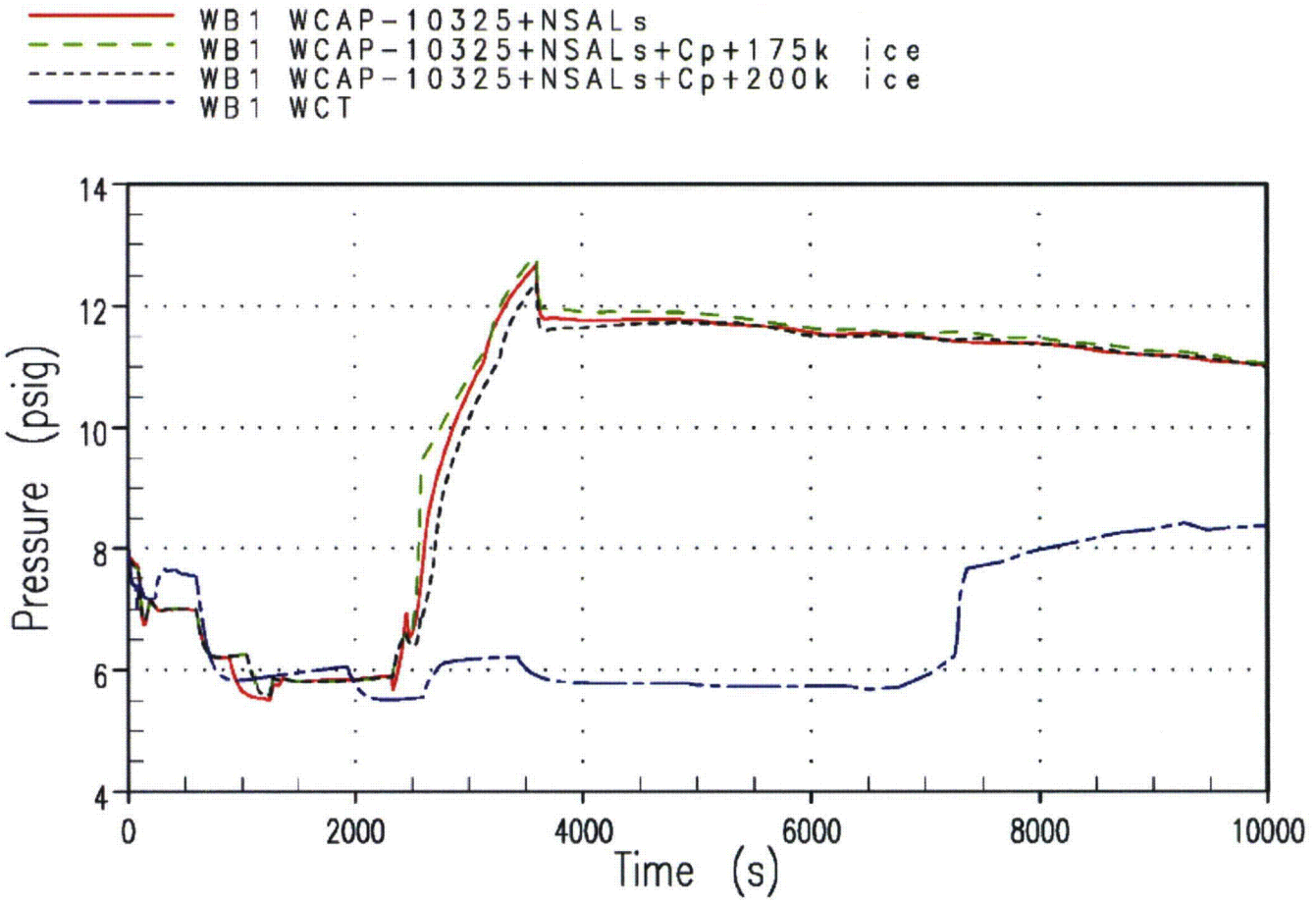
WCAP-8354-P-A (LOTIC1)

- WCAP-8354-P-A supports the Standard Review Plan acceptance criteria through the following:
  - Containment heat sink effectiveness is biased low
    - Volume and surface area
    - Heat transfer from atmosphere
  - Containment volumes are biased low
    - Upper compartment, lower compartment, and ice condenser
  - No heat transfer to sump pool surface area is credited
  - No heat transfer to ice condenser effluent is credited (LOCA)
  - Various TS parameters biased in conservative direction (e.g. UHS temperature, ice bed temperature)

IG-14-1 Discussion (InfoGram)

- Subsequent to issuance of the NSALs, further material property questions were raised
  - The stainless steel volumetric heat capacity value in WCAP-10325-P-A analyses was noted to be lower than ASME published data
  - WCAP-10325-P-A material properties are based on data generated prior to ASME data
    - Although not bounded by the ASME data, the values used were considered to be representative of available published data at the time

LOCA M&E Containment Pressure Plot (Preliminary)



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WCAP-10325-P-A Conservatism Rack-up

- Known Conservatisms
  - Single node thermal conductors
  - Maximized stored metal energy release rate
  - Maximized core power
  - Bias on RCS volumes
  - ANS-1979+2σ decay heat
  - Maximum RCS temperatures + uncertainty
  - Core stored energy maximized
- NRC Concern
  - Difference in volumetric heat capacity relative to ASME is non conservative

Comparison of Methodologies

- The containment pressure comparison shows that the large peak containment pressure increase is a consequence of conservative assumptions in the WCAP-10325-P-A and WCAP-8354-P-A methodologies
  - WCOBRA/TRAC is a more mechanistic LOCA M&E release tool
  - The material properties in WCOBRA/TRAC, as submitted, more closely reflect the ASME data (future WCOBRA/TRAC analyses will use the ASME data plus conservatism)
  - The increased time duration to ice melt seen with WCOBRA/TRAC reduces the effect of stored RCS metal energy contribution

Watts Bar Analysis of Record Status

- Containment Analyses for Watts Bar 1/2 are in progress
  - Supports dual unit operation with revised heat exchanger performance due to Unit 1 and Unit 2 shared systems (GDC-5)
    - Reduction in component cooling water heat exchanger performance is considered
  - The analyses are being finalized by Westinghouse
    - This revisions include all updates required
  - Analyses support Watts Bar Unit 2 startup
  - Used WCAP-10325-P-A methodology

Standard Review Plan Conformance

- Standard Review Plan (NUREG-0800) Section 6.2.1.3
  - Section II.A Acceptance Criteria requires that containments are designed with sufficient margin to accommodate the temperature and pressure conditions following a LOCA
    - Based on results calculated using WCOBRA/TRAC, the WCAP-10325-P-A methodology contains sufficient conservatism such that the acceptance criteria above is met

Standard Review Plan Conformance

- Section II.B Acceptance Criteria states that additional conservatism should be included to maximize energy release during blowdown and reflood, maximizing stored sensible heat is cited as an example
  - Although the amount of stored RCS metal energy is potentially underestimated, the rate at which it is transferred to containment is highly conservative, and the net result is an overall conservative model with respect to containment integrity
  - Therefore, the acceptance criteria above is met

Conclusions

- Watts Bar analyses fully comply with applicable General Design Criteria
- Standard Review Plan acceptance criteria are met
- WCAP-10325-P-A has been demonstrated to be conservative
  - Comparisons to WCOBRA/TRAC results demonstrate the level of conservatism in WCAP-10325-P-A

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