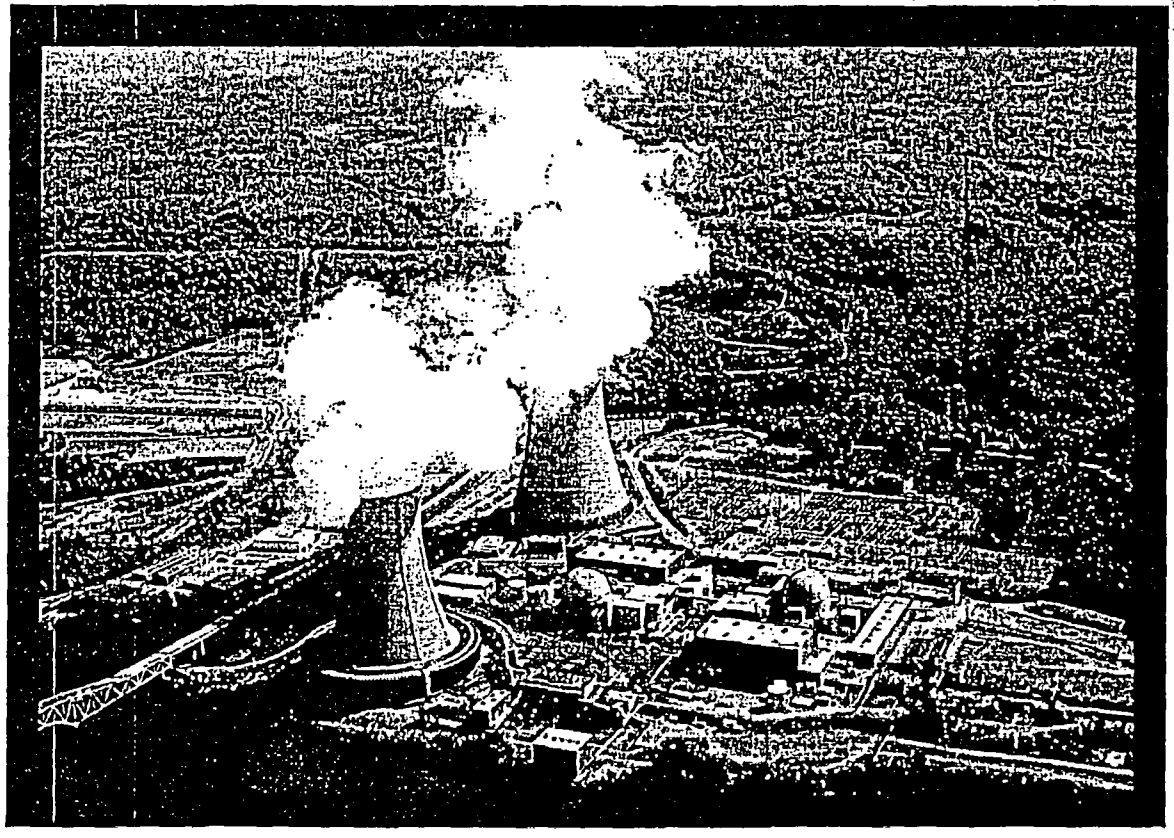
BEAVER VALLEY POWER STATION
Small Break LOCA



Small Break LOCA Meeting

August 24, 2005

Desired Outcome

- Provide NRC with information on the Westinghouse NOTRUMP modeling considerations for SBLOCA
- Provide NRC with overview of BV plan to address SBLOCA issues
- Ensure NRC understanding with proposed approach and schedule
- Establish confidence in our proposed approach to support RSG installation

Agenda

- Background
- Overview of SBLOCA issue
- Issue Description - specific to BV
- FENOC plans / schedule to address issue
- Preliminary NRC Questions
- Additional Questions / Comments

RSG Replacement

- Critical Decision Points
  - BV-1 Steam Generators are scheduled for replacement in 1R17 (Feb. 2006)
  - RSG fabrication complete *
  - N-stamp to be signed in September (to be shipped Sept. 3, 2005)
  - Steam Generators will be delivered to BV site in October 2005

* owners release at this point based upon ability to install

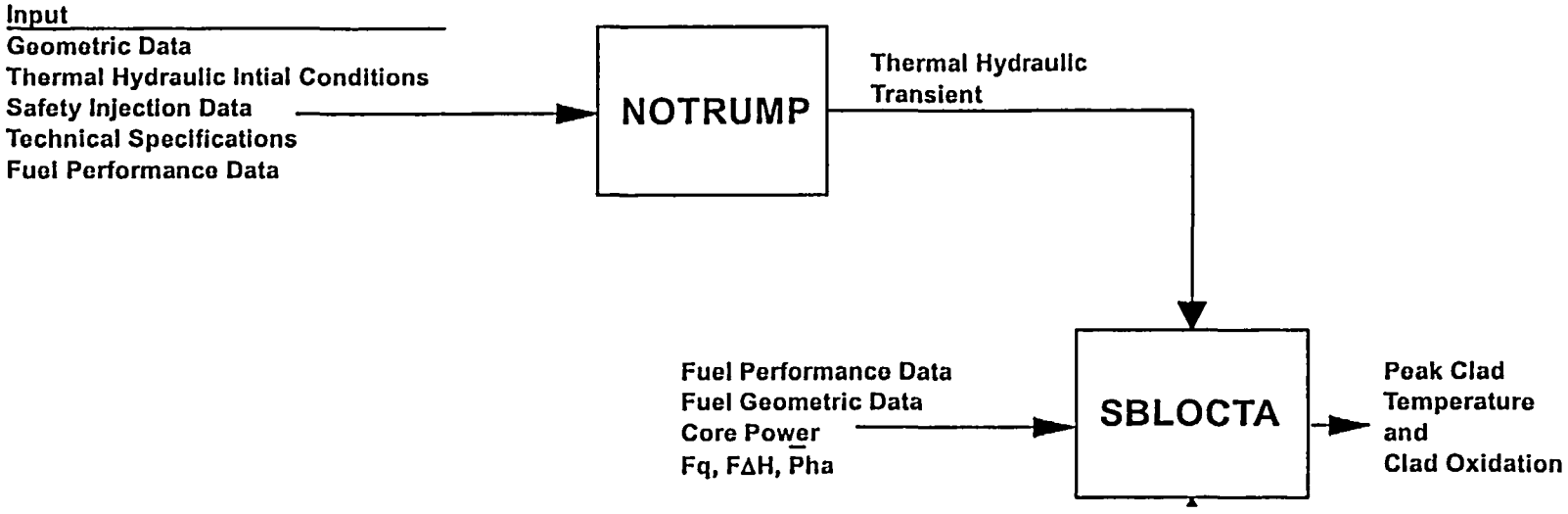
Current Submittal Background

- SBLOCA Modeling
  - Utilizes NOTRUMP Evaluation Model (EM)
- 'Integer' size breaks evaluated
- EPU/RSG submittal utilized loop seal clearing
  - Both the intact and broken loops, down to [ ]^{a,c} diameter
  - N-loop model demonstrated all loop seals cleared
- Single analysis utilized for both EPU and RSG

NOTRUMP Evaluation Model (EM)

- Comprised of two codes:
  - NOTRUMP
    - System pressure, temperature, fluid level, fluid flow rate
    - Thermal-hydraulic transient in reactor coolant system and steam generators
  - SBLOCTA
    - Fuel rod heatup transient
    - Fuel cladding pressure, strain, temperature, burst, and transient oxidation

NOTRUMP Evaluation Model



NOTRUMP Code Features

- Meets requirements of Three Mile Island action plan (NUREG-0737)
- General 1-D flow network, up to 200 nodes
- Mixture level tracking in stacked nodes
- Two-phase flow and drift flux models
- Loop seal model

NOTRUMP Features cont.

- Condensation heat transfer (Steam Generator)
- Core reflux model
- Flow regime mapping
- Condensation of Safety Injection (COSI) condensation model

SBLOCTA Code Features

- Models 3 rods in hot assembly (hot, average, adjacent)
- Radial and axial conduction [ ]^{a,c}
- Top-skewed power shape
- Assembly blockage due to clad swell and rupture
- Zirc/water reaction - Baker/Just correlation

NOTRUMP WCAP History

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 WCAP History

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 WCAP History

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

NOTRUMP EM

- Application of NOTRUMP EM has remained unchanged since 1985
- Code error corrections have been reported to NRC per Westinghouse 10 CFR 50.46 reporting process
  - NSBU-NRC-00-5972, NRC Report for NOTRUMP Version 38.0 Changes, June 30, 2000
- EPU/RSG used Code Version 39
  - V39.0 Reported in 2003 50.46 Annual Reporting Process

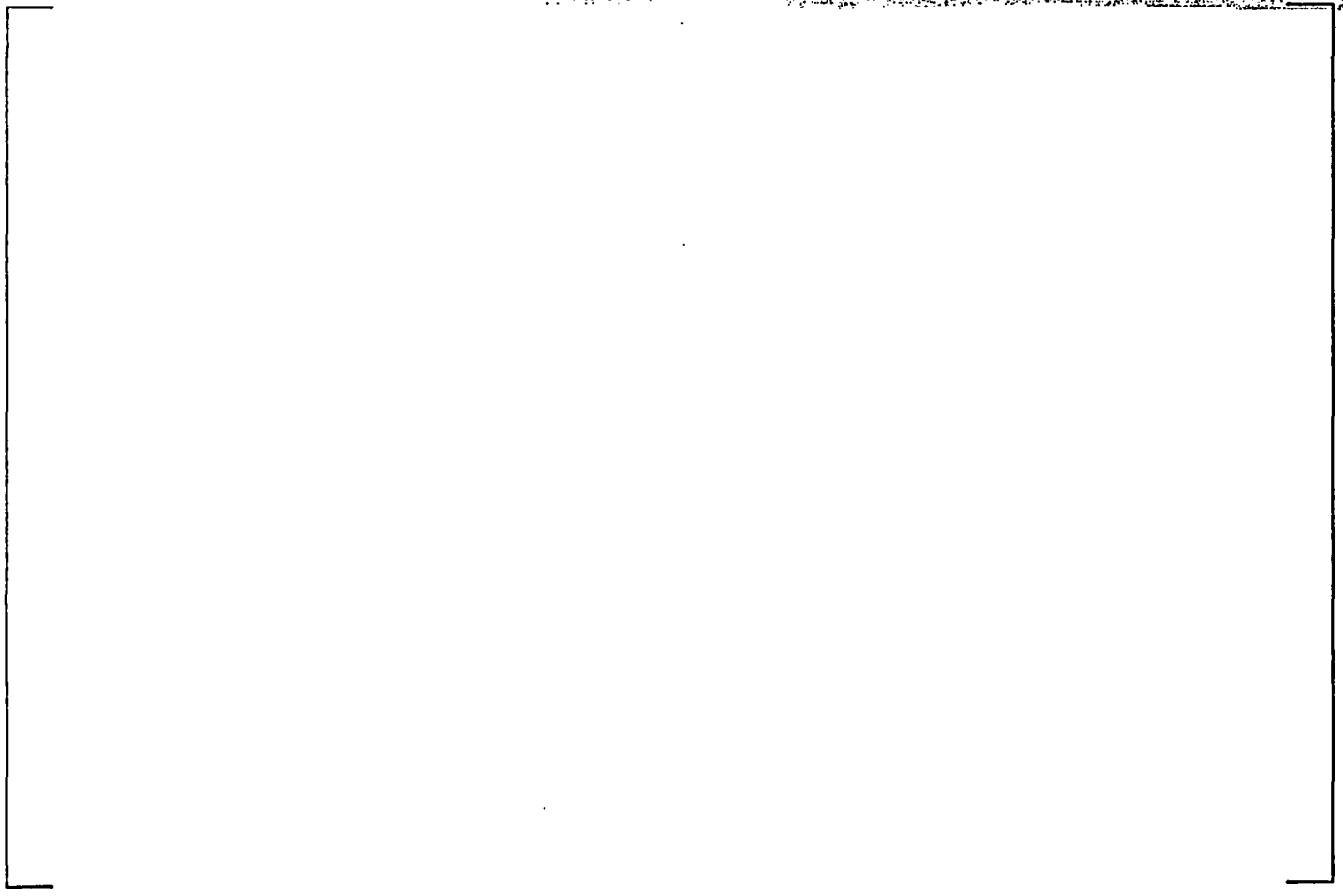
Non-integer Breaks

- Staff questioned modeling of 'integer' break sizes and requirements of 10 CFR 50.46
- 10 CFR 50.46 states in part,
  - "number of postulated loss of coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss of coolant accidents are calculated"
- For Beaver Valley inclusion of non-integer size breaks produces limiting small break results

Non-integer Break Sizes

- 0.25 inch increments used (25-27% changes in break flow area per increment)
  - 2 inch thru 3 inch
- This is considered adequate since Moody break flow model uncertainty is on the order of 30 to 40%
  - PCT curve family is well characterized

a,c



Generic Methodology Considerations

- Loop seal clearing restriction
- NOTRUMP model nodalization
- Pre-transient oxidation
- Condensation modeling / considerations
- Modeling of break orientations
- Consideration of breaks > 6 inch equiv diameter
- Transient termination considerations

Details of Beaver Valley Approach

- Loop seal clearing in broken loop only for break sizes less than [ ]^{a,c}
  - [ ]^{a,c} per WCAP-11145-P-A
- Maintain [ ]^{a,c} NOTRUMP model
  - WCAP-10054-P-A
- Pre-transient oxidation addressed
- Non-integer size breaks addressed
- COSI Model application and break orientation addressed in WCAP-10054-P-A Rev 1, Add 2
- Document through RAI process
  - Larger smaller breaks (0.5 and 1.0 ft^2 sizes) not limiting
  - Transient extension after [ ]^{a,c} in the NOTRUMP simulations since plant cooldown will occur per ES-1.2

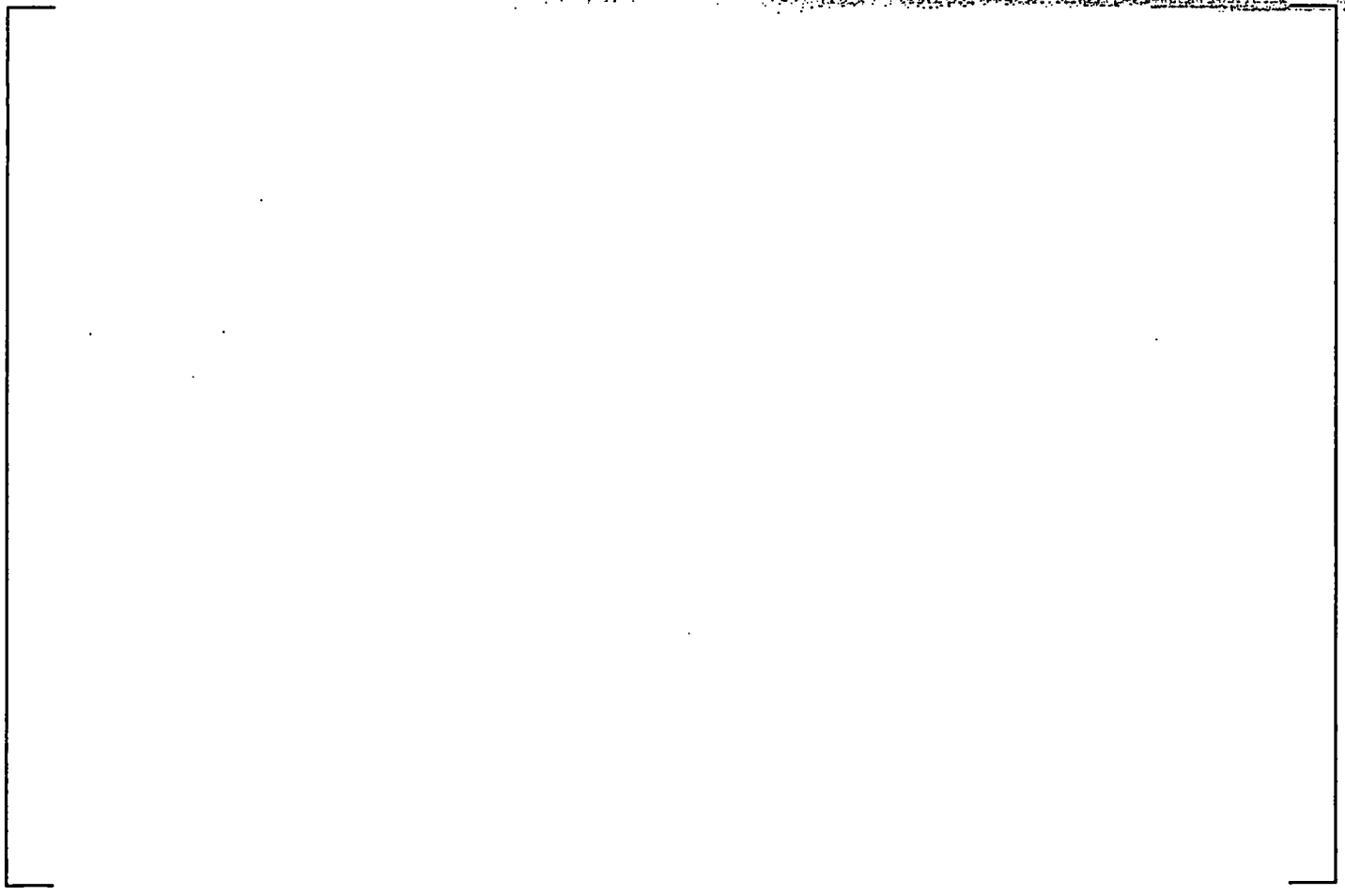
EPU / RSG Plan

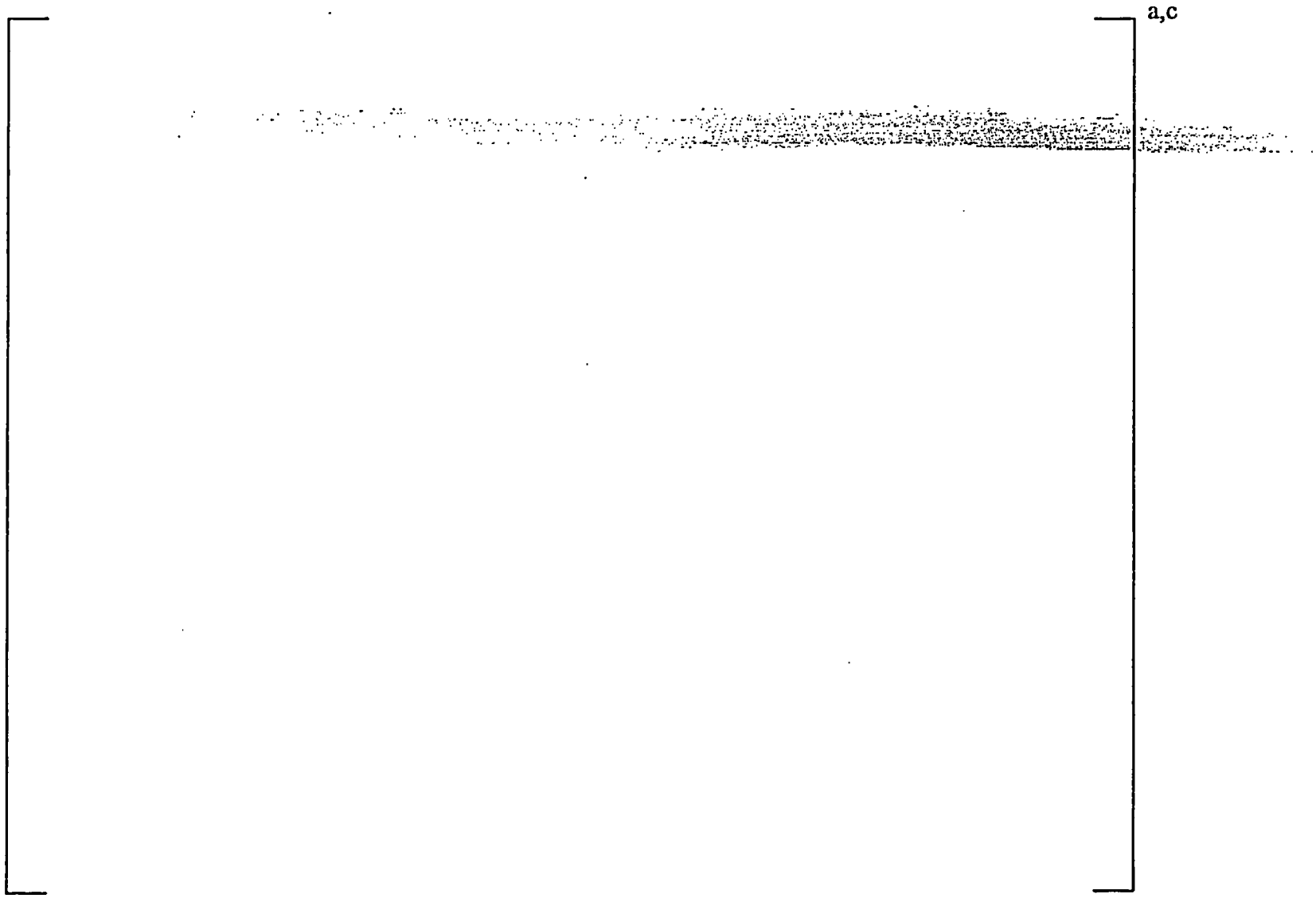
- Perform analysis at uprated thermal power
- [ ]^{a,c}
- Possible credit extension of COSI condensation model
- Submit revised analysis / TS change to support RSG installation

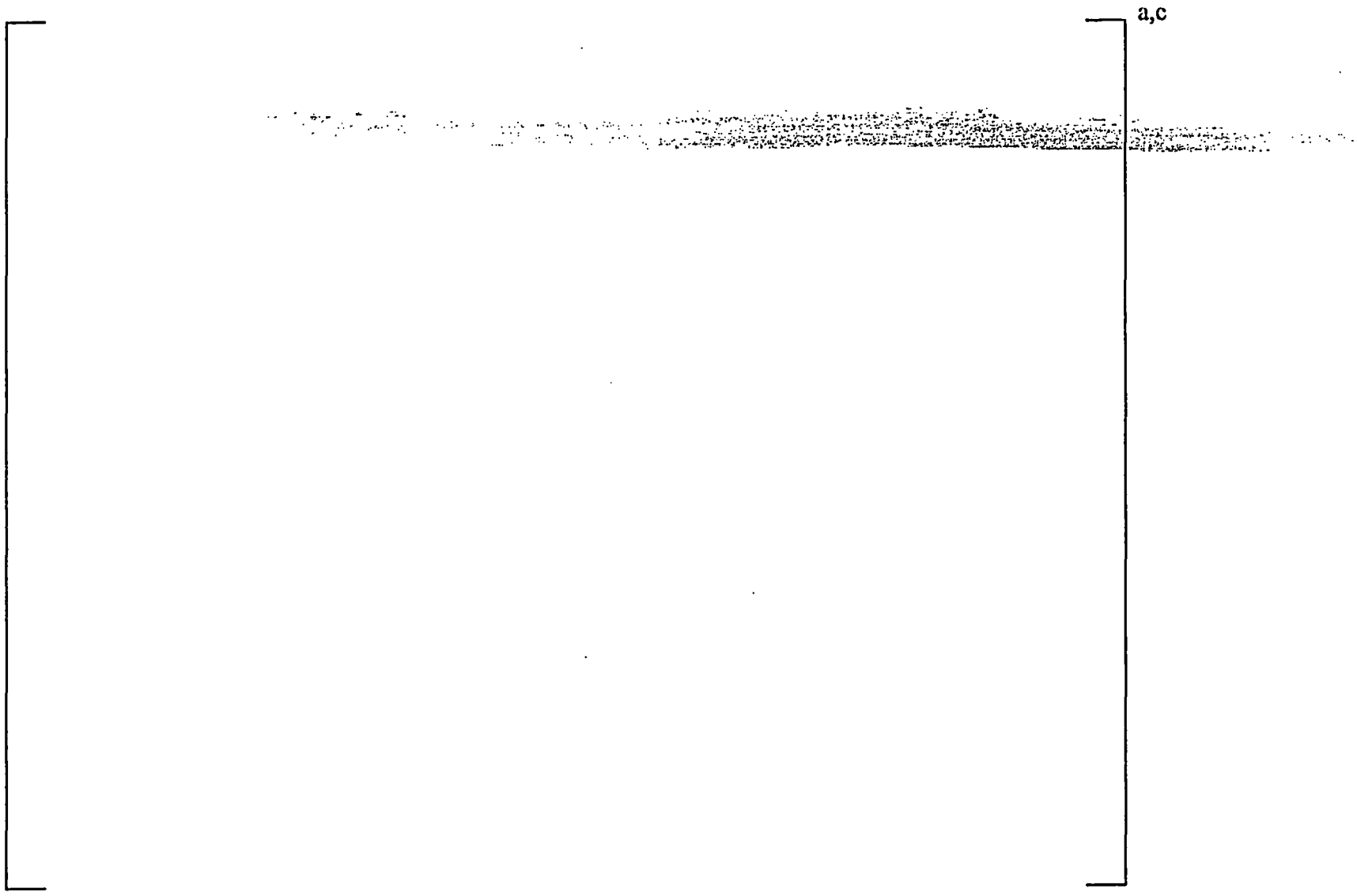
Preliminary Results

- Revised analysis drafted for BV-1
- Consideration of [SI Accumulator Pressure change][a,c]
  - PCT = ~ 1920 F
  - Total Oxidation < 17%

a,c




a,c


a,c

EPU/AOR Comparison

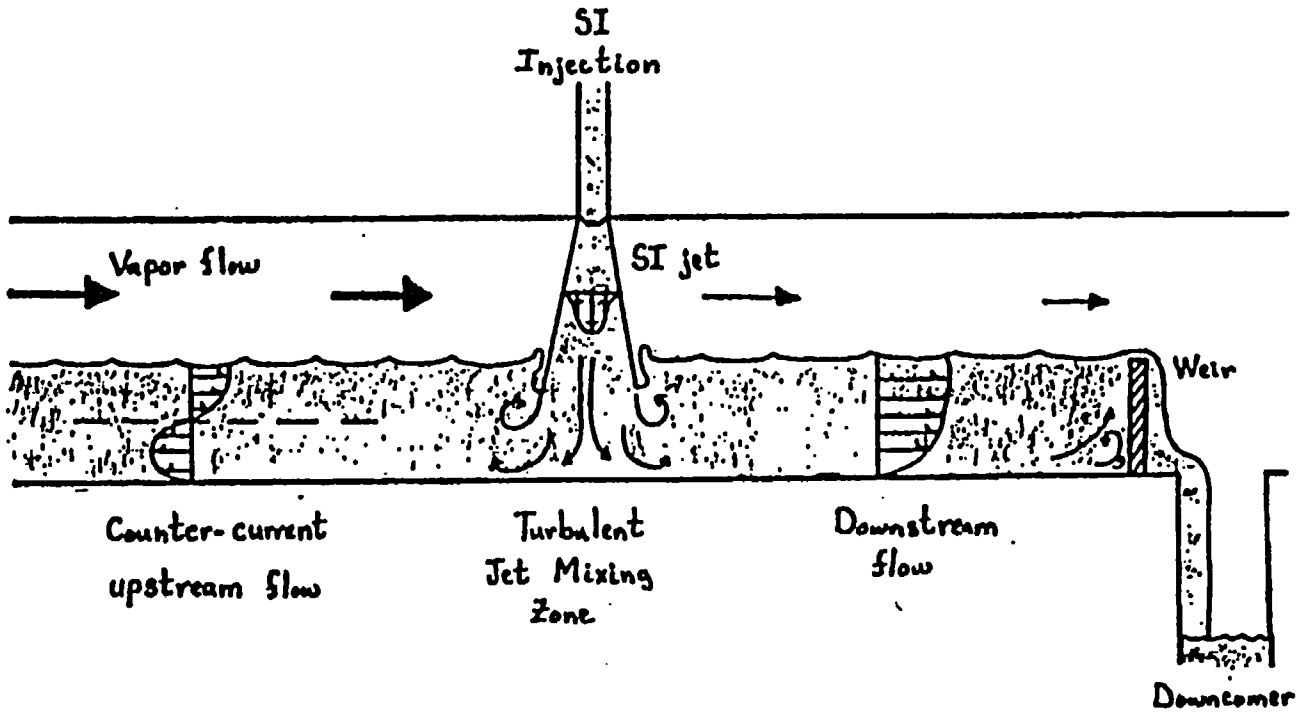
- Differences in Unit 2 PCT EPU Results vs. AOR are mainly a trade-off between increased ECCS flow and [ ]^{a,c} removal vs. core power
  - AOR: 3 inch break – 2,105°F
  - EPU: 3 inch break, no [ ]^{a,c} removal, AOR ECCS flows – 2,326°F
  - EPU: 3 inch break, no [ ]^{a,c} removal, EPU ECCS flows – 1,996°F
  - EPU: 3 inch break, [ ]^{a,c} removal, EPU ECCS flows – 1,678°F

COSI Extension

- COSI
  - Credits condensation of steam in RCS at safety injection points
  - Part of Evaluation Model over pressure range of [-]^{a,c} psia (WCAP-10054-P-A, Rev 1 Add2)
- Additional credit is justified for pressure range down to [ ]^{a,c} psia
  - Framatome studies

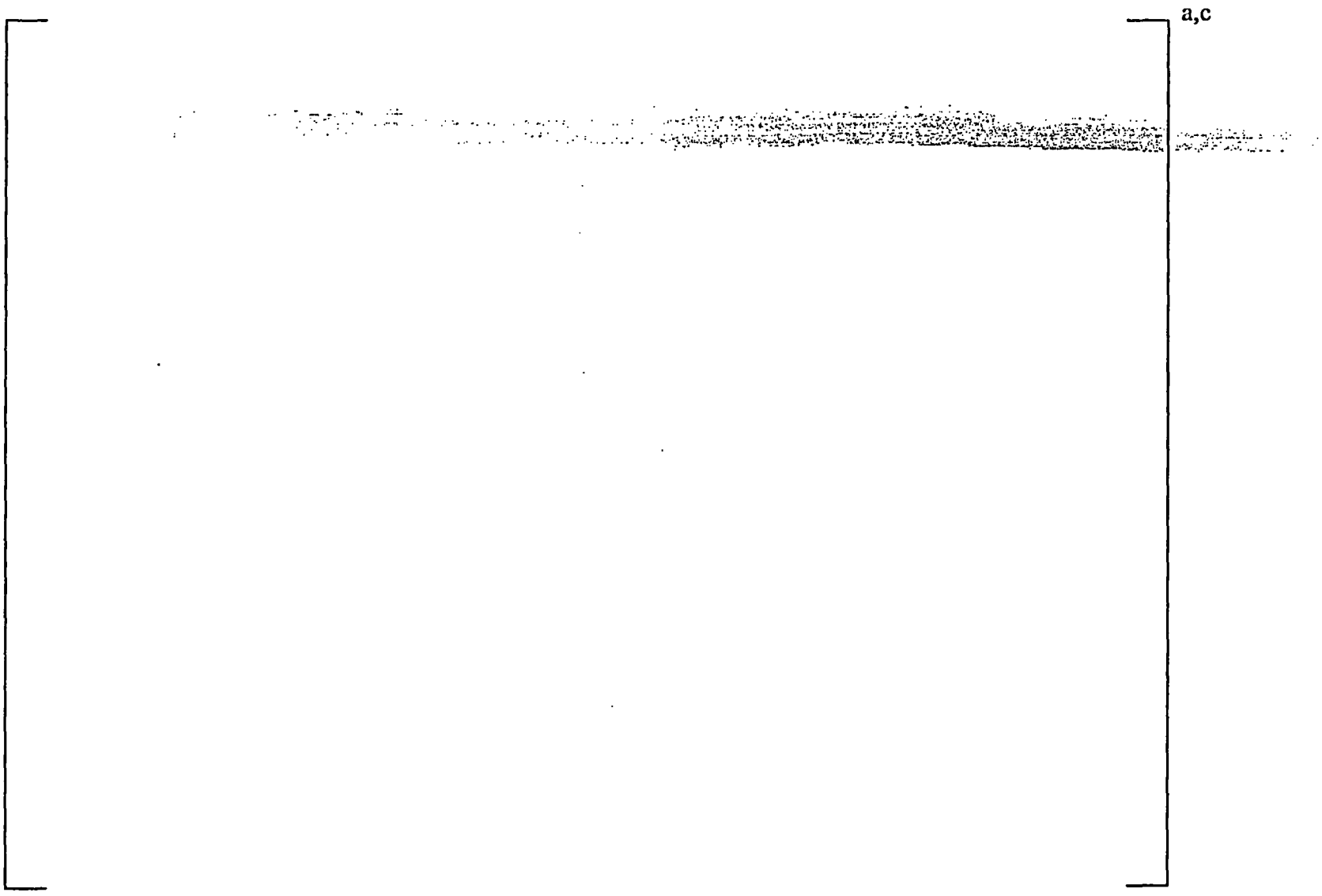
Safety Injection Condensation

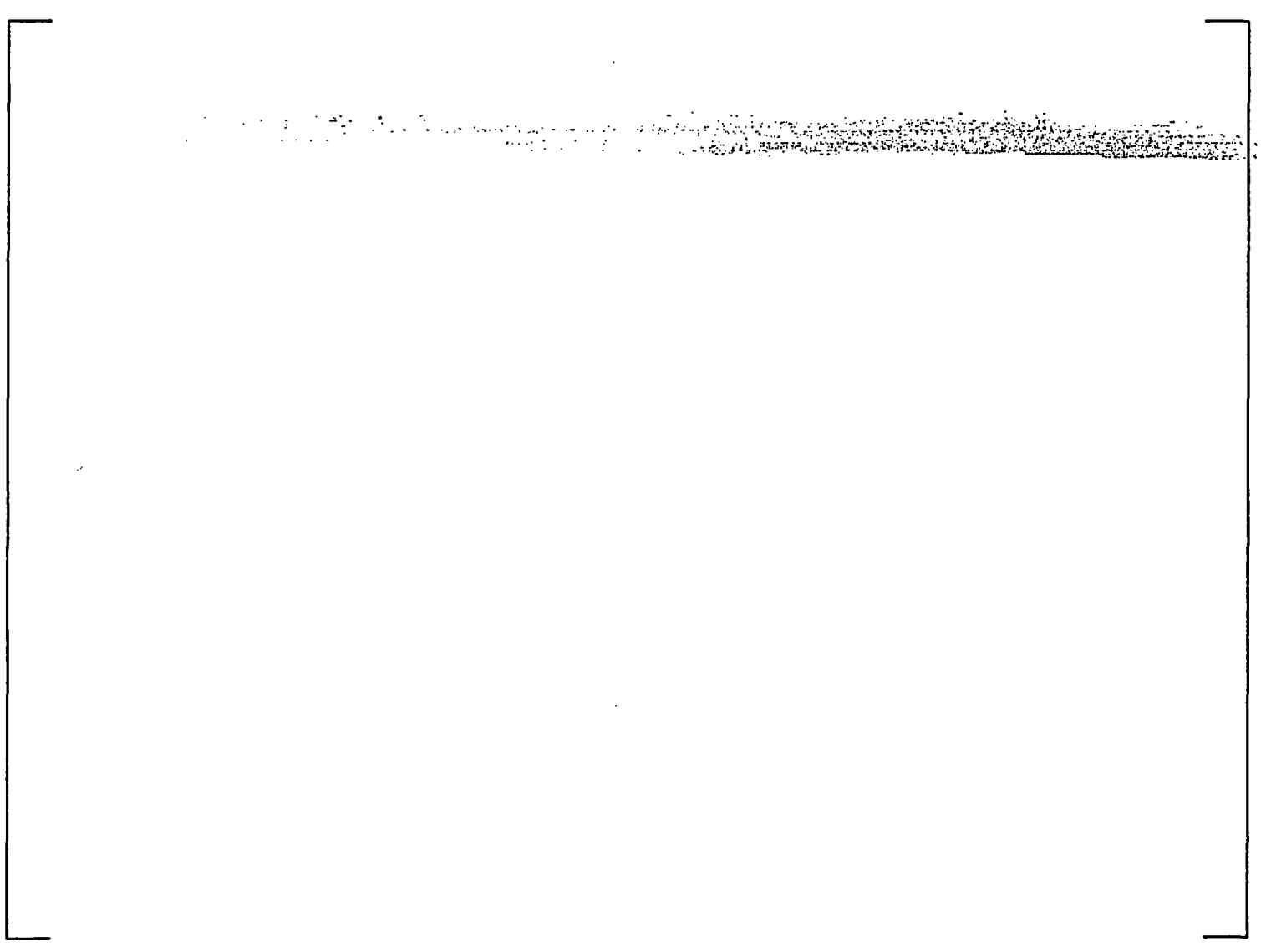
Depiction of Flow Patterns in the COSI Test Assembly



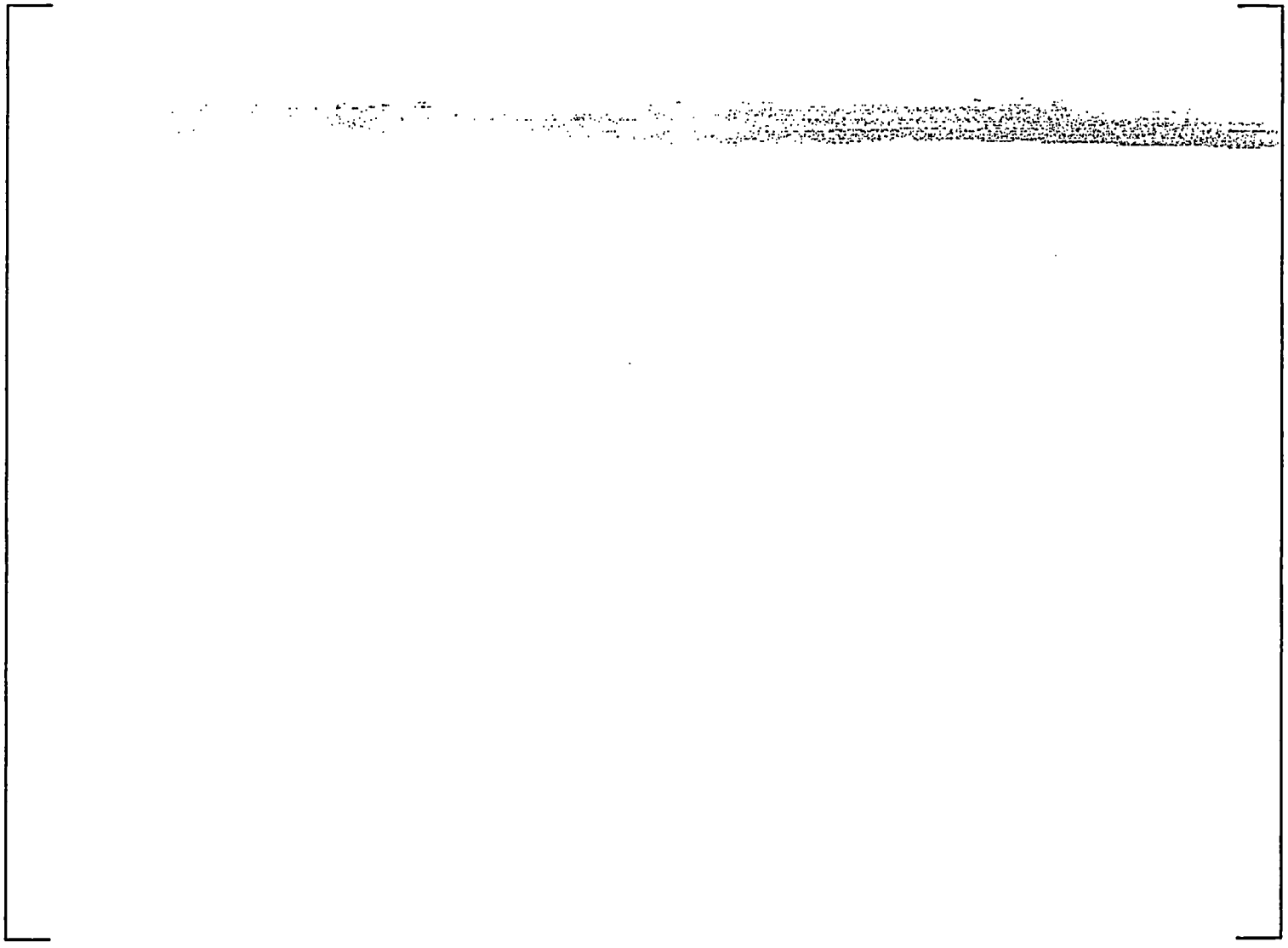
COSI Extension Benefit

[ ] a,c


a,c


a,c

a,c



Summary

- Acceptable results obtained using approved NOTRUMP EM
- Break spectrum issue addressed
- Pre-transient oxidation included
- Loop seal clearing restrictions included
- Generic methodology considerations are addressed by use of approved NOTRUMP EM

Concluding Remarks

- Approach being taken in SBLOCA Analyses believed to address NRC issues
- Revised analyses are expected to support the established review schedule

Questions / Answers

???