A BNFL Group company

R. E. Ginna SBLOCA EPU Results Summary

Overview

- Present Overview Of SBLOCA EPU Analysis Results
- Discuss SBLOCA Related Items Associated With NRC Acceptance Review

R. E. Ginna SBLOCA EPU Results Summary

SBLOCA EPU Analyses Performed With NOTRUMP EM

- EM Model Consists Of Two Main Codes
  - NOTRUMP V39.0
  - SBLOCTA V23.0
- EPU Analysis Results Demonstrate Considerable Margin To 10 CFR 50.46 Criteria
  - PCT << 2200°F
  - Maximum Local Oxidation << 17%

NOTRUMP EM WCAPs

WCAP #	SER	Application
WCAP-10054-P-A Over-all model application	Letter from C. O. Thomas (NRC) to E. P. Rahe (W), "Acceptance For Referencing Of Licensing Topical Report WCAP 10079(P) "NOTRUMP, A Nodal Transfer Small Break and General Network Code", May, 1985.	Generic
WCAP-10079-P-A Code proper	Letter from C. O. Thomas (NRC) to E. P. Rahe (W), "Acceptance For Referencing Of Licensing Topical Report WCAP 10054(P) "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code", May, 1985.	Generic

NOTRUMP EM WCAPs

WCAP #	SER	Application
WCAP-11145-P-A Forward-fit applicability	Letter from C. E. Rossi (NRC) to L. D. Butterfield (WOG), "Acceptance for Referencing of Licensing Topical Report WCAP-11145", October 1986.	Generic
WCAP-10054-P-A, Addendum. 2, Revision 1 COSI	NRC Letter from R. C. Jones (NRC) to N. J. Liparulo (W), "WCAP-10054-P, Addendum 2, Revision 1, "NOTRUMP SBLOCA Using the COSI Steam Condensation Model, " (TAC NO. M90784), August 1996.	Generic

NOTRUMP EM WCAPs

WCAP #	SER	Application
WCAP-14710-P-A	Letter from T. E. Collins (NRC) to N. J. Liparulo (W), "Acceptance For Referencing Of The Topical Report WCAP-14710(P) "1-D Heat Conduction Model For Annular Pellets" (TAC NO. M96746), March 1998.	Generic

R. E. Ginna SBLOCA EPU Results Summary

Analysis Features

- Only Broken Loop RCP Loop Seal Clearing Allowed For Breaks < 6-Inches
- No Auxiliary Feedwater Flow Modeled
- 10 Minute HHSI Interruption Modeled In Switchover To Recirculation Phase
  - ✦Limiting PCT Occurs During RWST Injection Phase

R. E. Ginna SBLOCA EPU Results Summary

Event/Result	1.5 Inch	2.0 Inch	3-Inch
Reactor Trip	51.0 sec	25.6 sec	11.4 sec
S.I. Signal	58.6 sec	26.7 sec	11.9 sec
B.L. Loop Seal Clears	985 sec	511 sec	236 sec
Top Of Core Uncovery	2820 sec	1157 sec	415 sec
Acc. Injection	8544 sec	2832 sec	673 sec
Top Of Core Recovery	4750 sec	2570 sec	897 sec
PCT	1011°F	1167°F	1117°F
PCT Time	3578 sec	1650 sec	748 sec
Burst Time	N/A	N/A	N/A
% Max ZrO_2	0.02	0.07	0.02

R. E. Ginna SBLOCA EPU Results Summary

SBLOCA Analysis Results Overview

- Supplemental Calculations Performed Indicate No Core Uncovery For 4- and 6-Inch Breaks

R. E. Ginna SBLOCA EPU Results Summary

NRC Review Acceptance Issues

- Only Limited Plots Provided For The 2-Inch Case
  - + Additional Information Transmitted To NRC
- No Information Provided Supporting No Core Uncovery Statement For 4- and 6-Inch Breaks
  - + Additional Details To Be Provided
- Integer Break Spectrum Approach Is Too Coarse
  - + Currently Being Evaluated As a Generic Issue
    - – Westinghouse Letter Being Generated For 9/15/05 Transmittal

R. E. Ginna SBLOCA EPU Results Summary

NRC Acceptance Issues (Continued)

- Provide An Analysis Of Break Sizes Up To and Including 1.0-ft^2
  - These Breaks Are Typically Non-Limiting Due To Rapid Depressurization Characteristics
    - This is planned to be addressed on a generic basis

Ginna Station Extended Power Uprate
Long-Term Cooling / Boric Acid Precipitation - Overview

Summary

- Subcriticality and decay heat removal evaluations consistent with Westinghouse established methods
- Break size and break location scenarios were evaluated with respect to operator actions to prevent boric acid precipitation
- Boric acid calculation methodology consistent with Westinghouse established methods
- Boric acid precipitation EOP action times reduced considerably for EPU (from 19 hours to 6 hours)

Ginna Station Extended Power Uprate
Post-LOCA Evaluation Methodology

Ginna EPU Post-LOCA Methodology

- Post-LOCA Subcriticality (Sump Boron Concentration)
  - Calculation of Sump Mixed Mean Boron Concentration
  - Confirmed for each reload as part of Reload Safety Evaluation
- Boric Acid Precipitation Evaluation
  - Methodology basis in 1975 W/NRC Letter
  - EOP actions to preclude boric acid precipitation
  - Boric calculations similar to CENP-254-P-A (SKBOR code versus BORON code)
- Decay Heat Removal (Recirculation SI Flow)
  - All core boiloff calculations use Appendix K decay heat
  - Confirmed that for a large hot leg or cold leg break, UPI flow provides sufficient core cooling flow at early entry into sump recirculation (24 minutes)
  - Confirmed that for a large cold leg break, UPI flow provides sufficient core dilution flow to prevent boric acid buildup (hot leg breaks are addressed by re-establishing CL flow at EOP action time)
  - Confirmed that for a large hot leg break, the re-established cold leg flow provides sufficient core dilution flow prior to reaching the boric acid solubility limit

Ginna Station Extended Power Uprate
Boric Acid Precipitation

Ginna Current Boric Acid Precipitation Methodology

- High head SI to cold legs, RHR to Upper Plenum Injection (UPI)
- Boric acid precipitation for 2-loop UPI plants originally addressed in 1975 W/NRC letter
- Ginna Station currently based on 20 hours boric acid precipitation action time
- High head SI must be re-established at 19 hours after event to address hot leg break

Ginna Station Extended Power Uprate
Boric Acid Precipitation

Ginna EPU - LAR Boric Acid Precipitation Methodology

Evaluated 3 classes of break sizes for breaks in either hot leg or cold leg

- Large Breaks
  - RCS quickly depressurizes to UPI cut-in pressure
- Intermediate Breaks
  - RCS initially stabilizes above UPI cut-in pressure. EOP ES-1.2 is entered to depressurize the system to initiate UPI flow.
- Small Breaks
  - RCS remains pressurized with high head SI.

Ginna Station Extended Power Uprate
Boric Acid Precipitation

Ginna EPU – LAR Boric Acid Precipitation Methodology (cont'd)

Large Breaks
- Cold leg breaks - UPI provides flushing flow to prevent boric acid buildup
- Hot leg breaks - boric acid buildup begins with termination of cold leg SI. Cold leg SI will be re-established before boric acid solubility limit is reached.

Intermediate Breaks
- Cold leg breaks - boric acid buildup occurs until UPI flow is established. UPI provides flushing flow to reverse the rate of boric acid buildup.
- Hot leg breaks - boric acid buildup occurs only after cold leg SI is terminated. Cold leg SI will be re-established before boric acid solubility limit is reached.

Small Breaks
- EOP ES 1.2 will depressurize and cooldown the reactor under controlled conditions
- Natural circulation or RHR normal shutdown cooling will prevent boric acid buildup in the core

Ginna Station Extended Power Uprate
Boric Acid Precipitation

Ginna EPU – LAR Boric Acid Precipitation Calculations
- Consistent with Westinghouse established methods
- Used 1975 W/NRC Letter methodology as a basis
  - No SI subcooling
  - No Lower plenum mixing
  - No core voiding
  - 1971 ANS finite decay heat
- Showed that BA concentration is < 23.53 wt. % at 6.5 hours
- Boric acid precipitation will not occur if UPI is established within 6.5 hours
- If SI to the cold legs is terminated, boric acid precipitation will not occur if SI to cold legs is re-established by 6 hours

Ginna Station Extended Power Uprate
Boric Acid Precipitation

Ginna EPU NRC Review Acceptance Issues – Boric Acid Precipitation

- Does the mixing volume vary with time?
- What constitutes the mixing volume?
- Was the loop resistance taken into account in calculating the mixing volume?

Ginna Station Extended Power Uprate
Boric Acid Precipitation

Ginna EPU NRC Review Acceptance Issues – Boric Acid Precipitation Evaluation – RAIs

- Does the mixing volume vary with time?
  - No (consistent with 1975 W/NRC letter)
- What constitutes the mixing volume?
  - Volume inside the core barrel from the top of the lower core plate to the to the bottom of the hot leg . . .
  - not including the former regions, displaced volume due to fuel and internal structures, and volume inside the RCCA thimble tubes
  - Lower plenum volume not included, nor volume in the hot leg piping

Ginna Station Extended Power Uprate
Boric Acid Precipitation

Ginna EPU NRC Review Acceptance Issues – Boric Acid Precipitation Evaluation – RAIs

- Was the loop resistance taken into account in calculating the mixing volume?
  - No (consistent with 1975 W/NRC letter)
  - All calculations used atmospheric conditions to maximize boiloff and minimize boric acid solubility limit
  - Effects of increased vessel pressure include;
    - Reduced boiloff (benefit)
    - Reduced voiding (benefit)
    - Higher solubility limit (benefit)
    - Lower core region liquid density (penalty)
    - Effect on core mixture level (penalty)