Docket File

52-003

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 22, 1995

APPLICANT: Westinghouse Electric Corporation

FACILITY: AP600

SUBJECT: SUMMARY OF MEETING TO DISCUSS THE PROBABILISTIC RISK ASSESSMENT (PRA) CHANGES FOR THE AP600 DESIGN

On March 29 and 30, 1995, representatives of the Nuclear Regulatory Commission and Westinghouse Electric Corporation met to discuss the recent changes that have been made to the PRA for the design of the AP600. Attachment 1 is a list of the attendees. Attachment 2 is a copy of the slides presented by Westinghouse.

Westinghouse opened the meeting with a presentation on the open items tracking system. The participants then discussed the changes to the PRA. Although it was agreed that the central issue concerned passive system reliability for the design, there are about 50 more conventional issues that were being reviewed in parallel with the reliability issue. Westinghouse indicated that it had significantly revised the format to make it easier to understand, and agreed to provide a cross-reference to further that understanding. The Level 1 PRA had been significantly changed, including revisions to the fault trees and reflection of the recent design changes. However, the Level 2 and 3 portions of the PRA had not been significantly changed. Westinghouse indicated that it used values from the Electric Power Research Institute's Advanced Light Water Reactor Utility Requirements Document, except where a value was deemed unattainable. In those cases, the applicant used typical Westinghouse values.

Westinghouse then presented a detailed discussion on the PRA concerning instrumentation and controls for the AP600.

Westinghouse also discussed the success criteria that it was proposing to use in its evaluation of the issue of passive system reliability. Westinghouse is using the MAAP4 code in its PRA evaluations. The staff indicated that it was concerned with the potential for core uncovery for extended periods. The staff further indicated that Westinghouse needed to systematically address adverse systems interactions for this design. The staff indicated that it expected the proposed approach would streamline the amount of work and the number of sequences necessary to be evaluated. However, the staff expressed concerns that Westinghouse's approach may not bound uncertainties, and requested the applicant to address its concerns.

DF03

At the end of the meeting, it was agreed to further discuss the evaluation approach around the third week of April.

original signed by:

Thomas J. Kenyon, Project Manager
Standardization Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Attachments:
As stated

cc w/attachments:
See next page

DISTRIBUTION w/attachment:
Docket File
PUBLIC
WHuffman
PDST R/F
TKenyon
DJackson
RArchitzel
MFranovich

DISTRIBUTION w/o attachment:
WRussell/FMiraglia, O-12 G18
DCrutchfield
ACRS (11)
Dean, EDO
MPolida, O-10 E4
BPalla, O-8 H7
MChiramal, O-8 H3
AThadani, O-12 G18
BGrimes
EJordan, T-4 D18
HLi, O-8 H3
AEl-Basioni, O-10 E4
YGHsii, O-8 E23
SSun, O-8 E23
RZimmerman, O-12 G18
TQuay
JMoore, O-15 B18
JGallagher, O-8 H3
NSaltos, O-10 E4
SWittenberg, O-8 H3

DOCUMENT NAME: A: OVERVW.LTE
To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	PM:DRPM:PDST		SC:DRPM:PDST							
NAME	TKenyon:sg		RArchitzel							
DATE	08/22/95		08/22/95							

cc: Mr. Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Analysis
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, PA 15230

Mr. B. A. McIntyre
Advanced Plant Safety & Licensing
Westinghouse Electric Corporation
Energy Systems Business Unit
Box 355
Pittsburgh, PA 15230

Mr. John C. Butler
Advanced Plant Safety & Licensing
Westinghouse Electric Corporation
Energy Systems Business Unit
Box 355
Pittsburgh, PA 15230

Mr. M. D. Beaumont
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
One Montrose Metro
11921 Rockville Pike
Suite 350
Rockville, MD 20852

Mr. Sterling Franks
U.S. Department of Energy
NE-42
Washington, DC 20585

Mr. S. M. Modro
EG&G Idaho Inc.
Post Office Box 1625
Idaho Falls, ID 83415

Mr. Charles Thompson, Nuclear Engineer
AP600 Certification
U.S. Department of Energy
NE-451
Washington, DC 20585

Mr. Frank A. Ross
U.S. Department of Energy, NE-42
Office of LWR Safety and Technology
19901 Germantown Road
Germantown, MD 20874

Mr. Ronald Simard, Director
Advanced Reactor Program
Nuclear Energy Institute
1776 Eye Street, N.W.
Suite 300
Washington, DC 20006-3706

STS, Inc.
Ms. Lynn Connor
Suite 610
3 Metro Center
Bethesda, MD 20814

Mr. James E. Quinn, Projects Manager
LMR and SBWR Programs
GE Nuclear Energy
175 Curtner Avenue, M/C 165
San Jose, CA 95125

Mr. John E. Leatherman, Manager
SBWR Design Certification
GE Nuclear Energy, M/C 781
San Jose, CA 95125

Barton Z. Cowan, Esq.
Eckert Seamans Cherin & Mellott
600 Grant Street 42nd Floor
Pittsburgh, PA 15219

Mr. Ed Rodwell, Manager
PWR Design Certification
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, CA 94303

PRA OVERVIEW
ATTENDANCE SHEET
MARCH 29 AND 30, 1995

NRC	**ORGANIZATION**
BRIAN MCINTYRE	WESTINGHOUSE
ANDREA STERDIS	WESTINGHOUSE
CINDY HAAG	WESTINGHOUSE
HULBERT LI	NRC/HICB
JOHN GALLAGHER	NRC/HICB
MARIE POLHIDA	NRC/SPSB
TOM KENYON	NRC/PDST
ADEL EL-BASSIONI	NRC/SPSB
NICK SALTOS	NRC/SPSB
NATHAN SIU	INEL
SELIM SANCAKTAR	W PRA
BARRY SLOANE	W PRA
JIM SCOBEL	W PRA
TRUDY MORRISON	W PRA
JIM FULFORD	NUS
CONSTANTINE TZANOS	ARGONNE NAT LAB
BOB PALLA	NRC/DSSA
EDMUND RUMBLE	ALWR PROGRAM
STEPHEN ADDITION	TENERA/ARSAP
ALAN BEARD	GE-NE
Y. GENE HSII	NRC/DSSA
SUZIE WITTENBERG	NRC/DRCH
MATT CHIRAMAL	NRC/HICB
S.B. SUN	NRC/DSSA
BRUCE MONTY	W RISK, RELIABILITY
JOHN WIESEMANN	W RISK, RELIABILITY

Attachment 1

AP600 PRA OVERVIEW

A TECHNICAL PRESENTATION OF THE RESULTS OF AP600 PRA REVISIONS 2 & 3

TO

UNITED STATES NUCLEAR REGULATORY COMMISSION

WESTINGHOUSE ROCKVILLE LICENSING OFFICE

MARCH 29, 1995

Attachment 2

AP600 PRA OVERVIEW

AGENDA

- Introduction — C. Haag
- Level 1 PRA Overview — S. Sancaktar
- Success Criteria Overview — B. Sloane
- Levels 2 & 3 PRA Overview — J. Scobel
- Discussion and Actions — All

CHRONOLOGY OF AP600 PRA

- Revision 0 — Original submittal of AP600 PRA (June 1992)
- Revision 1 — Update of Levels 2 & 3 PRA to include phenomenology (July 1994)
- Revision 2 — Update of Level 1 PRA (January 1995)
- Revision 3 — Update of Level 1 PRA to include conditional HRA
  Update Levels 2 & 3 PRA based on Level 1 results
  I&C PRA chapters
  Results chapter

AP600 PRA, REVISIONS 2 & 3

OUTLINE OF TABLE OF CONTENTS

Cross-Index of Rev. 0 AP600 PRA Chapter Numbers To Revised PRA Chapter Numbers

Rev. 2/3 Section No.	Rev. 0/1 Section No.	DESCRIPTION
1	1	INTRODUCTION
INTERNAL EVENTS - LEVEL I		
2	A, B	INTERNAL INITIATING EVENTS
3	A, B	MODELING OF SPECIAL INITIATORS
4	7, F	EVENT TREE MODELS
5	E	SUPPORT SYSTEMS
6	F, J	SUCCESS CRITERIA ANALYSIS
7	6, C1	FAULT TREE GUIDELINES
8	C19	PASSIVE CORE COOLING SYSTEM - PASSIVE RESIDUAL HEAT REMOVAL
9	C2	PASSIVE CORE COOLING SYSTEM - CORE MAKEUP TANK
10	C3	PASSIVE CORE COOLING SYSTEM - ACCUMULATOR
11	C5	PASSIVE CORE COOLING SYSTEM - AUTOMATIC DEPRESSURIZATION SYSTEM
12	C4	PASSIVE CORE COOLING SYSTEM - IN-CONTAINMENT REFUELING WATER STORAGE TANK
13	C7	PASSIVE CONTAINMENT COOLING SYSTEM
14	C8	MAIN AND STARTUP FEEDWATER SYSTEM
15	C9	CHEMICAL AND VOLUME CONTROL SYSTEM
16	C10	CONTAINMENT HYDROGEN CONTROL SYSTEM
17	C13	NORMAL RESIDUAL HEAT REMOVAL SYSTEM
18	C11	COMPONENT COOLING WATER SYSTEM
19	C14	SERVICE WATER SYSTEM
20	C15	CENTRAL CHILLED WATER SYSTEM
21	C16	AC POWER SYSTEM
22	C17	CLASS 1E DC POWER SYSTEM

Rev. 2/3 Section No.	Rev. 0/1 Section No.	DESCRIPTION
23	C17	NON-CLASS 1E DC POWER SYSTEM
24	C21	CONTAINMENT ISOLATION
25	C22	COMPRESSED AND INSTRUMENT AIR SYSTEM
26	C6, C18, C20	PROTECTION AND SAFETY MONITORING SYSTEM
27	C12	DIVERSE ACTUATION SYSTEM
28	C20	PLANT CONTROL SYSTEM
29	4, E	COMMON CAUSE ANALYSIS
30	5, D	HUMAN RELIABILITY ANALYSIS
31	---	OTHER EVENT TREE NODE PROBABILITIES
32	3	DATA ANALYSIS AND MASTER DATA BANK
33	F	FAULT TREE AND CORE MELT QUANTIFICATION
INTERNAL EVENTS - LEVEL II		
34	10, L	SEVERE ACCIDENT PHENOMENA TREATMENT
35	12, G	CONTAINMENT EVENT TREE ANALYSIS
36	R.1	DECOMPOSITION EVENT TREE - ANALYSIS OF IN-VESSEL RETENTION OF MOLTEN CORE DEBRIS
37	R.2	DECOMPOSITION EVENT TREE - ANALYSIS OF THERMALLY INDUCED FAILURES OF THE RCS PRESSURE BOUNDARY
38	R.3	DECOMPOSITION EVENT TREE - ANALYSIS OF IN-VESSEL STEAM EXPLOSION
39	R.4	DECOMPOSITION EVENT TREE - ANALYSIS OF EX-VESSEL STEAM EXPLOSION
40	R.5	DECOMPOSITION EVENT TREE - ANALYSIS OF EX-VESSEL DEBRIS COOLABILITY
41	R.6	DECOMPOSITION EVENT TREE - HYDROGEN COMBUSTION ANALYSIS
42	Q	CONDITIONAL CONTAINMENT FAILURE PROBABILITY DISTRIBUTION
43	G	RELEASE FREQUENCY QUANTIFICATION
44	K	MAAP 4.0 CODE DESCRIPTION AND AP600 MODELING

Rev. 2/3 Section No.	Rev. 0/1 Section No.	DESCRIPTION
45	11	FISSION PRODUCT SOURCE TERMS
46	15, O	HYDROGEN MIXING ANALYSIS
47	14, N	HYDROGEN BURN ANALYSIS
48	16	HYDROGEN IGNITER PLACEMENT
INTERNAL EVENTS - LEVEL III		
49	13, M	OFFSITE DOSE EVALUATION
ANALYSIS SUMMARY		
59	8, 17	PRA RESULTS

LEVEL 1 PRA

OVERVIEW

Selim Sancaktar

Risk, Reliability & Operations Improvement

AP600 PRA - AN OVERVIEW

- Objective of this presentation is to provide a technical overview of AP600 PRA revisions of 1995.

- Outline of this presentation:

  - An overview
  - Results
  - Initiating Events
  - Event Tree Models
  - Dominant Accident Sequences
  - System Failure Probabilities
  - Operator Actions
  - Common Cause
  - Plant Damage States
  - Conclusions

  - Success Criteria (Barry Sloane)
  - I&C Modeling (John Wiesemann)

  - Levels 2&3 Overview (Jim Scobel)

AP600 PRA - AN OVERVIEW

- Revisions 2 and 3, 1995
- Objectives of the revision
  - Incorporate design changes
  - Incorporate responses to review questions
  - Provide more basis for success criteria
  - Provide a more realistic I&C model
  - Incorporate level II upgrade (containment event tree)
  - Reorganize and improve technical documentation.

AP600 PRA - AN OVERVIEW

AP600

- Technical Scope : Internal Initiating Events at Power
  - Level I Analysis leading to Core Damage Frequency
  - Level II Analysis Leading to Severe Release Frequencies
  - Dose Analysis
  - Plant Risk Results associated with the above scope.

AP600 PRA - RESULTS

AP600

- Plant core damage frequency for internal initiating events at power is 2.4 E-07 /year.

- Large Fission Product Release frequency for internal initiating events at power is 1.0 E-08 /year. (*)

(*) "Large Release" = 25 rem or more at the site boundary in 24 hours.

AP600 PRA - INITIATING EVENTS

- 26 categories of generic and plant specific initiating events are studied.

- 11 loss of coolant accidents
  12 transients
  3 ATWS precursors, are evaluated.

- These categories were defined to accurately represent the AP600 design characteristics. Whenever appropriate, plant-specific initiating event categories such as safety injection line breaks, CMT line breaks and passive RHR tube ruptures are also defined.

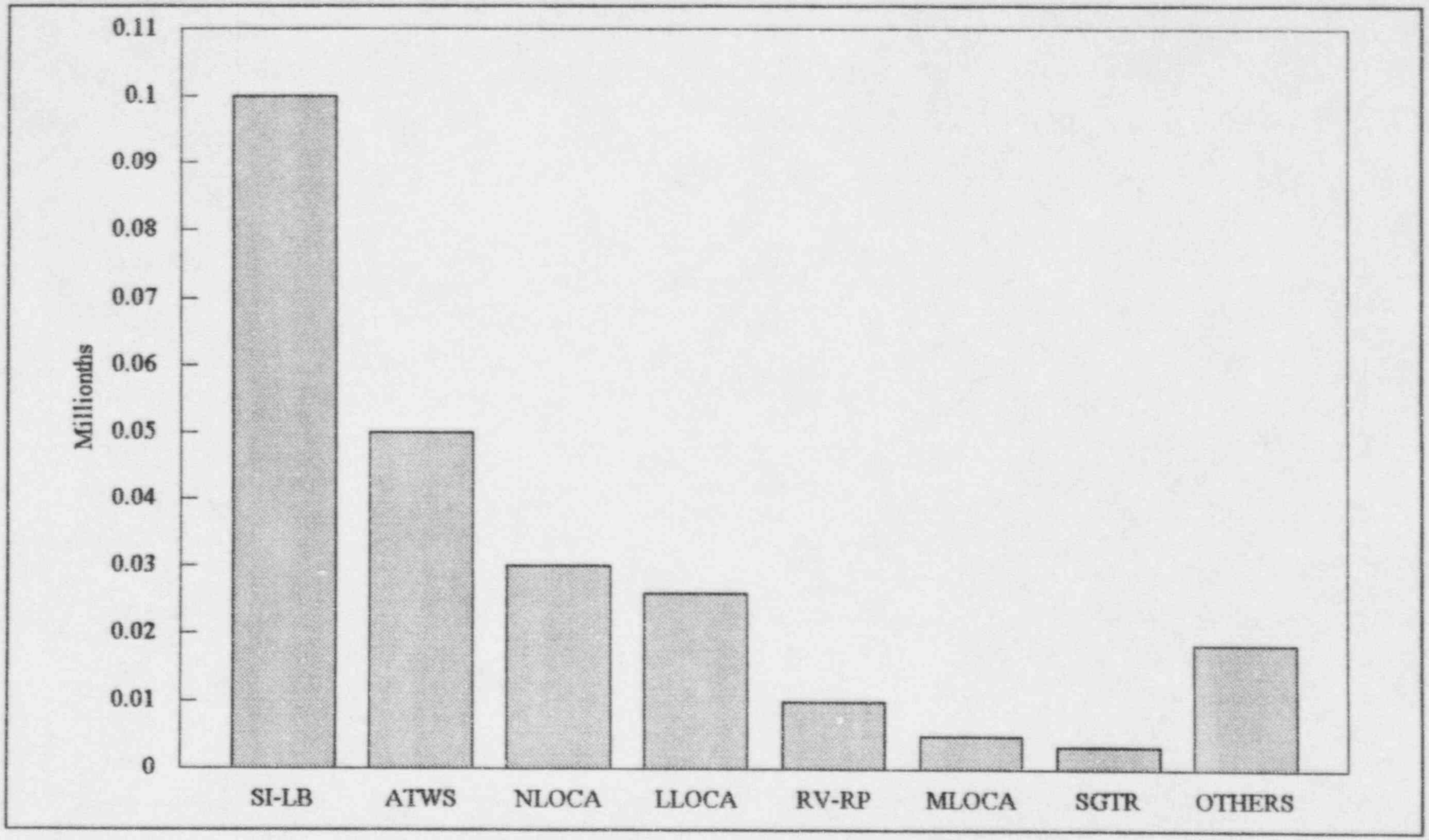
AP600 PRA - INITIATING EVENTS

- Four initiating events, three LOCAs and one ATWS precursor, comprise 85% of the total plant core damage frequency. These events are

  Safety Injection Line Break
  ATWS without MFW
  Intermediate LOCA
  Large LOCA.

- The reactor vessel rupture initiating event contributes an additional 4%; the remaining 21 initiating events contribute a total of 11% to the plant core damage frequency.

AP600 PRA - INITIATING EVENTS



AP600 PRA - INITIATING EVENTS

	CORE DAMAGE CONTRIBUTION	INITIATING EVENT CATEGORY	PERCENT CONTRIBUTION	I-EVENT FREQUENCY
1	1.0E-07	SAFETY INJECTION LINE BREAK INITIATING EVENT OCCURS	41.2	1.0E-04
2	5.0E-08	ATWS PRECURSOR WITH NO MFW INITIATING EVENT OCCURS	20.7	[6.1E-01](*)
3	3.0E-08	INTERMEDIATE LOCA INITIATING EVENT OCCURS	12.5	7.7E-04
4	2.6E-08	LARGE LOCA INITIATING EVENT OCCURS	10.6	1.1E-04
5	1.0E-08	REACTOR VESSEL RUPTURE INITIATING EVENT OCCURS	4.1	1.0E-08
6	5.0E-09	MEDIUM LOCA INITIATING EVENT OCCURS	2.0	1.6E-04
7	3.6E-09	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	1.5	5.2E-03
8	2.9E-09	RCS LEAK INITIATING EVENT OCCURS	1.2	1.2E-02
9	2.1E-09	SMALL LOCA INITIATING EVENT OCCURS	0.9	1.0E-04
10	2.0E-09	ATWS PRECURSOR WITH SI SIGNAL INITIATING EVENT OCCURS	0.8	[2.1E-02](*)
11	1.9E-09	PASSIVE RHR TUBE RUPTURE INITIATING EVENT OCCURS	0.8	5.0E-04
12	1.8E-09	CORE POWER EXCURSION INITIATING EVENT OCCURS	0.7	4.5E-03
13	1.7E-09	LOSS OF MAIN FEEDWATER INITIATING EVENT OCCURS	0.7	3.4E-01
14	1.7E-09	TRANSIENT WITH MFW INITIATING EVENT OCCURS	0.7	1.4E+00
15	1.5E-09	CMT LINE BREAK INITIATING EVENT OCCURS	0.6	8.9E-05
16	6.1E-10	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	0.2	1.2E-01
17	3.2E-10	LOSS OF CONDENSER INITIATING EVENT OCCURS	0.1	1.1E-01
18	2.8E-10	LOSS OF MFW TO ONE SG INITIATING EVENT OCCURS	0.1	1.9E-01
19	2.2E-10	MAIN STEAM LINE STUCK-OPEN SV INITIATING EVENT OCCURS	0.1	1.2E-03
20	1.9E-10	LOSS OF CCW/SW INITIATING EVENT OCCURS	0.1	1.6E-01
21	1.2E-10	INTERFACING SYSTEMS LOCA INITIATING EVENT OCCURS	0.1	1.2E-10
22	8.0E-11	ATWS PRECURSOR WITH MFW AVAILA. INITIATING EVENT OCCURS	0.0	[1.2E+00](*)
23	7.8E-11	LOSS OF COMPRESSED AIR INITIATING EVENT OCCURS	0.0	3.6E-02
24	5.2E-11	STEAM LINE UPSTREAM OF MSIV INITIATING EVENT OCCURS	0.0	3.7E-04
25	1.8E-11	LOSS OF RSC FLOW INITIATING EVENT OCCURS	0.0	1.8E-02
26	4.2E-12	STEAM LINE BREAK DOWNSTREAM OF MSIV INITIATING EVENT OCCURS	0.0	6.0E-04
	2.4E-07	TOTALS	100.0	2.4 (*)

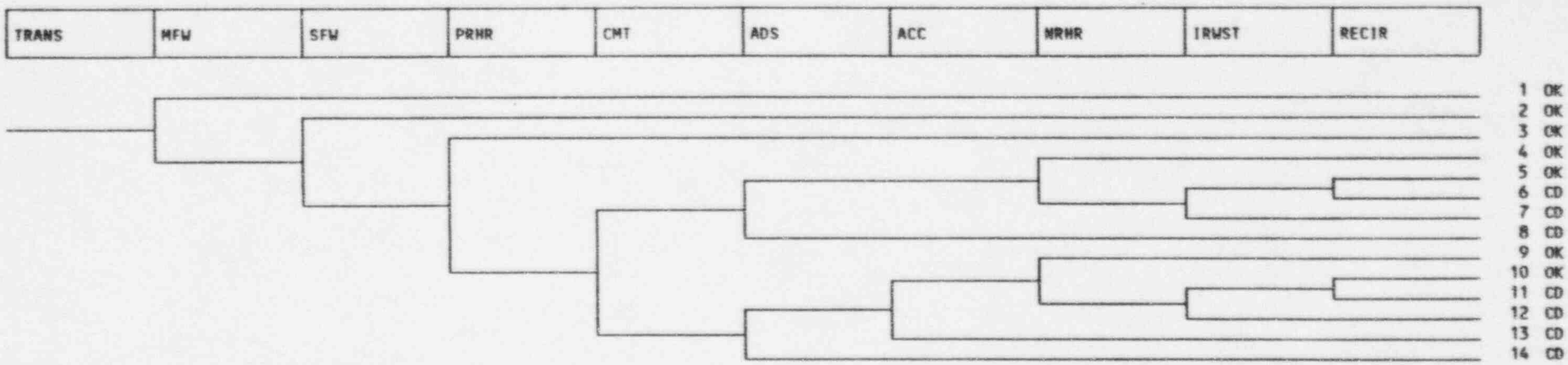
(*) = Note that the ATWS precursor frequencies are not included in the total initiating event frequency, since they are already accounted in the other categories.

AP600 PRA - EVENT TREE MODELS

- For each initiating event category, an event tree is constructed.
- Credit is taken for nonsafety as well as safety systems.
- Credit is taken for proceduralized tasks.
- Two templates define the general behavior of events for
  - transients and
  - Small LOCA.
- For each success path in an event tree, basis for success is established and documented.

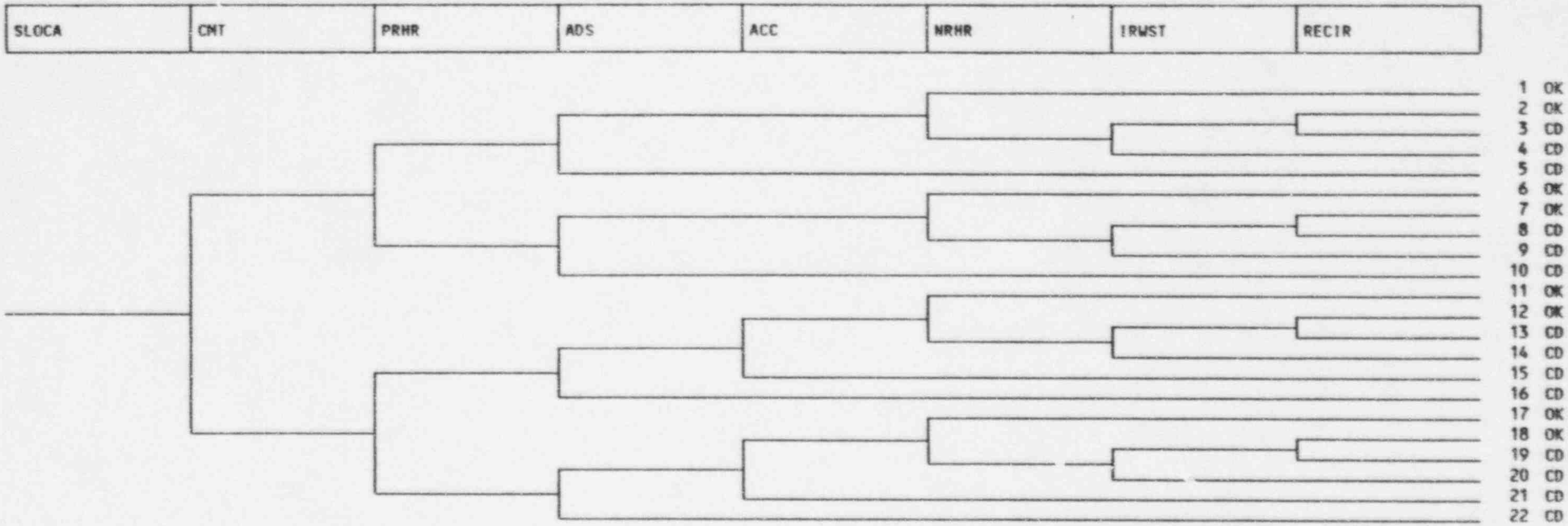
AP600 PRA - EVENT TREE MODELS

TRANSIENT EVENT TREE TEMPLATE



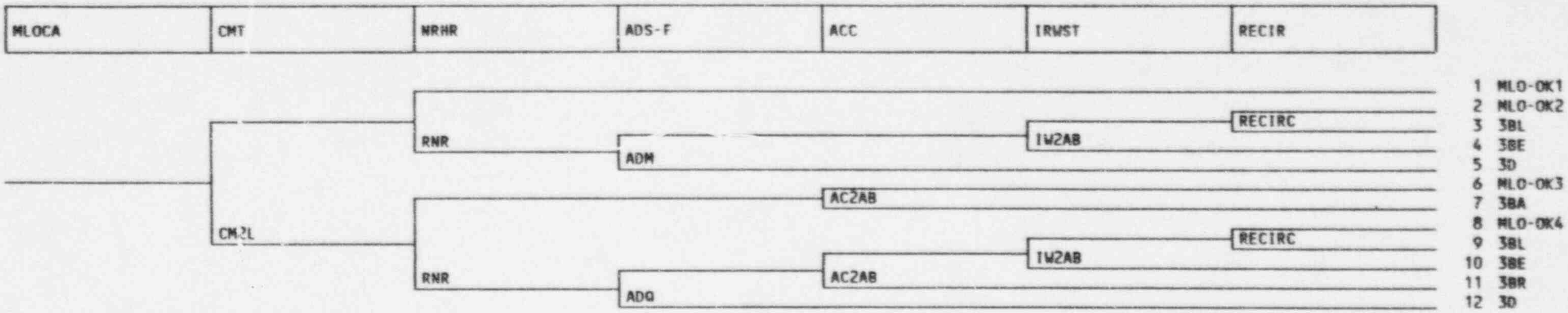
AP600 PRA - EVENT TREE MODELS

SMALL LOCA EVENT TREE TEMPLATE



AP600 PRA - EVENT TREE MODELS

MEDIUM LOCA EVENT TREE PICTURE



AP600 PRA - DOMINANT ACCIDENT SEQUENCES

- A total of 566 potential core damage event sequences for internal initiating events at power are modeled.

- Some sequences are composite sequences: they consist of similar event sequences combined and analyzed together (such as consequential SGTR resulting from various initiators). Therefore, a larger number of sequences are represented by the model.

- Of these 566 event sequences, 208 resulted in frequencies ranging from 8 E-08 to 2 E-15 per year. The remaining sequences did not produce any cutsets representing them in the top 21,000 cutsets that constitute the baseline analysis.

AP600 PRA - DOMINANT ACCIDENT SEQUENCES

- 13 sequences with the highest core damage frequency together contribute 90% of the total, or ~2.2 E-07 /year;
  - 50 sequences contribute 99.2% of the total, or ~2.41E-07/year;
  - 100 sequences contribute over 99.9% of the total, or over 2.43E-07/year.

AP600 PRA - DOMINANT ACCIDENT SEQUENCES

- Each sequence is composed of component-level cutsets, with a total of approximately 21,000 cutsets included in the baseline internal initiating events at power analysis (100% of 2.43E-07/year core damage frequency).

  - The 100 highest frequency cutsets contribute 90% of the total core damage frequency, or ~2.18E-07/year;

  - 200 cutsets contribute ~94% (2.28E-07/year);

  - 500 cutsets contribute ~97% (2.35E-07/year);

  - 1,000 cutsets contribute ~98% (2.39E-07/year);

  - 2,000 cutsets contribute ~99% (2.41E-07/year).

AP600 PRA - DOMINANT ACCIDENT SEQUENCES

NUMBER	SEQUENCE PROBABILITY	PERCENT CONTRIB	SEQUENCE DESCRIPTION				SEQUENCE IDENTIFIER
1	8.36E-08	34.36	SAFETY INJECTION	LINE BREAK	INITIATING EVENT OCCURS		IEV-SI-LB
			SUCCESS OF ONE	OF ONE CORE	MAKEUP TANK		DEL-CM1A
			SUCCESS OF	FULL ADS	DEPRESSURIZATION		DEL-ADM
			FAILURE OF ONE	OF ONE IRWST	INJECTION LINE		SYS-IW1A
2	2.97E-08	12.18	ATWS PRECURSOR	WITH NO MFW	INITIATING EVENT OCCURS		IEV-ATWS
			FAILURE OF	REACTOR TRIP DUE	TO PMS FAULTS		SYS-RTPMSS
			FAILURE OF	DIVERSE	ACTUATION SYSTEM		SYS-DAS
3	1.99E-08	8.17	ATWS PRECURSOR	WITH NO MFW	EVENT SEQUENCE	CONTINUES	SYS-ATWS
			SUCCESS OF	STARTUP FW OR	PASSIVE RHR	SYSTEM	DEL-XSRT
			FAILURE OF	MANUAL ROD	INSERTION		SYS-RTSTP
			FAILURE OF	PRIMARY DEPRESS.	DUE TO PRZR SV	OR UET	OTH-PRESU
4	1.72E-08	7.07	LARGE LOCA	INITIATING EVENT	OCCURS		IEV-LLOCA
			SUCCESS OF	ONE OR TWO	ACCUMULATORS		DEL-AC2AB
			FAILURE OF TWO	IRWST INJECTION	LINES		SYS-IW2AB
5	1.59E-08	6.53	SAFETY INJECTION	LINE BREAK	INITIATING EVENT OCCURS		IEV-SI-LB
			SUCCESS OF ONE	OF ONE CORE	MAKEUP TANK		DEL-CM1A
			FAILURE OF	FULL ADS	DEPRESSURIZATION		SYS-ADM
6	1.17E-08	4.79	INTERMEDIATE	LOCA INITIATING	EVENT OCCURS		IEV-NLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS		DEL-CM2NL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP		DEL-RCN
			SUCCESS OF	FULL ADS	DEPRESSURIZATION		DEL-ADM
			FAILURE OF	NORMAL RHR IN	INJECTION MODE		SYS-RNR
			FAILURE OF TWO	IRWST INJECTION	LINES		SYS-IW2AB
7	1.08E-08	4.43	INTERMEDIATE	LOCA INITIATING	EVENT OCCURS		IEV-NLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS		DEL-CM2NL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP		DEL-RCN
			FAILURE OF	FULL ADS	DEPRESSURIZATION		SYS-ADM
			SUCCESS OF	PARTIAL ADS	DEPRESSURIZATION		DEL-ADU
			FAILURE OF	NORMAL RHR IN	INJECTION MODE		SYS-RNR

AP600 PRA DOMINANT ACCIDENT SEQUENCES

AP600

8	1.00E-08	4.11	REACTOR VESSEL RUPTURE INITIATING EVENT OCCURS	IEV-RV-RP
9	7.32E-09	3.01	LARGE LOCA INITIATING EVENT OCCURS	IEV-LLOCA
			FAILURE OF TWO ACCUMULATORS	SYS-AC2AB
10	5.77E-09	2.37	INTERMEDIATE LOCA INITIATING EVENT OCCURS	IEV-NLOCA
			FAILURE OF REACTOR COOLANT PUMPS TO TRIP	SYS-RCN
			FAILURE OF FULL ADS DEPRESSURIZATION	SYS-ADQ
			FAILURE OF PARTIAL ADS DEPRESSURIZATION	SYS-ADUM
11	2.44E-09	1.00	MEDIUM LOCA INITIATING EVENT OCCURS	IEV-MLOCA
			SUCCESS OF ONE OR TWO CORE MAKEUP TANKS	DEL-CM2L
			FAILURE OF NORMAL RHR IN INJECTION MODE	SYS-RNR
			SUCCESS OF FULL ADS DEPRESSURIZATION	DEL-ADM
			FAILURE OF TWO IRWST INJECTION LINES	SYS-IW2AB
12	2.32E-09	.95	RCS LEAKAGE EVENT SEQUENCE LEADS TO SMALL LOCA EVENT	SYS-XRCSLK
			SUCCESS OF ONE OR TWO CORE MAKEUP TANKS	DEL-CM2SL
			SUCCESS OF REACTOR COOLANT PUMPS TO TRIP	DEL-RCL
			SUCCESS OF PASSIVE RHR SYSTEM	DEL-PRL
			SUCCESS OF FULL ADS DEPRESSURIZATION	DEL-ADS
			FAILURE OF NORMAL RHR IN INJECTION MODE	SYS-RNR
			FAILURE OF TWO IRWST INJECTION LINES	SYS-IW2AB
13	2.32E-09	.95	MEDIUM LOCA INITIATING EVENT OCCURS	IEV-MLOCA
			SUCCESS OF ONE OR TWO CORE MAKEUP TANKS	DEL-CM2L
			FAILURE OF NORMAL RHR IN INJECTION MODE	SYS-RNR
			FAILURE OF FULL ADS DEPRESSURIZATION	SYS-ADM
14	2.31E-09	.95	CONSEQUENTIAL SGTR EVENT OCCURS	SYS-IECSGTR
			SUCCESS OF REACTOR COOLANT PUMPS TO TRIP	DEL-RCL
			SUCCESS OF ONE OR TWO CORE MAKEUP TANKS	DEL-CM2SL
			SUCCESS OF PASSIVE RHR SYSTEM	DEL-PRL
			SUCCESS OF FULL ADS DEPRESSURIZATION	DEL-ADS
			FAILURE OF NORMAL RHR IN INJECTION MODE	SYS-RNR
			FAILURE OF TWO IRWST INJECTION LINES	SYS-IW2AB

AP600 PRA - DOMINANT ACCIDENT SEQUENCES

15	2.22E-09	.91	SGTR EVENT	SEQUENCE	CONTINUES	SYS-SGTR
			FAILURE OF	REACTOR COOLANT	PUMPS TO TRIP	SYS-RCL
			SUCCESS OF	PASSIVE RHR	SYSTEM	DEL-PRL
			FAILURE OF	FULL ADS	DEPRESSURIZATION	SYS-ADT
			FAILURE OF	PARTIAL ADS	DEPRESSURIZATION	SYS-ADZ
16	1.53E-09	.63	SMALL LOCA	INITIATING EVENT	OCCURS	IEV-SLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS	DEL-CM2SL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP	DEL-RCL
			SUCCESS OF	PASSIVE RHR	SYSTEM	DEL-PRL
			SUCCESS OF	FULL ADS	DEPRESSURIZATION	DEL-ADS
			FAILURE OF	NORMAL RHR IN	INJECTION MODE	SYS-RNR
			FAILURE OF TWO	IRWST INJECTION	LINES	SYS-IW2AB
17	1.46E-09	.60	CONSEQUENTIAL	SMALL LOCA FOLL.	PASSIVE RHR TUBE RUPTURE EVENT	SYS-IECSLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS	DEL-CM2SL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP	DEL-RCL
			SUCCESS OF	FULL ADS	DEPRESSURIZATION	DEL-ADA
			FAILURE OF	NORMAL RHR IN	INJECTION MODE	SYS-RNR
			FAILURE OF TWO	IRWST INJECTION	LINES	SYS-IW2AB
18	1.32E-09	.54	LARGE LOCA	INITIATING EVENT	OCCURS	IEV-LLOCA
			SUCCESS OF	ONE OR TWO	ACCUMULATORS	DEL-AC2AB
			SUCCESS OF ONE	OR TWO IRWST	INJECTION LINES	DEL-IW2AB
			FAILURE OF WATER	RECIRCULATION	THROUGH TWO OF TWO RECIRC LINES	SYS-RECIRC
19	1.28E-09	.53	ATWS PRECURSOR	WITH SI SIGNAL	INITIATING EVENT OCCURS	IEV-ATW-S
			FAILURE OF	REACTOR TRIP	BY PMS	SYS-RTPMS
			FAILURE OF	DIVERSE	ACTUATION SYSTEM	SYS-DAS

AP600 PRA DOMINANT ACCIDENT SEQUENCES

20	1.28E-09	.53	CMT LINE BREAK	INITIATING EVENT	OCCURS		IEV-CMTLB
			SUCCESS OF ONE	OF ONE CORE	MAKEUP TANK		DEL-CM1A
			FAILURE OF	NORMAL RHR IN	INJECTION MODE		SYS-RNR
			FAILURE OF	FULL ADS	DEPRESSURIZATION		SYS-ADM
21	1.00E-09	.41	INTERMEDIATE	LOCA INITIATING	EVENT OCCURS		IEV-NLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS		DEL-CM2NL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP		DEL-RCN
			SUCCESS OF	FULL ADS	DEPRESSURIZATION		DEL-ADM
			FAILURE OF	NORMAL RHR IN	INJECTION MODE		SYS-RNR
			SUCCESS OF ONE	OR TWO IRWST	INJECTION LINES		DEL-IW2AB
			FAILURE OF WATER	RECIRCULATION	THROUGH TWO OF	TWO RECIRC LINES	SYS-RECIRC
22	8.76E-10	.36	TRANSIENT WITH	MFW INITIATING	EVENT OCCURS		IEV-TRANS
			FAILURE OF MAIN	FW & STARTUP FW	& PASSIVE RHR	SYSTEMS	SYS-XSTW
			FAILURE OF	TWO CORE MAKEUP	TANKS		SYS-CM2AB
			FAILURE OF	FULL ADS	DEPRESSURIZATION		SYS-ADT
			FAILURE OF	PARTIAL ADS	DEPRESSURIZATION		SYS-AD1
23	7.71E-10	.32	SGTR EVENT	SEQUENCE	CONTINUES		SYS-SGTR
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP		DEL-RCL
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS		DEL-CM2SL
			SUCCESS OF	PASSIVE RHR	SYSTEM		DEL-PRL
			FAILURE OF	FULL ADS	DEPRESSURIZATION		SYS-ADS
			FAILURE OF	PARTIAL ADS	DEPRESSURIZATION		SYS-ADV
24	7.50E-10	.31	ATWS PRECURSOR	WITH NO MFW	EVENT SEQUENCE	CONTINUES	SYS-ATWS
			SUCCESS OF	STARTUP FW OR	PASSIVE RHR	SYSTEM	DEL-XSRT
			SUCCESS OF	MANUAL ROD	INSERTION		DEL-RTSTP
			FAILURE OF	PRIMARY	DEPRESSURIZATION	DUE TO PRZR SV	OTH-PRES
25	7.17E-10	.29	INTERMEDIATE	LOCA INITIATING	EVENT OCCURS		IEV-NLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS		DEL-CM2NL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP		DEL-RCN
			FAILURE OF	FULL ADS	DEPRESSURIZATION		SYS-ADM
			FAILURE OF	PARTIAL ADS	DEPRESSURIZATION		SYS-ADU

AP600 PRA DOMINANT ACCIDENT SEQUENCES

AP600

26	6.79E-10	.28	CONSEQUENTIAL	INTERMEDIATE	LOCA EVENT	OCCURS	SYS-IECNLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS		DEL-CM2NL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP		DEL-RCN
			SUCCESS OF	FULL ADS	DEPRESSURIZATION		DEL-ADM
			FAILURE OF	NORMAL RHR IN	INJECTION MODE		SYS-RNR
			FAILURE OF TWO	IRWST INJECTION	LINES		SYS-IW2AB
27	6.43E-10	.27	ATWS PRECURSOR	WITH SI SIGNAL	INITIATING EVENT	OCCURS	IEV-ATW-S
			FAILURE OF	REACTOR TRIP	BY PMS		SYS-RTPMS
			SUCCESS OF	DIVERSE	ACTUATION SYSTEM		DEL-DAS
			FAILURE OF	MGSETS TO OPEN			OTH-MGSET
			SUCCESS OF	STARTUP FW OR	PASSIVE RHR	SYSTEM	DEL-XSRT
			FAILURE OF	MANUAL ROD	INSERTION		SYS-RTSTP
			FAILURE OF	PRIMARY DEPRESS.	DUE TO PRZR SV	OR UET	OTH-PRESU
28	6.30E-10	.26	CONSEQUENTIAL	INTERMEDIATE	LOCA EVENT	OCCURS	SYS-IECNLOCA
			SUCCESS OF ONE	OR TWO CORE	MAKEUP TANKS		DEL-CM2NL
			SUCCESS OF	REACTOR COOLANT	PUMPS TO TRIP		DEL-RCN
			FAILURE OF	FULL ADS	DEPRESSURIZATION		SYS-ADM
			SUCCESS OF	PARTIAL ADS	DEPRESSURIZATION		DEL-ADU
			FAILURE OF	NORMAL RHR IN	INJECTION MODE		SYS-RNR

AP600 PRA - SYSTEM FAILURE PROBABILITIES

- System failure probabilities are calculated by fault tree modeling for safety and nonsafety systems.

- Mostly, EPRI URD data is used for basic event probabilities. noted.

- Typical system failure probabilities are shown in the next slide.

AP600 PRA - SYSTEM FAILURE PROBABILITIES

	Diesel Generators	1.2e-02	DGEN	
	Startup Feedwater	1.2e-02	SFWT	
	Comp. Cooling Water	1.4e-02	CCT	
	Service Water	1.4e-02	SWT	
	Compressed Air	1.5e-02	CAIR	
	Condenser	3.2e-02	CDS	
	Main Feedwater	3.8e-02	FWT	(including condenser)
	CVCS	4.4e-02	CVS	
	Normal RHR	9.0e-02	RNR	
	Containment Isol.	1.4e-03	CIC	
	Hydrogen Control	1.5e-03	VLH	
	Reactor Trip by DAS	1.6e-03	DAS	(including operator action; excluding MGSET failure))
	Chilled Water	1.6e-03	VWH	
	RC Pump Trip	2.1e-03	RCT	
	4160 vac Bus	4.0e-03	ECES1	(one bus only)
	480 vac Bus	6.7e-03	ECEK11	(one bus only)
	Passive Cont. Cool.	1.0e-04	PCT	
	Passive RHR	1.0e-04	PRT	
	Core makeup Tanks	1.1e-04	CM2SL	
*	ADS	1.5e-04	ADS	(no credit for operator actions)
	IRWST	1.6e-04	IW2AB	
	125 vdc 1E Bus	3.1e-04	IDADS1	(one bus only)
	DC Bus (Non-1E)	3.6e-04	ED1DS1	(one bus only)
*	CMT Valve Signal	5.2e-06	CMT-IC11	(one train; auto actuation only)
	ADS	3.3e-06	ADS	(including operator actions)
	Reactor Trip by PMS	1.2e-05	RTPMS	(including operator actions; Westinghouse RT breaker data)
	Accumulators	6.9e-05	AC2AB	
*	Reactor Trip by PMS	8.8e-05	ADS	(no credit for operator actions)
*	P-RHR Valve Signal	1.2e-05	RHR-IC01	(one train; auto actuation only)
	CMT Valve Signal	4.2e-07	CMT-IC11	(one train; auto and manual actuation)
	P-RHR Valve Signal	9.3e-07	RHR-IC01	(one train; auto and manual actuation)

* = For these systems/trains, failure probability with or without credit for manual actuation is provided.

AP600 PRA - OPERATOR ACTIONS

- Credit is taken for various team tasks to be performed in the control room by a team of trained professionals.

- Credit is taken for extensive improvements in Westinghouse ERGs and FRGs since mid 1980; namely

  - symptom-based procedures eliminate or minimize diagnosis errors;

  - a very strong diversity is introduced through monitoring of status trees by an engineer, who is not a regular member of the team.

- Most tasks are rule-based, with few skill based tasks for ATWS precursors.

AP600 PRA - OPERATOR ACTIONS

- Tasks are usally termed as operator actions, which may be misleading in most cases; the tasks almost always refer to the completion of a well defined mission by a team of trained professionals following procedures.

- Not every individual or group error during a mission necessarily fails the mission. Procedural recovery is built into emergency procedures; additional recovery is available through monitoring of status trees.

- 32 such "operator actions" appear in the dominant core damage cutsets. These actions are listed later.

AP600 PRA - OPERATOR ACTIONS

- It is expected that a team of trained professionals will have an average mission failure probability at the order of 1.0E-03 or less, during the performance of a task, when the following conditions are met:

  - there is no prior related team failure during the event; or if there is one, it has been followed by a successful task;

  - time window available for the task is equal to or greater than the expected time interval for completion of the task;

  - task is not knowledge-based.

AP600 PRA - OPERATOR ACTIONS

List of Team Mission Failure ("Operator Actions") Probabilities in Dominant Core Damage Cutsets

ATW-MAN01C	5.2E-01	
ATW-MAN04C	5.3E-01	Very High Failure Probability
LPM-MAN02C	5.0E-01	
LPM-MAN04C	5.0E-01	
REC-MANDASC	5.1E-01	
REG-MAN00	2.0E-01	
ATW-MAN01	3.3E-02	
ATW-MAN03	5.2E-02	
ATW-MAN04	5.2E-02	High Failure Probability
CVN-MAN04	4.0E-02	
REC-MANDAS	1.2E-02	
ATW-MAN05	5.2E-03	
ATW-MAN06	5.2E-03	
ATW-MAN11	1.1E-03	
CIB-MAN00	1.8E-03	
CIB-MAN01	1.3E-03	
CVN-MAN02	1.6E-03	Average Failure Probabilities
CVN-MAN03	1.1E-03	
DUMP-MAN01	1.3E-03	
LPM-MAN01	2.2E-03	
LPM-MAN02	6.5E-03	
LPM-MAN03	2.2E-03	
LPM-MAN04	6.5E-03	
LPM-MAN08	6.5E-03	
REN-MAN02	2.0E-03	
RHN-MAN01	2.9E-03	
VWN-MAN01	5.2E-03	
ZON-MAN01	2.7E-03	
ADN-MAN01	4.9E-04	
HPM-MAN01	5.0E-04	Low Failure Probabilities
PRI-MAN01	5.0E-04	
PRN-MAN03	8.8E-04	
None		Very Low Failure Probabilities

AP600 PRA - OPERATOR ACTIONS

- Most of the task failure probabilities used in the dominant cutsets are within a close range of an average (1.0 E-03) failure probability.

- The very high failure probability tasks are mostly the conditional failures following a prior related task failure in the same event sequence. Such conditional probabilities are assigned when multiple related task failures not separated by intermediate task succcesses are identified in dominant cutsets.

- The following represents a preliminary evaluation of human error basic event importances based on the core damage frequency results. Further importance evaluation may result in additional insights.

AP600 PRA - OPERATOR ACTIONS

AP600

- RISK- IMPORTANCE - RISK DECREASE

  - The risk decrease table shows that there are only two tasks with importance greater than 10%, and only six with importances greater than 1%.

  - This indicates that there would be no significant benefit from additional refinement of the actions modeled.

  - The three most important tasks in this ranking are ATWS-response actions, and two of these have been assigned dependent, or conditional, failure values; that is, their importance is increased as a result of their dependence on preceding failed tasks.

AP600 PRA - OPERATOR ACTIONS

- RISK IMPORTANCE - RISK INCREASE

  - There are five tasks with importance greater than 100%. These are the only modeled tasks whose guaranteed failure would result in a core damage contribution greater than the base case CDF.

  - The most important action in this ranking (Operator Fails to Actuate ADS) results in a order of magnitude, increase in CDF.

  - All five of the top tasks in this ranking would increase CDF by a factor of roughly 20. This indicates that the plant design is relatively insensitive to failure of tasks and the core damage models do not take undue credit for operator response.

AP600 PRA - COMMON CAUSE

Common-cause failure (CCF) of the following sets of components was found to have a impact on the estimated CDF from internal events (using risk-increase measure):

- Software CCF of all logic cards in the various control and protection systems. Should such a common software failure occur and go undetected, the CDF from internal events would increase from 2.43E-7 events per year to 2E-3 events per year.

- Logic boards of the protection and safety monitoring system (PMS). Should such sets of hardware components fail and go undetected, the CDF would increase to 6.1E-4.

AP600 PRA - COMMON CAUSE

- CCF of other PMS components also have importance; these include EPO boards (CDF increase of 520 times), and input circuitry/cabinets (CDF increase of 16 times).

- Transmitters used in the PMS. Should all of such transmitters become unavailable and the plant continues to operate at power, the CDF would increase to 6E-4. Other specific transmitter and sensor CCF with significant importance include temperature transmitters (CDF increase of 56 times) and CMT level switches (CDF increase of 21 times). If all indication were to fail by common cause and be left undetected, the CDF would increase by 72 times.

AP600 PRA - COMMON CAUSE

- The reactor trip breakers. Should they become unable to operate as designed (i.e., fail to open when a reactor trip signal is generated) and the plant continues to operate at power, the CDF would increase to 4.9E-4.

- Containment sump recirculation screen plugging. Should the recirculation screens all become plugged following a severe accident, the CDF would increase to 2.5E-04.

- The IRWST gravity injection line check valves. Should such check valves in both injection lines become unable to operate as designed (i.e., open), the CDF would increase to 2.5E-4. Should both check valves be unable to operate in the one available gravity injection line following a safety injection line break, the CDF would increase to 1.0E-4.

AP600 PRA - COMMON CAUSE

- The strainers in the IRWST tank. Should the strainers in both injection lines from the IRWST become plugged, the CDF would increase to 2.4E-4. Should the strainer in only IRWST discharge line "A" become plugged, the CDF would increase to 1.1E-4.

- The fourth stage ADS explosive ("squib") valves. Should all of these valves become unable to operate when required, the CDF would increase to 2.1E-4.

- The accumulator check valves. Should the accumulator check valves in both accumulators become unable to open, the CDF would increase to 1.1E-4.

AP600 PRA - COMMON CAUSE

AP600

- The accumulator tanks. If both accumulator tanks were to somehow fail due to common cause and not be detected, the CDF would increase to 1.1 E-04.

- The four air operated valves (AOVs) in both CMT injection lines. Should such AOVs become unable to operate as designed (i.e., open) and the plant continues to operate at power, the CDF would increase approximately to about 4.6E-6 events per year.

AP600 PRA - PLANT DAMAGE STATES

- The dominant core damage sequence are grouped into 7 end states (plant damage states/ PDS).

  - Three of these PDS are high pressure core damage states (RCS pressure is high at the time of core damage).

  - One of the PDS is a containment bypass state.

  - The remaining three PDS states are low pressure states (equivalent to Large LOCA or full ADS depresurization).

- The core damage sequences are grouped by these states, to be further processed for containment response analysis. The frequencies of these PDS states are shown next.

AP600 PRA - PLANT DAMAGE STATES

Plant Damage State Frequencies
Before Credit Taken for ADS Depressurization

PDS	Frequency	Description
1A	5.4E-08	High pressure RCS; passive RHR not available;
1AP	7.9E-09	1A with passive RHR available;
3D	3.5E-08	Partial RCS depressurization after a LOCA (except Large LOCA);
3BE	1.2E-07	Full RCS depressurization;
3BR	7.9E-09	Full RCS depressurization; CMT and accumulators fail;
3C	1.0E-08	Core damage following reactor vessel rupture;
6E	5.7E-09	Early core damage with containment bypass (such as SGTR or ISLOCA).
TOTAL	2.4E-07 /year.	

AP600 PRA - PLANT DAMAGE STATES

- However, credit is taken for manual RCS depressurization after core damage by using ADS. This allows some high pressure PDS states to progress like the 3BR low pressure state.

- After this RCS depressurization, the four affected PDS states are labeled by a "c" extension (for example 1AC = 1A continues).

- The ensuing seven PDS are then further processed by containment analysis.

The contribution of these seven end states to core damage is shown next. This distribution of frequencies by plant damage state is illustrated in the next figure.

AP600 PRA - PLANT DAMAGE STATES

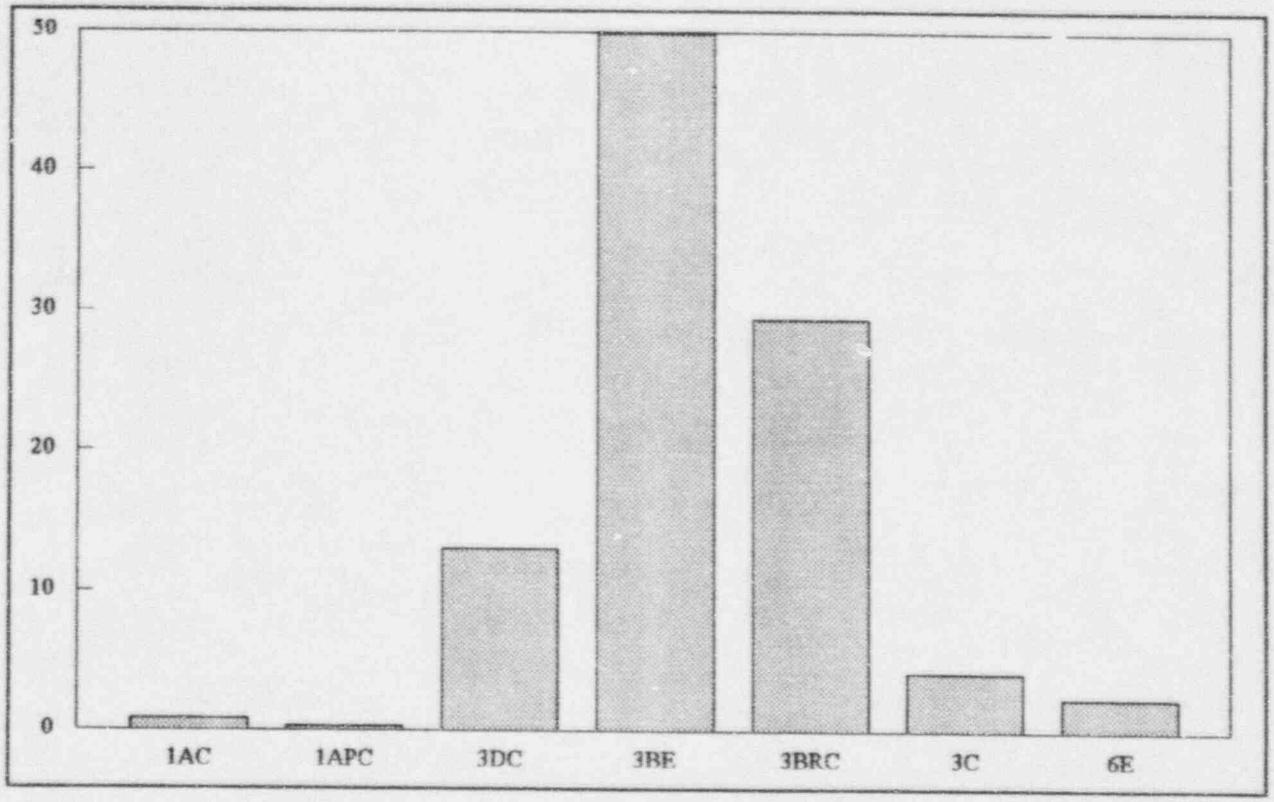
AP600

Plant Damage State Frequencies
After Credit Taken for ADS Depressurization

PDS	Frequency	% Contribution
1AC	2.0E-09	0.8
1APC	8.1E-10	0.3
3DC	3.1E-08	12.9
3BE	1.2E-07	49.9
3BRC	7.1E-08	29.5
3C	1.0E-08	4.2
6E	5.7E-09	2.4
TOTAL	2.4 E-07	100

AP600 PRA - PLANT DAMAGE STATES

PLANT DAMAGE STATE FREQUENCIES
(percent contribution to total)



AP600 PRA - CONCLUSIONS

The following conclusions can be drawn from the results of the AP600 PRA for internal initiating events at power:

- CDF is very low - two orders of magnitude lower than current PWRs.
- 4 % of the CDF is classified as large fission product release.
- The plant is very robust against transients and loss of support system events.
- Loss of Offsite Power and Station Blackout Events are not risk-important.
- LOCAs and ATWS are the risk-important events.

AP600 PRA - CONCLUSIONS

- CDF is not sensitive to operator actions, although important operator actions still exist for ATWS mitigation, and ADS actuation if automatic actuation fails.

- System and sequence failures are dominated by CCF.

- Common cause I&C failures are important contributors to sequence failures, as expccted, since they can potentially defeat the existing multiple layers of safety and nonsafety systems.

AP600 PRA - CONCLUSIONS

AP600

- The current PRA is a more mature product and better represents the AP600 design.
- The technical documentation and supporting bases are improved in all areas; especially in success criteria and I&C modeling.
- One of the reasons for the improvements is the rigorous reviews that the model has undergone, and incorporation of the review comments into the current revision.

SUCCESS CRITERIA

OVERVIEW

Barry Sloane

Risk, Reliability & Operations Improvement

AP600 PRA SUCCESS CRITERIA OVERVIEW

Discussion of

- Analysis Objectives
- Starting Point
- Approach
- Significant Observations

SUCCESS CRITERIA ANALYSIS OBJECTIVES

AP600

The Success Criteria Must Be:

- Complete
  - Developed Complete Set of Success Criteria to Cover
    - All Success Paths for All Events
    - Each Case for Each Event Tree Node
  - Prepared Clear, Traceable Documentation

- Consistent
  - Among Event Sequence and Fault Tree Assumptions
  - Among Event Sequence and HRA Assumptions
  - With Design Bases

The Success Criteria Must:

- Have Clearly Defined Bases

- Account for Appropriate Uncertainties and System Interactions

SUCCESS CRITERIA ANALYSIS STARTING POINT

PRA Revision 2 Task Started With

- PRA Revision 0 Criteria
  - Existing Set of Sequence Success Paths
  - Existing Set of Fault Tree Cases
- Set of AP600 Design Refinements Since Rev. 0
- Several NRC RAIs on the Rev. 0 Information
- Weak Documentation

SUCCESS CRITERIA ANALYSIS END POINT

AP600

PRA Revision 2 Task Ended With

- Updated Criteria
  - Reflecting Updated Sequence Success Paths
  - Specifying Complete Set of Updated Fault Tree Cases
  - Addressing AP600 Design Refinements Since Rev. 0
  - Addressing Questions Raised in NRC RAIs and in Reviews
    - Sensitivities to: System Interactions
      Actuation Timing
      T/H Parameters

- Substantially Enhanced Documentation
  - PRA Section 6 (Main Documentation)
  - PRA Appendix A (Supporting MAAP Analyses)

SUCCESS CRITERIA APPROACH

AP600

GENERAL APPROACH

Iterative, Interactive Approach to Establishing Success Paths and Criteria

- Start With Event Sequence as Defined
- Identify Appropriate Tool for Defining Criteria
- Perform Analyses as Required to Justify Criteria, Including Interaction With HRA, Event/Fault Tree, Design Functions
- Establish Criteria, Revise Sequence and Fault Trees as Necessary

GENERAL TOOLS FOR SUCCESS CRITERIA

AP600

- Design Basis Analyses, Where
  - Conservatisms Do Not Affect Conclusions
    - e.g., Large LOCA
  - Success Criteria Cannot Be Otherwise Refined
    - e.g., 1 of 2 Trains for a Required System

- MAAP Analyses Using MAAP4

- Other Analyses (e.g., for ATWS)

- Engineering Calculations

- Engineering Judgement Based on Relevant Experience or Data

SUCCESS CRITERIA EVOLUTION

AP600

- Primary Modeling Tool is MAAP4
  - LOCAs (Except Large LOCA)
  - Transients Following Loss of Decay Heat Removal
- Model Sequence With MAAP4 to Verify Base Case Success
- Identify Other Possible Conditions Covered By Sequence, e.g.,
  - Actuation Delay if Crediting Operator Actions
  - Range of Break Sizes and Locations
  - Operation of More Injection Sources Than "Required"
  - Logic "Transfers" to Other Scenarios (e.g., Stuck PSV)
- Model Other Sequence Conditions With MAAP to Verify Success of Sequence for the Range of Conditions Covered
- Establish Sequence Success Criteria to Bound Conditions

SUMMARY OF SUCCESS CRITERIA

AP600

ACTIVE SYSTEMS

- Success Criteria Generally Based on Existing Design Bases Analyses, Design Specifications, or Engineering Judgement

- In General, Success of a 2-Train System Requires Operation of 1 Train, e.g.,

  - Startup Feedwater
  - Normal Residual Heat Removal
  - Chemical and Volume Control System

SUMMARY OF SUCCESS CRITERIA

AP600

PASSIVE SYSTEMS

- Success Criteria Generally Based on MAAP4 Analyses or Design Basis

- General Sequence Success Philosophy for Passive System Success Criteria

  - Credit Only One CMT OR Accumulator
  - Credit Only One Passive RHR Heat Exchanger
  - Credit Only One IRWST Injection/Recirc Path

  - Vary ADS Requirements to Establish Sequence Success

  - Verify That Additional Injection Train Credit Produces Results As Good As Or Better Than With One Injection Train

SCOPE OF MAAP4 ANALYSES

MAAP ANALYSES:

- Establish ADS Configuration Required to Depressurize RCS to Normal RHR Injection Pressure
- Establish ADS Configuration Required to Depressurize RCS to Gravity Injection Conditions
- Establish Time Window Available for Operator Actions to Actuate RCS Depressurization and Normal RHR
- Establish Time to Conditions at Which Normal RHR Injection and Gravity Injection Can Function to Avoid Core Damage
- Do Not Credit Startup Feedwater Operation

OVER 300 MAAP4 RUNS WERE MADE TO ESTABLISH THE PRA SUCCESS CRITERIA

WHAT WE HAVE LEARNED

AP600

- Results Do Not Show Unexpected System Interactions
- No Analysis Assumptions Were Identified Which Would Change Conclusions if Varied Over a Credible Range (i.e., no "Cliffs")
- LOCA Break Size Categories Have Been Defined Based on System Performance
- Margin Exists in the Selected Success Criteria for All Sequences
  - If a Currently Unidentified Sensitivity Were Identified Later, We Have Ability to Make ADS Criteria More Restrictive
  - Since We Are Not "Out of Valves," This Would Not Invalidate the Sequence, Only Affect the Probability of Success
  - Impact of Any Such Changes on Core Damage/Risk Results Not Expected to Affect Conclusions

AP600

LEVELS 2 & 3 PRA

OVERVIEW

Jim Scobel

Risk, Reliability & Operations Improvement

AP600 Containment Event Tree

- Structure and phenomena split fractions not updated since revision 1, (all quantification differences due to system fault tree revisions.)

- Total of 20 Nodes on Tree

  - 2 Operator Action Nodes
  - 5 Systems Nodes
  - 9 Phenomena Nodes
  - 4 Containment Failure Nodes

- 2860 Paths on the CET Structure

  - Quantified Explicitly for 6 Accident Classes
  - 17160 Accident Sequences Quantified

- End-States Grouped into 11 Release Categories

Summary of CET Top Events (Nodes)

- Operator Actions Modeled on CET
  - Post-Core Damage Manual Depressurization
  - Cavity Flooding

- Systems Modeled on CET
  - Containment Isolation (2 Nodes, Operation and Leakage)
  - Passive Containment Cooling Water
  - Hydrogen Control
  - Water Sources to Containment (Accums, CMTs, IRWST)

- Containment Failure Nodes and Time Frames
  - Early Containment Failure (Prior to Vessel Failure)
  - Intermediate Containment Failure (VF to 24 Hours)
  - Late Containment Failure (24 to 72 Hours)
  - Very Late Containment Failure (> 72 Hours)

Summary of CET Top Events (Continued)

- Phenomena Modeled on CET
  - Creep Rupture Failure of SG Tubes
  - Creep Rupture Failure of Hot Leg Nozzles
  - In-Vessel Steam Explosion
  - Reactor Vessel Failure into a Flooded Cavity
  - Early Hydrogen Deflagration and Detonation
  - Debris Quench and Long-Term Coolability
  - Short-Term Core-Concrete Interaction
  - Intermediate Hydrogen Deflagration and Detonation
  - Late Hydrogen Deflagration and Detonation

CET Quantification

- Operator actions and containment systems failure quantified using fault tree linking. Updated in revision 2/3.
- Severe accident phenomena quantified with decomposition event trees. Unchanged in revision 2/3.
- Containment failure probability quantified using a conditional containment failure probability distribution as function of pressure. Unchanged in revision 2/3.

Results

- The frequency of large release is 1.0×10^{-8} per reactor year. This is a conditional containment failure probability of 4.1%.
  - 57% of LRF due to SGTR initiated accidents
  - 21% due to containment isolation failure
  - 19% due to excessive containment leakage
  - 1.5% due to thermally-induced SGTR
  - 1.5% due to basemat penetration
  - 1.3% due to early containment failure
  - <0.1% due to intermediate containment failure
  - <0.1% due to late containment failure

Severe Accident Insights from PRA Revision 2/3

- Overall risk is dominated by containment bypass (SGTR) which contributes greater than 84% of the risk
- The other major contributor to risk is containment isolation failure which contributes greater than 14% of the risk
- Many core damage sequences are arrested in-vessel by flooding the reactor cavity and externally cooling the reactor vessel. Cavity flooding is failed in only 1.8% of the sequences
- Flooding the reactor cavity to maintain core debris in the vessel reduces the likelihood of containment failure. For cases in which the containment is not initially failed:
    - CCFP with successful flooding 0.65%
    - CCFP with failure of flooding 2.2%

PRA Severe Accident Insights (continued)

- The likelihood of HPME is very low based on the reliability of the ADS and passive RHR

- The probability of long-term failure of the containment due to decay heat steaming is very near zero due to the passive containment heat removal. This does not depend of the operation of the passive containment cooling water since dry-shell heat removal is sufficient to remove decay heat at pressure significantly below the ultimate capacity of the containment.

- The containment of the AP600 provides water and surface area in the cavity to promote ex-vessel debris coolability in the event of vessel failure

- Hydrogen deflagration for 100% zirc-water reaction results in containment pressurization well within the ultimate capacity of the containment

PRA Severe Accident Insights (continued)

- The conditional probability of containment failure, including bypass, isolation failure, excessive leakage, and basemat penetration is 0.041. The containment provides a reliable barrier to fission product release.

PRA I&C ANALYSIS

John S. Wiesemann

Reliability Engineering

March 29, 1995

PRA I&C ANALYSIS

- Agenda
  - Data, Sources, CCF
  - Availability Results for ADS, CMTS
  - Modeling Changes for Rev 2 PRA
  - Design Change Highlights

PRA I&C ANALYSIS - DATA

- Component Data Sources
  - Vendor Data (e.g. Intel)
  - Operating Data (e.g. IEEE 500)
  - Analysis Data (e.g. MIL-217F)
  - Typical Board Rate = 50000 hrs MTBF
- CCF - Beta Factor Sources
  - Rolls Royce and Assoc. LTD
  - M-Board Beta = .08
  - E-Board Beta = .05
  - Sensor Beta = .04

PRA I&C ANALYSIS - CCF

- Development of Beta Factors
  - Design
    - Separation
    - Similarity
    - Complexity
    - Analysis
  - Operation
    - Procedures
    - Training
  - Environment
    - Control
    - Tests

PRA I&C ANALYSIS - CCF

- Expert opinion guideline value: 1E-04 f/d
  - Applied and the overall system level
  - Represents the expected CCF contribution

- AP600 PRA Application
  - CCF contribution at the system level 1E-04 f/d
  - CCF contribution at the component level = 1E-06 to 1E-05 f/d
  - Software CCF among equivalent subsystems: 1.1E-05 f/d
    - Integrated Protection Cabinets
    - Engineered Safety Features Cabinets
    - Protection Logic Cabinets
    - Control Logic Cabinets
  - Software CCF among different subsystems: 1.2E-06 f/d
    - Protection and Safety Monitoring System
    - Plant Control System
  - Development and support of Software CCF addressed in response to RAI 720.91

PRA I&C ANALYSIS - EXPERIENCE DATA & CCF

- Sizewell B 1000 hour test
  - Approximately 4E+06 Board Hours
  - 2-Sided 90% confidence bound results
    - LCB = 130,000 hours
    - UCB = 290,000 hours
    - Avg. analysis board rate = 45,000 hours
  - No hardware CCF events
  - No software CCF events

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS fault tree
  - ADS automatically actuated given small LOCA and PRHR success
    - Unavailability = 3.26E-06 f/d
    - I&C importance decrease = 5.8%

- CM2SL fault tree
  - Failure of CMT system given small LOCA
    - Unavailability = 1.13E-04 f/d
    - I&C importance decrease = .06%

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**

```
VER 1.6
 File created by linking ads.wlk          WLINK ** Ver. 3.11 **
   55     93  3.260E-06   .00    1.00E-10
                1  AD2MOD01              5.5400E-02       .0000E+00
                2  AD2MOD02              5.5400E-02       .0000E+00
                3  AD3MOD03              5.5400E-02       .0000E+00
                4  AD3MOD04              5.5400E-02       .0000E+00
                5  ADN-MAN01             4.9300E-04       .0000E+00
                6  ADX-EV-SA             1.5000E-04       .0000E+00
                7  ADX-MV-GO             1.1000E-03       .0000E+00
                8  ALL-IND-FAIL          1.0000E-06       .0000E+00
                9  CCX-BC-SA             8.4000E-06       .0000E+00
               10  CCX-BY-PN             4.7000E-05       .0000E+00
               11  CCX-EP-SAM            8.6200E-06       .0000E+00
               12  CCX-IN-LOGIC-SW       1.1000E-05       .0000E+00
               13  CCX-INPUT-LOGIC       1.0300E-04       .0000E+00
               14  CCX-PMA030            9.6900E-05       .0000E+00
               15  CCX-PMAMOD1           1.4100E-04       .0000E+00
               16  CCX-PMB030            9.6900E-05       .0000E+00
               17  CCX-PMBMOD1           1.4100E-04       .0000E+00
               18  CCX-SFTW              1.2000E-06       .0000E+00
               19  CCX-XMTR              2.0100E-04       .0000E+00
               20  CMX-VS-FA             3.8400E-05       .0000E+00
               21  DUMMY                 1.0000E-10       .0000E+00
               22  ECOMOD01              1.3100E-02       .0000E+00
               23  EC1BS001TM            2.7000E-03       .0000E+00
               24  EC1BS012TM            2.7000E-03       .0000E+00
               25  EC1BS121TM            2.7000E-03       .0000E+00
               26  EC1CB100VO            1.2300E-02       .0000E+00
               27  EC2BS002TM            2.7000E-03       .0000E+00
               28  EC2BS022TM            2.7000E-03       .0000E+00
               29  EC2BS221TM            2.7000E-03       .0000E+00
               30  EC2CB200VO            1.2300E-02       .0000E+00
               31  ECX-CB-GC             7.3000E-04       .0000E+00
               32  ECX-CB-GO             1.2000E-03       .0000E+00
               33  ED3MOD07              3.0500E-04       .0000E+00
               34  IDABSDD1TM            3.0000E-04       .0000E+00
               35  IDABSDK1TM            3.0000E-04       .0000E+00
               36  IDABSDS1TM            3.0000E-04       .0000E+00
               37  IDBBSDD1TM            3.0000E-04       .0000E+00
               38  IDBBSDK1TM            3.0000E-04       .0000E+00
               39  IDBBSDS1TM            3.0000E-04       .0000E+00
               40  IDCBSDD1TM            3.0000E-04       .0000E+00
               41  IDCBSDK1TM            3.0000E-04       .0000E+00
               42  IDCBSDS1TM            3.0000E-04       .0000E+00
```

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**

43	IDDBSDD1TM	3.0000E-04	.0000E+00
44	IDDBSDK1TM	3.0000E-04	.0000E+00
45	IDDBSDS1TM	3.0000E-04	.0000E+00
46	LPM-MAN03	2.2000E-03	.0000E+00
47	MDAS	1.0000E-02	.0000E+00
48	REC-MANDAS	1.1600E-02	.0000E+00
49	ZO1DG001TM	4.6000E-02	.0000E+00
50	ZO1MOD01	2.0200E-02	.0000E+00
51	ZO2DG002TM	4.6000E-02	.0000E+00
52	ZO2MOD01	2.0200E-02	.0000E+00
53	ZOX-DG-DR	4.4000E-04	.0000E+00
54	ZOX-DG-DS	3.8000E-04	.0000E+00
55	ZOX-PD-ES	2.0000E-03	.0000E+00

1.	4.60E-07	3	ADX-EV-SA	AD3MOD03	AD3MOD04
2.	4.60E-07	3	ADX-EV-SA	AD2MOD02	AD3MOD04
3.	4.60E-07	3	ADX-EV-SA	AD2MOD02	AD3MOD03
4.	4.60E-07	3	ADX-EV-SA	AD2MOD01	AD3MOD04
5.	4.60E-07	3	ADX-EV-SA	AD2MOD01	AD3MOD03
6.	4.60E-07	3	ADX-EV-SA	AD2MOD01	AD2MOD02
7.	1.65E-07	2	ADX-MV-GO	ADX-EV-SA	
8.	1.00E-07	2	REC-MANDAS	CCX-EP-SAM	
9.	8.62E-08	2	MDAS	CCX-EP-SAM	
10.	1.39E-08	2	CCX-SFTW	REC-MANDAS	
11.	1.20E-08	2	CCX-SFTW	MDAS	
12.	7.72E-09	2	CMX-VS-FA	CCX-XMTR	
13.	2.63E-09	2	CCX-EP-SAM	ED3MOD07	
14.	2.63E-09	3	REC-MANDAS	CCX-INPUT-LOGIC	LPM-MAN03
15.	2.49E-09	3	ADX-EV-SA	AD3MOD03	IDBBSDS1TM
16.	2.49E-09	3	ADX-EV-SA	AD3MOD03	IDBBSDD1TM
17.	2.49E-09	3	ADX-EV-SA	AD3MOD03	IDBBSDK1TM
18.	2.49E-09	3	ADX-EV-SA	IDABSDS1TM	AD3MOD04
19.	2.49E-09	3	ADX-EV-SA	IDABSDD1TM	AD3MOD04
20.	2.49E-09	3	ADX-EV-SA	IDABSDK1TM	AD3MOD04
21.	2.49E-09	3	ADX-EV-SA	AD2MOD02	IDBBSDS1TM
22.	2.49E-09	3	ADX-EV-SA	AD2MOD02	IDBBSDD1TM
23.	2.49E-09	3	ADX-EV-SA	AD2MOD02	IDBBSDK1TM
24.	2.49E-09	3	ADX-EV-SA	IDDBSDS1TM	AD3MOD04
25.	2.49E-09	3	ADX-EV-SA	IDDBSDD1TM	AD3MOD04
26.	2.49E-09	3	ADX-EV-SA	IDDBSDK1TM	AD3MOD04
27.	2.49E-09	3	ADX-EV-SA	AD2MOD02	IDABSDS1TM
28.	2.49E-09	3	ADX-EV-SA	AD2MOD02	IDABSDD1TM
29.	2.49E-09	3	ADX-EV-SA	AD2MOD02	IDABSDK1TM
30.	2.49E-09	3	ADX-EV-SA	IDDBSDS1TM	AD3MOD03
31.	2.49E-09	3	ADX-EV-SA	IDDBSDD1TM	AD3MOD03

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**

32.	2.49E-09	3	ADX-EV-SA	IDDBSDK1TM	AD3MOD03	
33.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDBBSDS1TM	
34.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDBBSDD1TM	
35.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDBBSDK1TM	
36.	2.49E-09	3	ADX-EV-SA	IDCBSDS1TM	AD3MOD04	
37.	2.49E-09	3	ADX-EV-SA	IDCBSDD1TM	AD3MOD04	
38.	2.49E-09	3	ADX-EV-SA	IDCBSDK1TM	AD3MOD04	
39.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDABSDS1TM	
40.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDABSDD1TM	
41.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDABSDK1TM	
42.	2.49E-09	3	ADX-EV-SA	IDCBSDS1TM	AD3MOD03	
43.	2.49E-09	3	ADX-EV-SA	IDCBSDD1TM	AD3MOD03	
44.	2.49E-09	3	ADX-EV-SA	IDCBSDK1TM	AD3MOD03	
45.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDDBSDS1TM	
46.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDDBSDD1TM	
47.	2.49E-09	3	ADX-EV-SA	AD2MOD01	IDDBSDK1TM	
48.	2.49E-09	3	ADX-EV-SA	IDCBSDS1TM	AD2MOD02	
49.	2.49E-09	3	ADX-EV-SA	IDCBSDD1TM	AD2MOD02	
50.	2.49E-09	3	ADX-EV-SA	IDCBSDK1TM	AD2MOD02	
51.	2.27E-09	3	MDAS	CCX-INPUT-LOGIC	LPM-MAN03	
52.	1.30E-09	4	CCX-BY-PN	ZO1DG001TM	EC0MOD01	ZO2DG002TM
53.	1.23E-09	3	CCX-BY-PN	ZOX-PD-ES	EC0MOD01	
54.	9.80E-10	3	REC-MANDAS	CMX-VS-FA	LPM-MAN03	
55.	8.45E-10	3	MDAS	CMX-VS-FA	LPM-MAN03	
56.	7.39E-10	3	CCX-BY-PN	ECX-CB-GO	EC0MOD01	
57.	5.89E-10	3	REC-MANDAS	CCX-INPUT-LOGIC	ADN-MAN01	
58.	5.72E-10	4	CCX-BY-PN	ZO1DG001TM	EC0MOD01	ZO2MOD01
59.	5.72E-10	4	CCX-BY-PN	ZO1MOD01	EC0MOD01	ZO2DG002TM
60.	5.08E-10	3	MDAS	CCX-INPUT-LOGIC	ADN-MAN01	
61.	4.49E-10	3	CCX-BY-PN	ECX-CB-GC	EC0MOD01	
62.	3.95E-10	2	CCX-BC-SA	CCX-BY-PN		
63.	3.66E-10	2	CCX-SPTW	ED3MOD07		
64.	3.48E-10	4	CCX-BY-PN	ZO1DG001TM	EC0MOD01	EC2CB200VO
65.	3.48E-10	4	CCX-BY-PN	EC1CB100VO	EC0MOD01	ZO2DG002TM
66.	3.43E-10	3	CCX-BY-PN	EC1BS001TM	EC2BS002TM	
67.	3.43E-10	3	CCX-BY-PN	EC1BS001TM	EC2BS022TM	
68.	3.43E-10	3	CCX-BY-PN	EC1BS001TM	EC2BS221TM	
69.	3.43E-10	3	CCX-BY-PN	EC1BS012TM	EC2BS002TM	
70.	3.43E-10	3	CCX-BY-PN	EC1BS012TM	EC2BS022TM	
71.	3.43E-10	3	CCX-BY-PN	EC1BS012TM	EC2BS221TM	
72.	3.43E-10	3	CCX-BY-PN	EC1BS121TM	EC2BS002TM	
73.	3.43E-10	3	CCX-BY-PN	EC1BS121TM	EC2BS022TM	
74.	3.43E-10	3	CCX-BY-PN	EC1BS121TM	EC2BS221TM	
75.	2.81E-10	3	REC-MANDAS	CCX-IN-LOGIC-SW	LPM-MAN03	
76.	2.71E-10	3	CCX-BY-PN	ZOX-DG-DR	EC0MOD01	

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ## ADS

77.	2.51E-10	4	CCX-BY-PN	ZO1MOD01	EC0MOD01	ZO2MOD01
78.	2.45E-10	3	ADX-EV-SA	REC-MANDAS	CCX-PMBMOD1	
79.	2.45E-10	3	ADX-EV-SA	REC-MANDAS	CCX-PMAMOD1	
80.	2.42E-10	3	MDAS	CCX-IN-LOGIC-SW	LPM-MAN03	
81.	2.20E-10	3	REC-MANDAS	CMX-VS-FA	ADM-MAN01	
82.	2.11E-10	3	ADX-EV-SA	MDAS	CCX-PMBMOD1	
83.	2.11E-10	3	ADX-EV-SA	MDAS	CCX-PMAMOD1	
84.	1.89E-10	3	MDAS	CMX-VS-FA	ADM-MAN01	
85.	1.72E-10	3	CCX-BY-PN	ZOX-DG-DS	EC0MOD01	
86.	1.69E-10	3	ADX-EV-SA	REC-MANDAS	CCX-PMB030	
87.	1.69E-10	3	ADX-EV-SA	REC-MANDAS	CCX-PMA030	
88.	1.53E-10	4	CCX-BY-PN	ZO1MOD01	EC0MOD01	EC2CB200VO
89.	1.53E-10	4	CCX-BY-PN	EC1CB100VO	EC0MOD01	ZO2MOD01
90.	1.45E-10	3	ADX-EV-SA	MDAS	CCX-PMB030	
91.	1.45E-10	3	ADX-EV-SA	MDAS	CCX-PMA030	
92.	1.03E-10	2	ALL-IND-FAIL	CCX-INPUT-LOGIC		
93.	1.00E-10	1	DUMMY			

SUM OF CUTSET PROBABILITIES = 3.260E-06

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**

COMPLNK Version 3.10 3/28/1995 10: 7:16

File created by linking ads.wlk WLINK ** Ver. 3.11 ** Page: 1

SYSTEM UNAVAILABILITY (Q) = 3.258E-06
NUMBER OF BASIC EVENTS = 55
NUMBER OF CUTSETS = 93

BASIC EVENT		IMPORTANCE (%DECREASE)	NUMBER OF CUTSETS	DECREASE IN SYSTEM UNAVAILABILITY	BASIC EVENT PROBABILITY
1	ADX-EV-SA	92.58	51	3.0162E-06	1.5000E-04
2	AD2MOD01	43.05	12	1.4024E-06	5.5400E-02
3	AD2MOD02	43.05	12	1.4024E-06	5.5400E-02
4	AD3MOD03	43.05	12	1.4024E-06	5.5400E-02
5	AD3MOD04	43.05	12	1.4024E-06	5.5400E-02
6	CCX-EP-SAM	5.80	3	1.8883E-07	8.6200E-06
7	ADX-MV-GC	5.06	1	1.6500E-07	1.1000E-03
8	REC-MANDAS	3.67	11	1.1943E-07	1.1600E-02
9	MDAS	3.16	11	1.0297E-07	1.0000E-02
10	CCX-SFTW	.81	3	2.6266E-08	1.2000E-06
11	CCX-BY-PN	.31	23	1.0040E-08	4.7000E-05
12	CMX-VS-FA	.31	5	9.9540E-09	3.8400E-05
13	CCX-XMTR	.24	1	7.7200E-09	2.0100E-04
14	IDABSDD1TM	.23	3	7.4700E-09	3.0000E-04
15	IDABSDK1TM	.23	3	7.4700E-09	3.0000E-04
16	IDABSDS1TM	.23	3	7.4700E-09	3.0000E-04
17	IDBBSDD1TM	.23	3	7.4700E-09	3.0000E-04
18	IDBBSDK1TM	.23	3	7.4700E-09	3.0000E-04
19	IDBBSDS1TM	.23	3	7.4700E-09	3.0000E-04
20	IDCBSDD1TM	.23	3	7.4700E-09	3.0000E-04
21	IDCBSDK1TM	.23	3	7.4700E-09	3.0000E-04

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**

22	IDCBSDS1TM	.23	3	7.4700E-09	3.0000E-04
23	IDDBSDD1TM	.23	3	7.4700E-09	3.0000E-04
24	IDDBSDK1TM	.23	3	7.4700E-09	3.0000E-04
25	IDDBSDS1TM	.23	3	7.4700E-09	3.0000E-04
26	LPM-MAN03	.22	6	7.2480E-09	2.2000E-03
27	EC0MOD01	.20	13	6.5580E-09	1.3100E-02
28	CCX-INPUT-LOGIC	.19	5	6.1000E-09	1.0300E-04
29	ED3MOD07	.09	2	2.9960E-09	3.0500E-04
30	ZO1DG001TM	.07	3	2.2200E-09	4.6000E-02
31	ZO2DG002TM	.07	3	2.2200E-09	4.6000E-02
32	ADN-MAN01	.05	4	1.5060E-09	4.9300E-04
33	ZOX-PD-ES	.04	1	1.2300E-09	2.0000E-03
34	EC1BS001TM	.03	3	1.0290E-09	2.7000E-03
35	EC1BS012TM	.03	3	1.0290E-09	2.7000E-03
36	EC1BS121TM	.03	3	1.0290E-09	2.7000E-03
37	EC2BS002TM	.03	3	1.0290E-09	2.7000E-03
38	EC2BS022TM	.03	3	1.0290E-09	2.7000E-03
39	EC2BS221TM	.03	3	1.0290E-09	2.7000E-03
40	ZO1MOD01	.03	3	9.7600E-10	2.0200E-02
41	ZO2MOD01	.03	3	9.7600E-10	2.0200E-02
42	ECX-CB-GO	.02	1	7.3900E-10	1.2000E-03
43	CCX-IN-LOGIC-SW	.02	2	5.2300E-10	1.1000E-05
44	EC1CB100VO	.02	2	5.0100E-10	1.2300E-02
45	EC2CB200VO	.02	2	5.0100E-10	1.2300E-02
46	CCX-PMAMOD1	.01	2	4.5600E-10	1.4100E-04
47	CCX-PMBMOD1	.01	2	4.5600E-10	1.4100E-04
48	ECX-CB-GC	.01	1	4.4900E-10	7.3000E-04
49	CCX-BC-SA	.01	1	3.9500E-10	8.4000E-06
50	CCX-PMA030	.01	2	3.1400E-10	9.6900E-05
51	CCX-PMB030	.01	2	3.1400E-10	9.6900E-05
52	ZOX-DG-DR	.01	1	2.7100E-10	4.4000E-04
53	ZOX-DG-DS	.01	1	1.7200E-10	2.8000E-04
54	ALL-IND-FAIL	.00	1	1.0300E-10	1.0000E-05

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**

SYSTEM UNAVAILABILITY (Q) = 3.258E-06
NUMBER OF BASIC EVENTS = 54
NUMBER OF CUTSETS = 92

	BASIC EVENT	IMPORTANCE (%INCREASE)	NUMBER OF CUTSETS	INCREASE IN SYSTEM UNAVAILABILITY	BASIC EVENT PROBABILITY
1	CCX-EP-SAM	672394.	3	2.1906E-02	8.6200E-06
2	CCX-SFTW	671856.	3	2.1888E-02	1.2000E-06
3	ADX-EV-SA	617112.	51	2.0105E-02	1.5000E-04
4	CMX-VS-FA	7956.34	5	2.5921E-04	3.8400E-05
5	CCX-BY-PN	6556.61	23	2.1361E-04	4.7000E-05
6	ADX-MV-GO	4599.15	1	1.4984E-04	1.1000E-03
7	ALL-IND-FAIL	3161.56	1	1.0300E-04	1.0000E-06
8	CCX-INPUT-LOGIC	1817.66	5	5.9217E-05	1.0300E-04
9	CCX-IN-LOGIC-SW	1459.38	2	4.7545E-05	1.1000E-05
10	CCX-BC-SA	1443.37	1	4.7023E-05	8.4000E-06
11	CCX-XMTR	1178.68	1	3.8400E-05	2.0100E-04
12	IDABSDD1TM	764.069	3	2.4893E-05	3.0000E-04
13	IDABSDK1TM	764.069	3	2.4893E-05	3.0000E-04
14	IDABSDS1TM	764.069	3	2.4893E-05	3.0000E-04
15	IDBBSDD1TM	764.069	3	2.4893E-05	3.0000E-04
16	IDBBSDK1TM	764.069	3	2.4893E-05	3.0000E-04
17	IDBBSDS1TM	764.069	3	2.4893E-05	3.0000E-04
18	IDCBSDD1TM	764.069	3	2.4893E-05	3.0000E-04
19	IDCBSDK1TM	764.069	3	2.4893E-05	3.0000E-04
20	IDCBSDS1TM	764.069	3	2.4893E-05	3.0000E-04

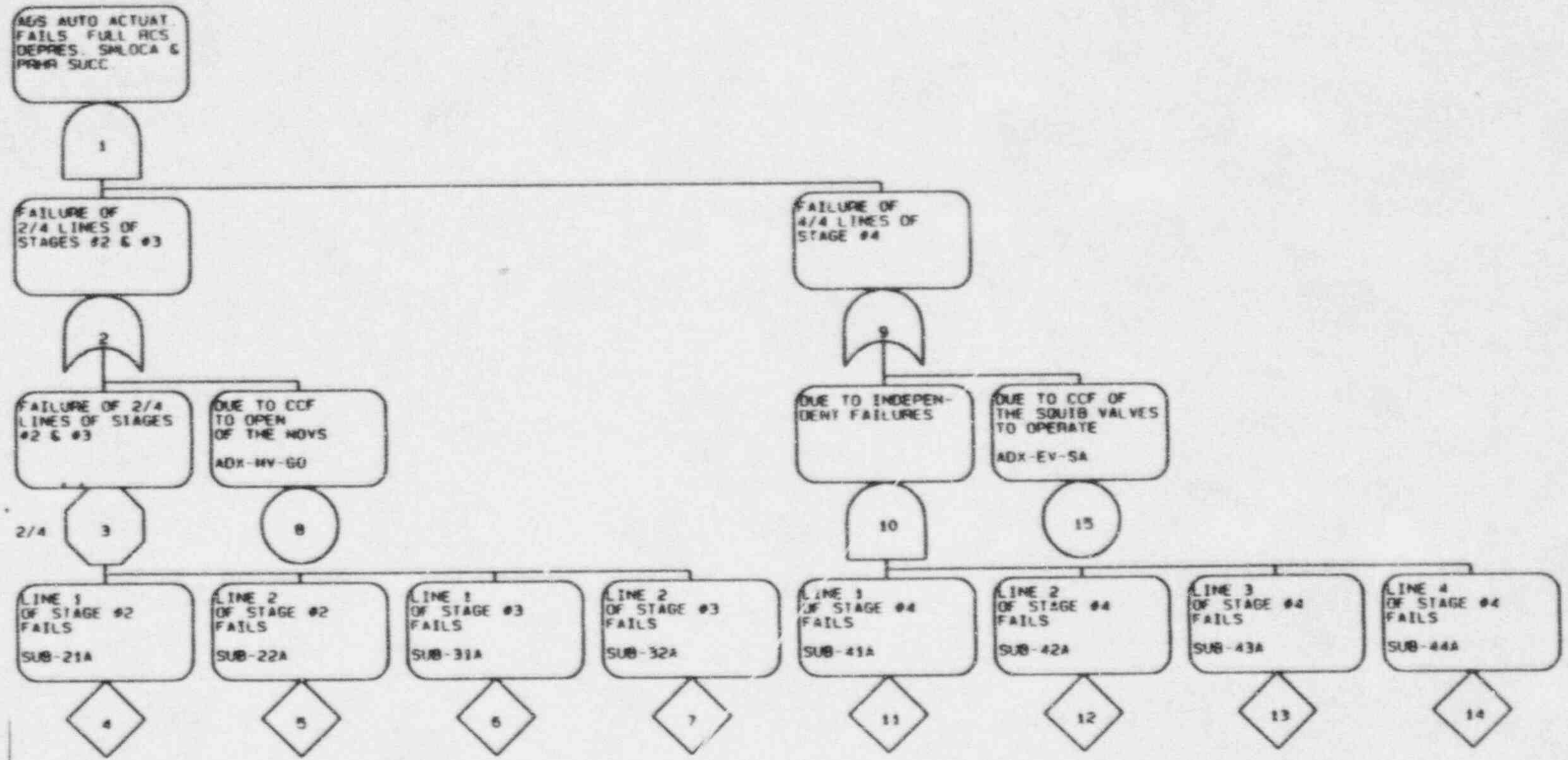
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**

21	IDDBSDD1TM	764.069	3	2.4893E-05	3.0000E-04
22	IDDBSDK1TM	764.069	3	2.4893E-05	3.0000E-04
23	IDDBSDS1TM	764.069	3	2.4893E-05	3.0000E-04
24	AD2MOD01	733.967	12	2.3912E-05	5.5400E-02
25	AD2MOD02	733.967	12	2.3912E-05	5.5400E-02
26	AD3MOD03	733.967	12	2.3912E-05	5.5400E-02
27	AD3MOD04	733.967	12	2.3912E-05	5.5400E-02
28	MDAS	312.891	11	1.0194E-05	1.0000E-02
29	REC-MANDAS	312.352	11	1.0176E-05	1.1600E-02
30	ED3MOD07	301.421	2	9.8200E-06	3.0500E-04
31	LPM-MAN03	100.903	6	3.2873E-06	2.2000E-03
32	CCX-PMA030	99.4552	2	3.2401E-06	9.6900E-05
33	CCX-PMB030	99.4552	2	3.2401E-06	9.6900E-05
34	CCX-PMAMOD1	99.2541	2	3.2336E-06	1.4100E-04
35	CCX-PMBMOD1	99.2541	2	3.2336E-06	1.4100E-04
36	ADN-MAN01	93.7190	4	3.0533E-06	4.9300E-04
37	ZOX-DG-DR	18.8968	1	6.1564E-07	4.4000E-04
38	ECX-CB-GO	18.8802	1	6.1509E-07	1.2000E-03
39	ECX-CB-GC	18.8656	1	6.1462E-07	7.3000E-04
40	ZOX-DG-DS	18.8500	1	6.1411E-07	2.8000E-04
41	ZOX-PD-ES	18.8395	1	6.1377E-07	2.0000E-03
42	EC0MOD01	15.1648	13	4.9405E-07	1.3100E-02
43	EC1BS001TM	11.6665	3	3.8008E-07	2.7000E-03
44	EC1BS012TM	11.6665	3	3.8008E-07	2.7000E-03
45	EC1BS121TM	11.6665	3	3.8008E-07	2.7000E-03
46	EC2BS002TM	11.6665	3	3.8008E-07	2.7000E-03
47	EC2BS022TM	11.6665	3	3.8008E-07	2.7000E-03
48	EC2BS221TM	11.6665	3	3.8008E-07	2.7000E-03
49	ZO1MOD01	1.45311	3	4.7341E-08	2.0200E-02
50	ZO2MOD01	1.45311	3	4.7341E-08	2.0200E-02
51	ZO1DG001TM	1.41321	3	4.6041E-08	4.6000E-02
52	ZO2DG002TM	1.41321	3	4.6041E-08	4.6000E-02
53	EC1CB100VO	1.23487	2	4.0231E-08	1.2300E-02
54	EC2CB200VO	1.23487	2	4.0231E-08	1.2300E-02

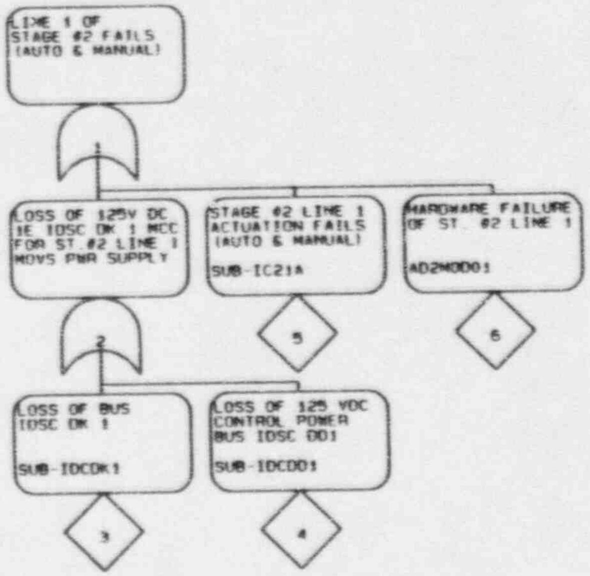
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS**



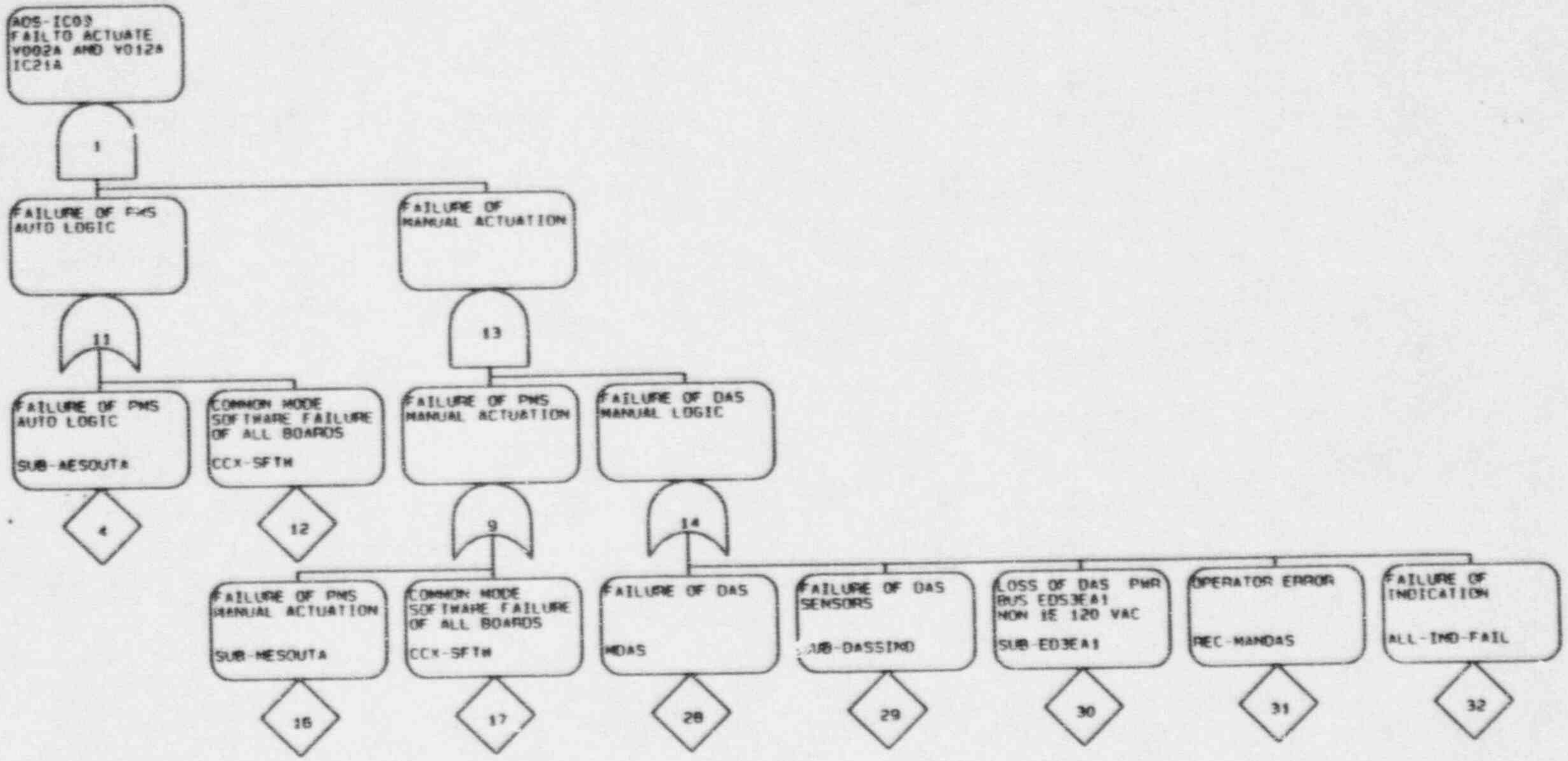
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- 21A



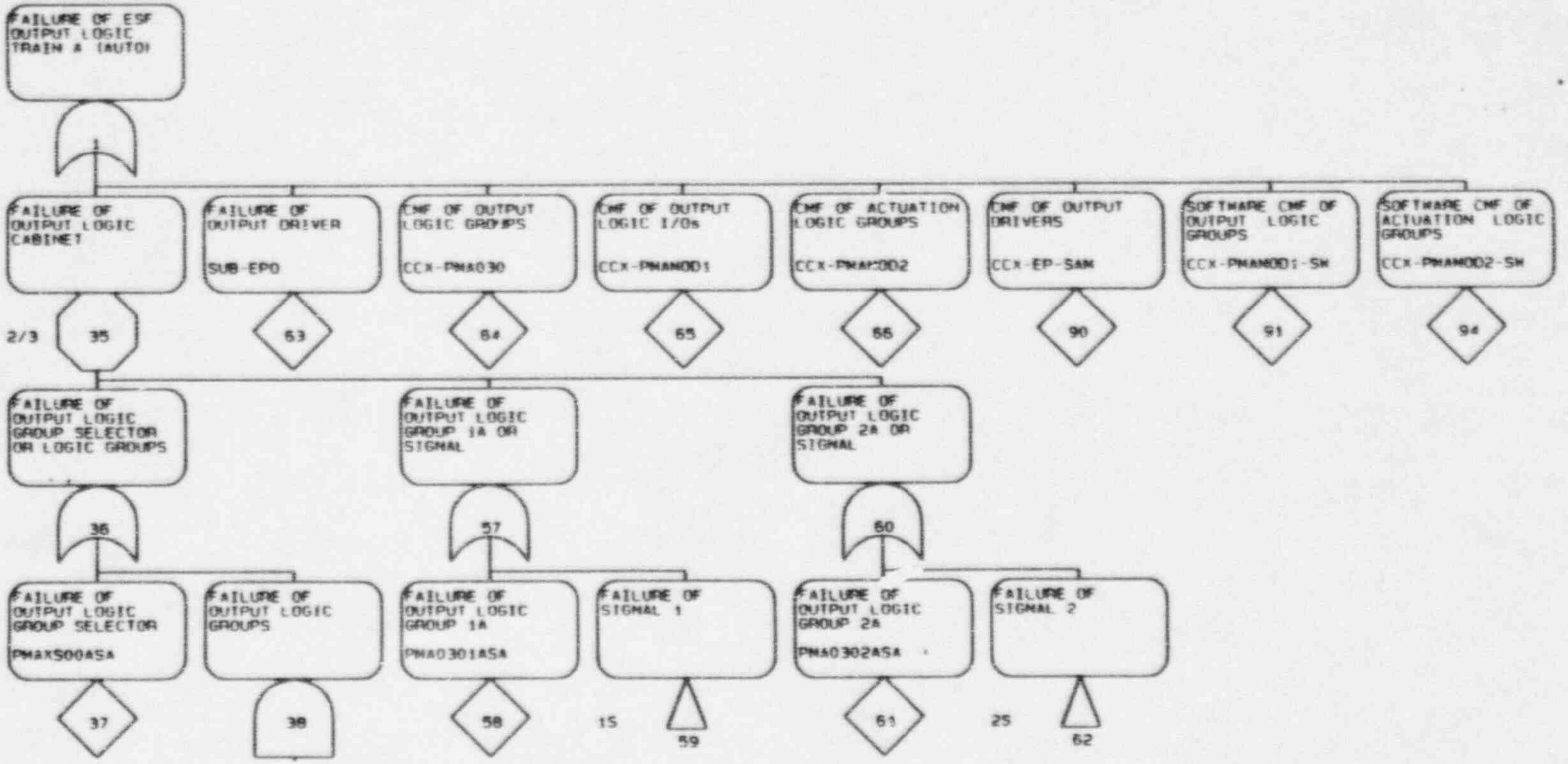
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - ADS-IC03 (IC21A)



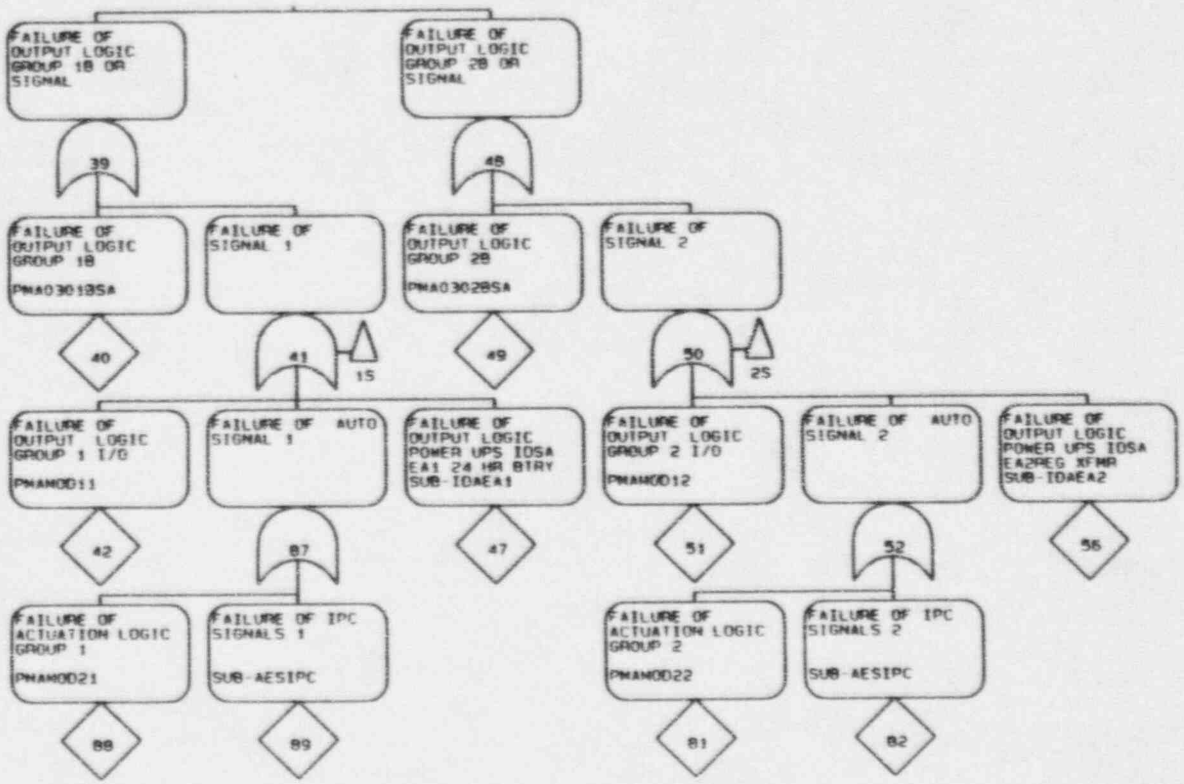
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS - AESOUTA**



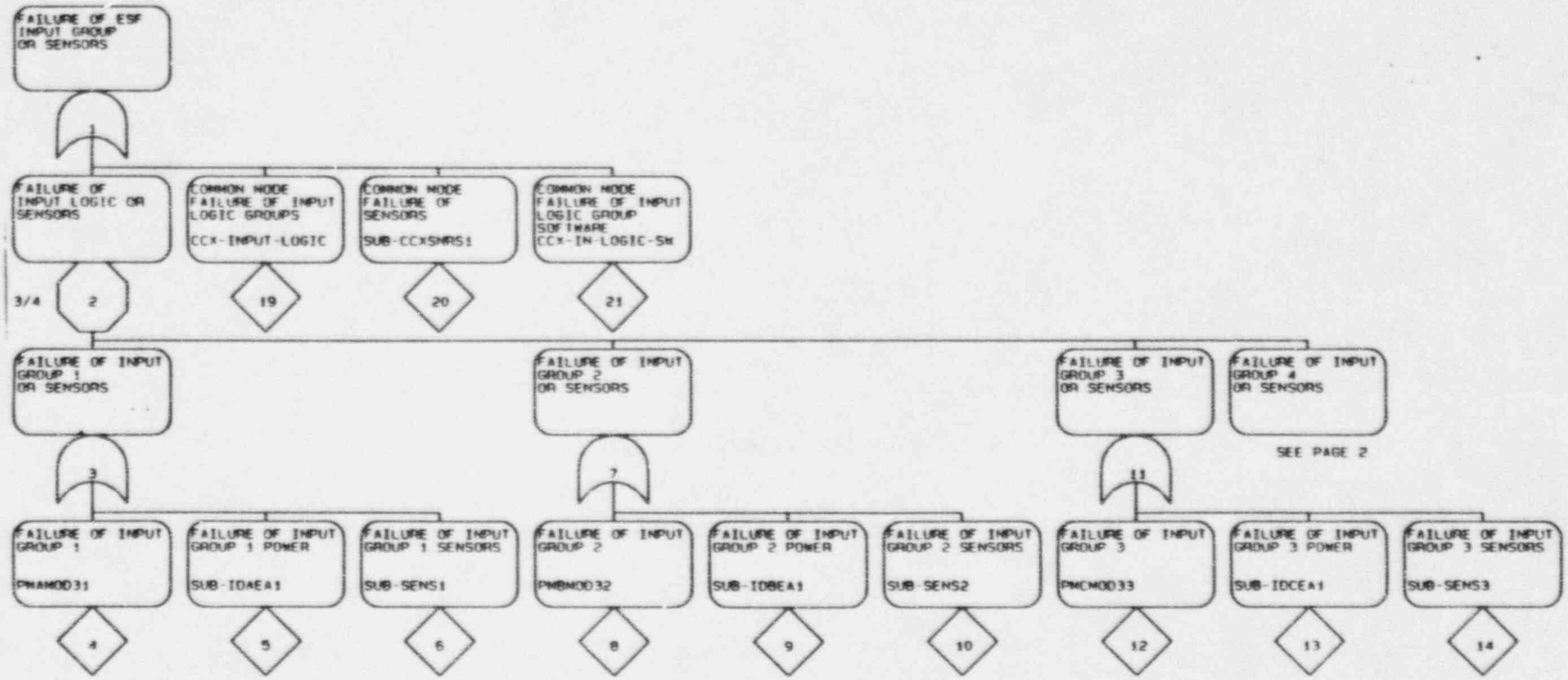
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - AESOUTA



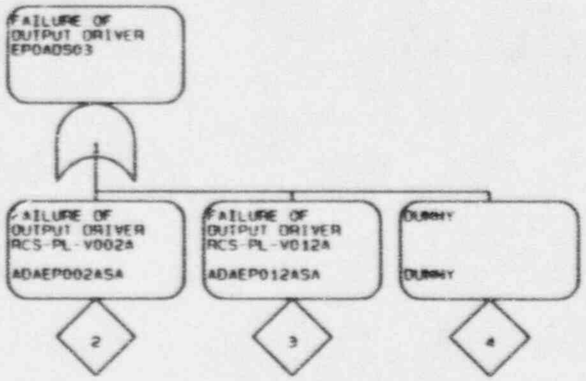
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - AESIPC



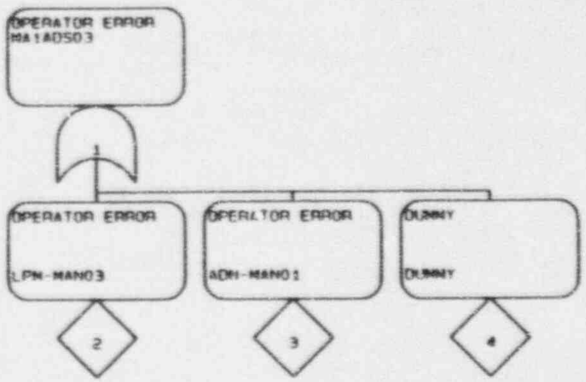
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - EPOADS03



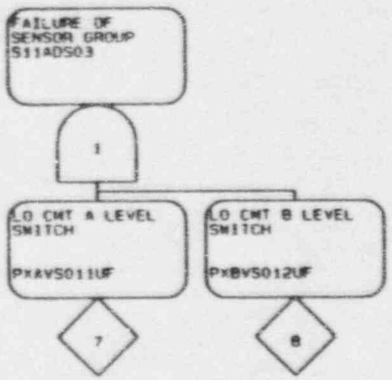
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - MA1ADS03



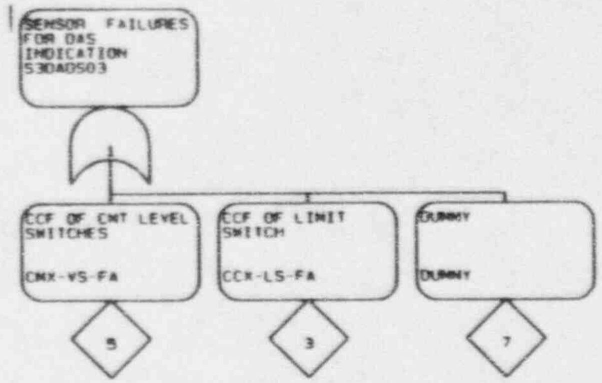
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - S11ADS03



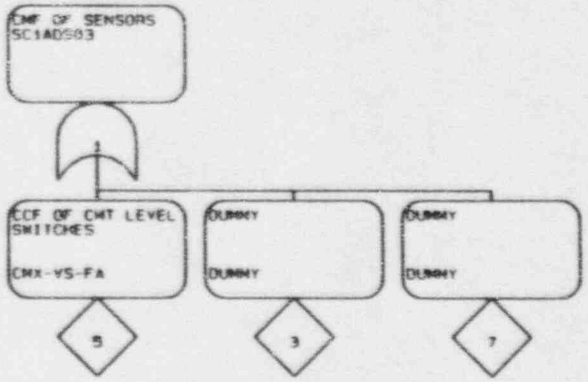
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS - S3DADS03**



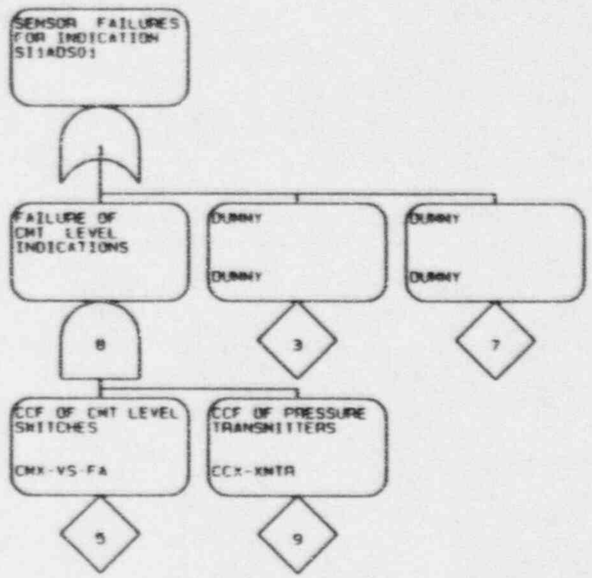
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - SC1ADS03



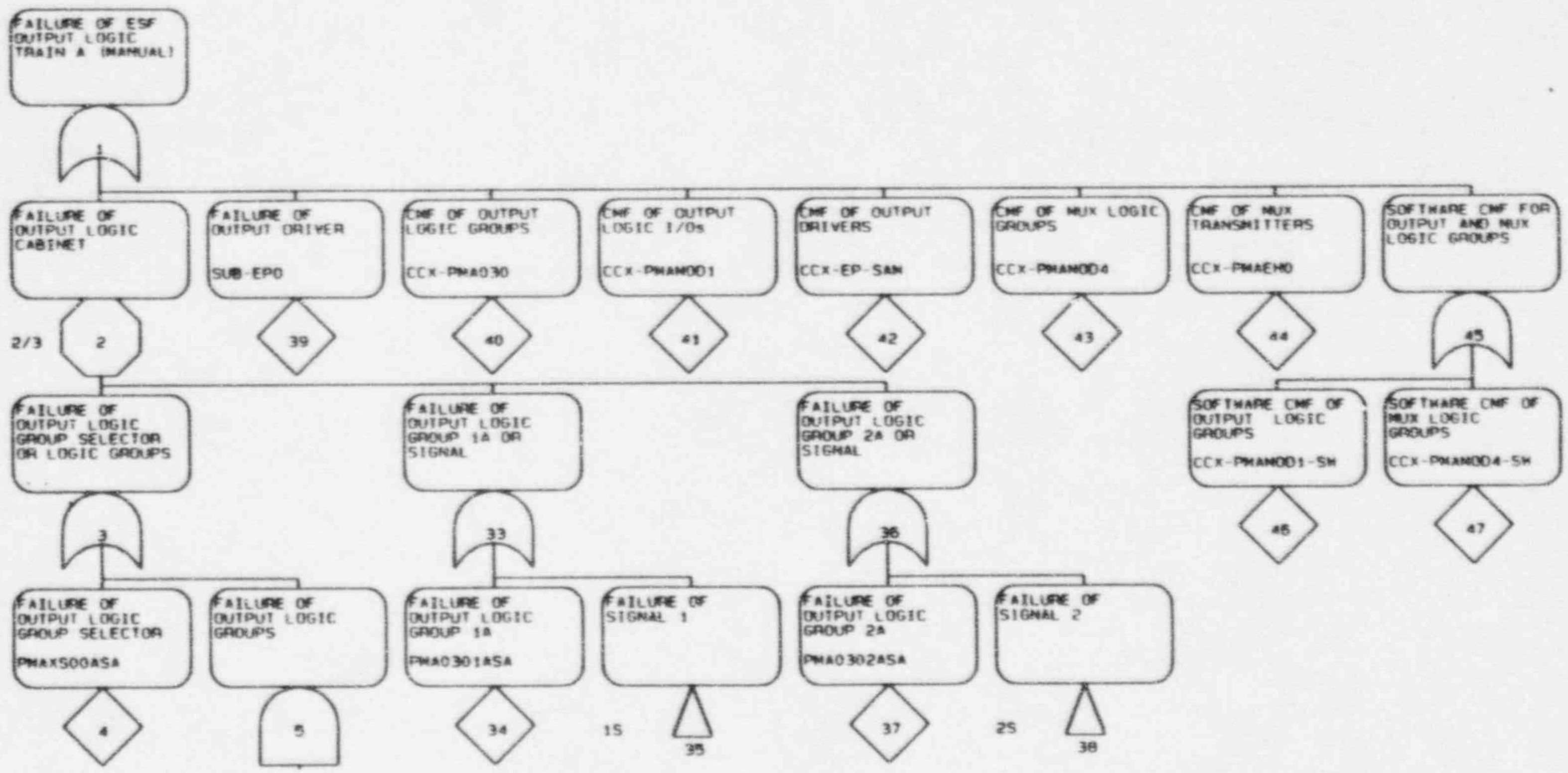
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - SI1ADS03



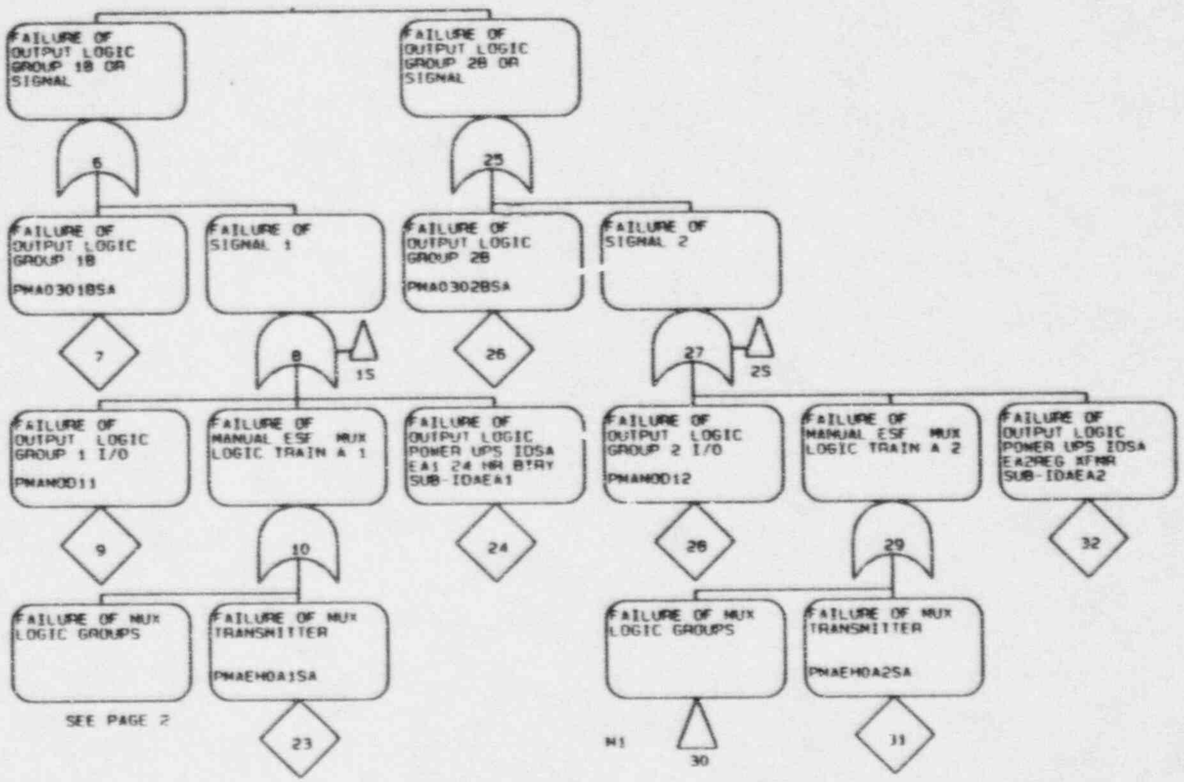
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **ADS - MESOUTA**



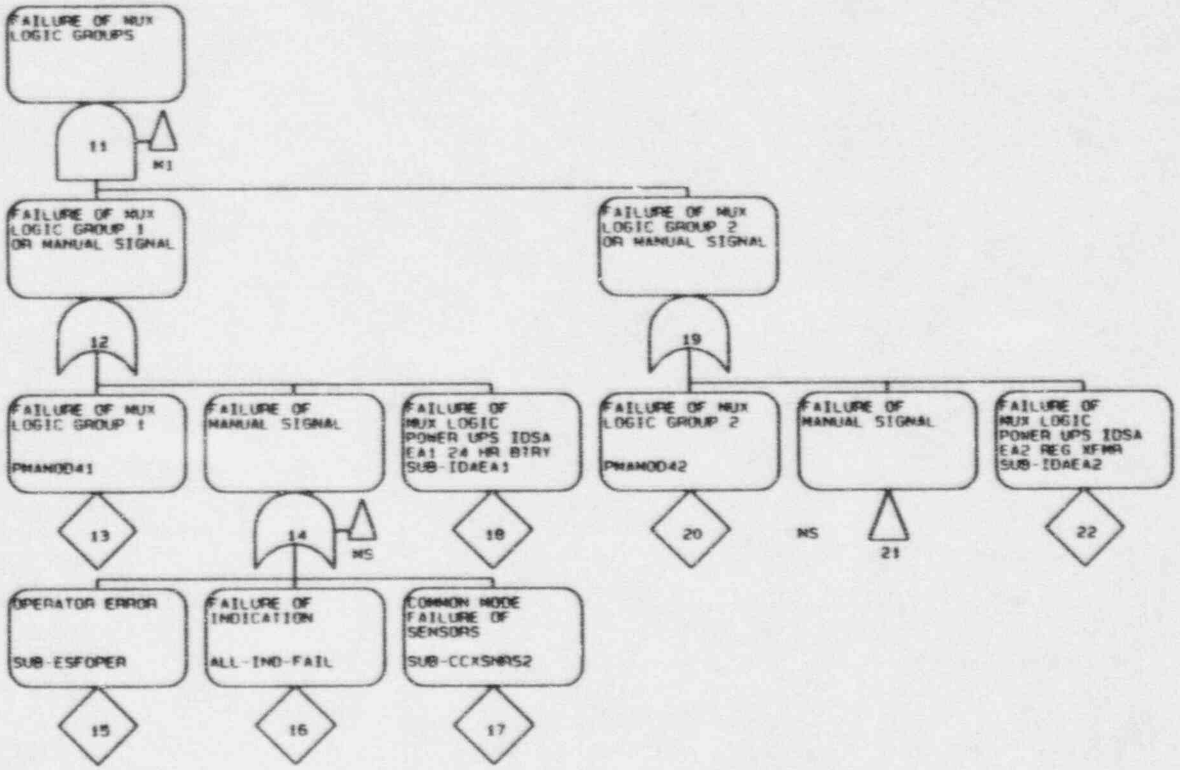
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - MESOUTA



PRA I&C ANALYSIS - AVAILABILITY RESULTS

- ADS - MESOUTA



PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL

```
VER 1.6
 File created by linking cm2sl.wlk       WLINK ** Ver. 3.11 **
   27     22  1.127E-04  .00   1.00E-10
               1  CCX-AV-LA            6.1000E-05       .0000E+00
               2  CCX-EP-SAM           8.6200E-06       .0000E+00
               3  CCX-INPUT-LOGIC      1.0300E-04       .0000E+00
               4  CCX-LS-FA            5.3700E-06       .0000E+00
               5  CCX-SFTW             1.2000E-06       .0000E+00
               6  CCX-TT-UF            1.1700E-04       .0000E+00
               7  CCX-XMTR             2.0100E-04       .0000E+00
               8  CCX-XMTR195          2.0100E-04       .0000E+00
               9  CMA-CV               2.0000E-06       .0000E+00
              10  CMA-PLUG             7.2700E-04       .0000E+00
              11  CMAAV014LA           1.0900E-03       .0000E+00
              12  CMAAV015LA           1.0900E-03       .0000E+00
              13  CMAOR001EB           7.2000E-07       .0000E+00
              14  CMATK002AF           2.4000E-06       .0000E+00
              15  CMB-CV               2.0000E-06       .0000E+00
              16  CMB-PLUG             7.2700E-04       .0000E+00
              17  CMBAV014LA           1.0900E-03       .0000E+00
              18  CMBAV015LA           1.0900E-03       .0000E+00
              19  CMBOR001EB           7.2000E-07       .0000E+00
              20  CMBTK002AF           2.4000E-06       .0000E+00
              21  CMN-MAN01            5.1000E-03       .0000E+00
              22  CMX-CV-GO            5.1000E-05       .0000E+00
              23  CMX-TK-AF            1.2000E-07       .0000E+00
              24  DAS                  1.0000E-02       .0000E+00
              25  ED3MOD07             3.0500E-04       .0000E+00
              26  MDAS                 1.0000E-02       .0000E+00
              27  REC-MANDAS           1.1600E-02       .0000E+00
```

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL

1.	6.10E-05	1	CCX-AV-LA		
2.	5.10E-05	1	CMX-CV-GO		
3.	5.29E-07	2	CMA-PLUG	CMB-PLUG	
4.	1.20E-07	1	CMX-TK-AF		
5.	4.04E-08	2	CCX-XMTR195	CCX-XMTR	
6.	2.35E-08	2	CCX-XMTR195	CCX-1T-UF	
7.	2.63E-09	2	CCX-EP-SAM	ED3MOD07	
8.	1.74E-09	2	CMATK002AF	CMB-PLUG	
9.	1.74E-09	2	CMA-PLUG	CMBTK002AF	
10.	1.45E-09	2	CMA-CV	CMB-PLUG	
11.	1.45E-09	2	CMA-PLUG	CMB-CV	
12.	1.00E-09	3	DAS	REC-MANDAS	CCX-EP-SAM
13.	8.64E-10	3	CMA-PLUG	CMBAV014LA	CMBAV015LA
14.	8.64E-10	3	CMAAV014LA	CMAAV015LA	CMB-PLUG
15.	8.62E-10	3	DAS	MDAS	CCX-EP-SAM
16.	5.53E-10	2	CCX-INPUT-LOGIC	CCX-LS-FA	
17.	5.23E-10	2	CMAOR001EB	CMB-PLUG	
18.	5.23E-10	2	CMA-PLUG	CMBOR001EB	
19.	3.66E-10	2	CCX-SFTW	ED3MOD07	
20.	1.60E-10	3	CCX-INPUT-LOGIC	CMN-MAN01	ED3MOD07
21.	1.39E-10	3	DAS	CCX-SFTW	REC-MANDAS
22.	1.20E-10	3	DAS	CCX-SFTW	MDAS

SUM OF CUTSET PROBABILITIES = 1.127E-04

PRA I&C ANALYSIS - AVAILABILITY RESULTS

- **CM2SL**

SYSTEM UNAVAILABILITY (Q) = 1.127E-04
NUMBER OF BASIC EVENTS = 27
NUMBER OF CUTSETS = 22

	BASIC EVENT	IMPORTANCE (%DECREASE)	NUMBER OF CUTSETS	DECREASE IN SYSTEM UNAVAILABILITY	BASIC EVENT PROBABILITY
1	CCX-AV-LA	54.11	1	6.1000E-05	6.1000E-05
2	CMX-CV-GO	45.24	1	5.1000E-05	5.1000E-05
3	CMA-PLUG	.47	5	5.3358E-07	7.2700E-04
4	CMB-PLUG	.47	5	5.3358E-07	7.2700E-04
5	CMX-TK-AF	.11	1	1.2000E-07	1.2000E-07
6	CCX-XMTR195	.06	2	6.3900E-08	2.0100E-04
7	CCX-XMTR	.04	1	4.0400E-08	2.0100E-04
8	CCX-TT-UF	.02	1	2.3500E-08	1.1700E-04
9	CCX-EP-SAM	.00	3	4.4920E-09	8.6200E-06
10	ED3MOD07	.00	3	3.1560E-09	3.0500E-04
11	DAS	.00	4	2.1210E-09	1.0000E-02
12	CMATK002AF	.00	1	1.7400E-09	2.4000E-06
13	CMBTK002AF	.00	1	1.7400E-09	2.4000E-06
14	CMA-CV	.00	1	1.4500E-09	2.0000E-06
15	CMB-CV	.00	1	1.4500E-09	2.0000E-06
16	REC-MANDAS	.00	2	1.1390E-09	1.1600E-02
17	MDAS	.00	2	9.8200E-10	1.0000E-02
18	CMAAV014LA	.00	1	8.6400E-10	1.0900E-03
19	CMAAV015LA	.00	1	8.6400E-10	1.0900E-03
20	CMBAV014LA	.00	1	8.6400E-10	1.0900E-03
21	CMBAV015LA	.00	1	8.6400E-10	1.0900E-03
22	CCX-INPUT-LOGIC	.00	2	7.1300E-10	1.0300E-04
23	CCX-SFTW	.00	3	6.2500E-10	1.2000E-06
24	CCX-LS-FA	.00	1	5.5300E-10	5.3700E-06
25	CMAOR001EB	.00	1	5.2300E-10	7.2000E-07
26	CMBOR001EB	.00	1	5.2300E-10	7.2000E-07
27	CMN-MAN01	.00	1	1.6000E-10	5.1000E-03

PRA I&C ANALYSIS - AVAILABILITY RESULTS

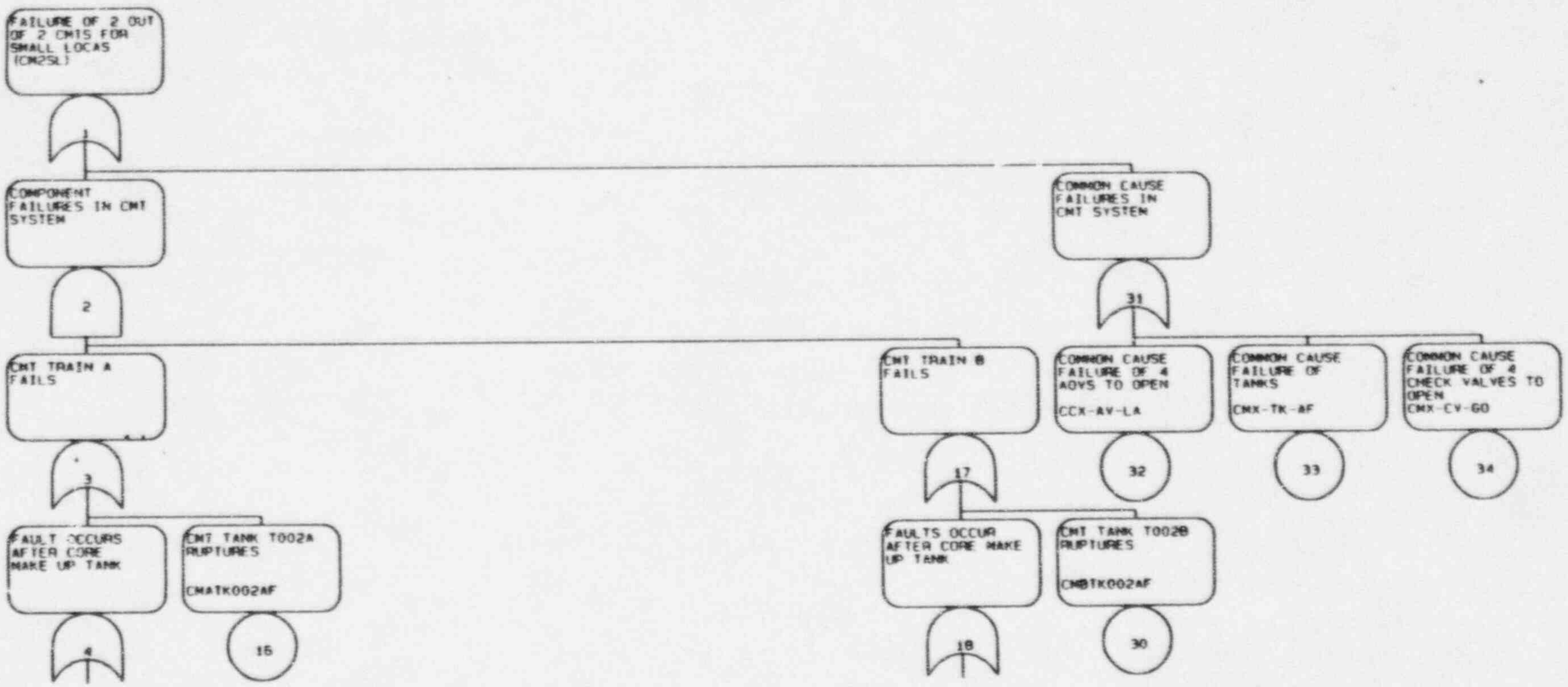
- **CM2SL**

SYSTEM UNAVAILABILITY (Q) = 1.127E-04
NUMBER OF BASIC EVENTS = 27
NUMBER OF CUTSETS = 22

	BASIC EVENT	IMPORTANCE (%INCREASE)	NUMBER OF CUTSETS	INCREASE IN SYSTEM UNAVAILABILITY	BASIC EVENT PROBABILITY
1	CMX-TK-AF	887117.	1	1.0000E+00	1.2000E-07
2	CMX-CV-GO	887072.	1	9.9995E-01	5.1000E-05
3	CCX-AV-LA	887063.	1	9.9994E-01	6.1000E-05
4	CMA-PLUG	650.621	5	7.3341E-04	7.2700E-04
5	CMB-PLUG	650.621	5	7.3341E-04	7.2700E-04
6	CMAOR001EB	644.391	1	7.2639E-04	7.2000E-07
7	CMBOR001EB	644.391	1	7.2639E-04	7.2000E-07
8	CMA-CV	643.159	1	7.2500E-04	2.0000E-06
9	CMB-CV	643.159	1	7.2500E-04	2.0000E-06
10	CMATK002AF	643.158	1	7.2500E-04	2.4000E-06
11	CMBTK002AF	643.158	1	7.2500E-04	2.4000E-06
12	CCX-EP-SAM	462.285	3	5.2111E-04	8.6200E-06
13	CCX-SFTW	462.040	3	5.2083E-04	1.2000E-06
14	CCX-XMTR195	281.967	2	3.1785E-04	2.0100E-04
15	CCX-XMTR	178.270	1	2.0095E-04	2.0100E-04
16	CCX-TT-UF	178.161	1	2.0083E-04	1.1700E-04
17	CCX-LS-FA	91.3544	1	1.0298E-04	5.3700E-06
18	ED3MOD07	9.17668	3	1.0344E-05	3.0500E-04
19	CCX-INPUT-LOGIC	6.14029	2	6.9216E-06	1.0300E-04
20	CMAAV014LA	.702416	1	7.9180E-07	1.0900E-03
21	CMAAV015LA	.702416	1	7.9180E-07	1.0900E-03
22	CMBAV014LA	.702416	1	7.9180E-07	1.0900E-03
23	CMBAV015LA	.702416	1	7.9180E-07	1.0900E-03
24	DAS	.186276	4	2.0998E-07	1.0000E-02
25	MDAS	8.624376E-02	2	9.7218E-08	1.0000E-02
26	REC-MANDAS	8.609530E-02	2	9.7051E-08	1.1600E-02
27	CMN-MAN01	2.768919E-02	1	3.1213E-08	5.1000E-03

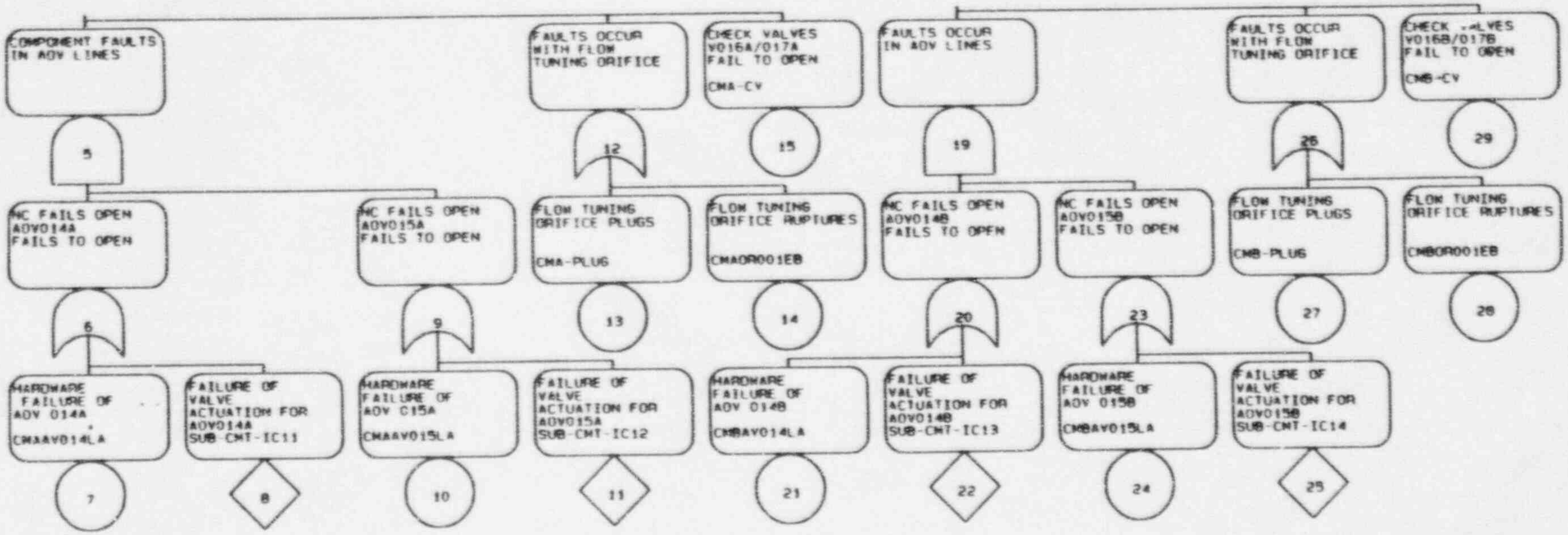
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL



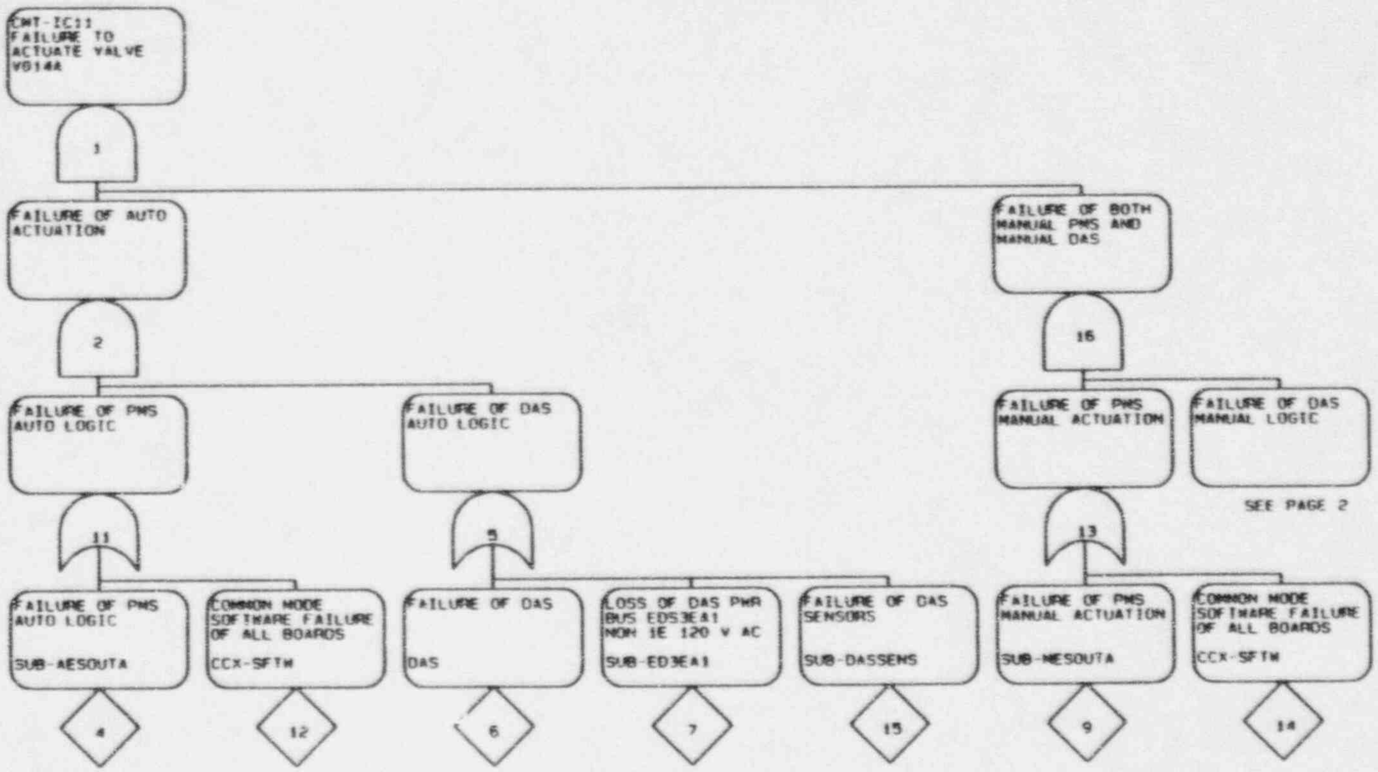
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL



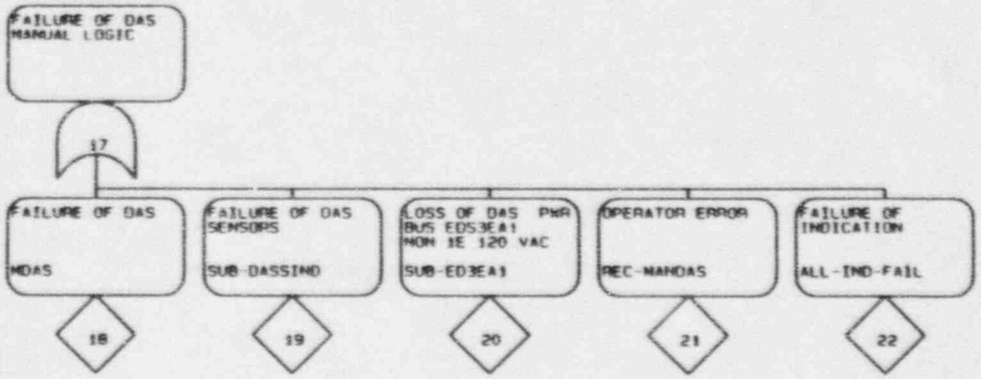
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - CMT-IC11



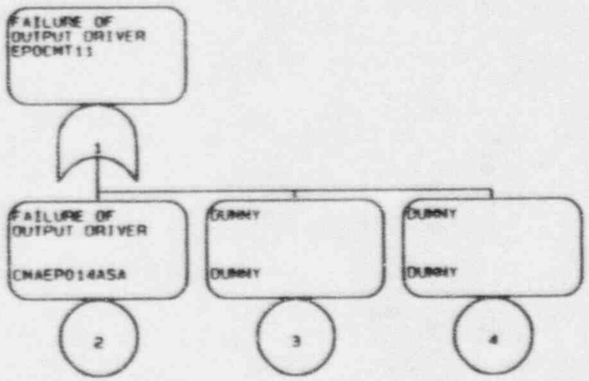
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - CMT-IC11



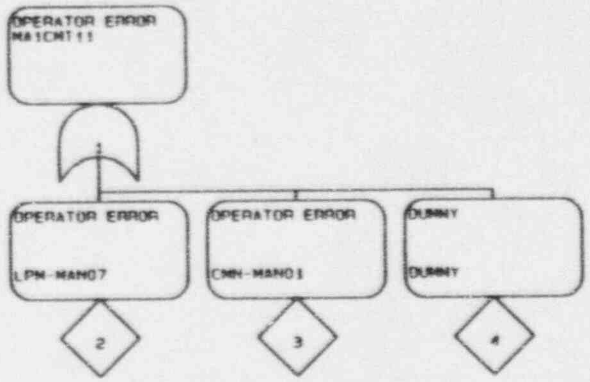
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - EPOCMT11



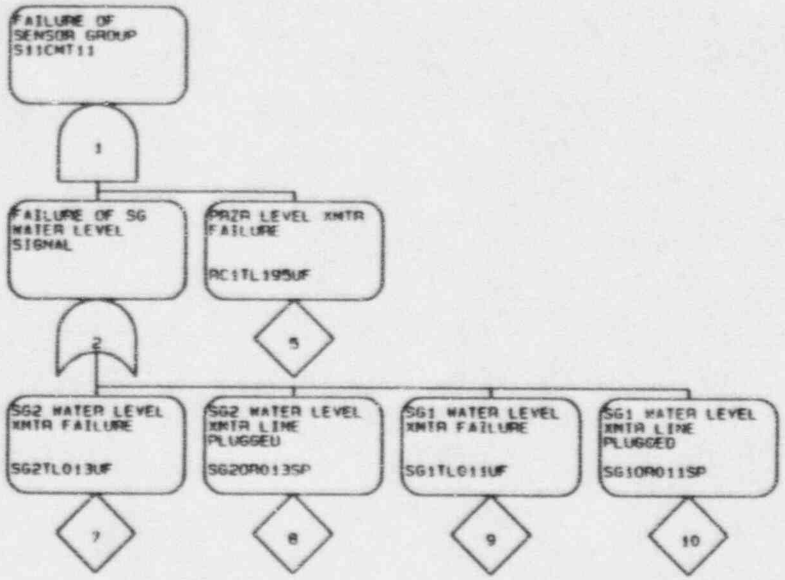
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - MA1CMT11



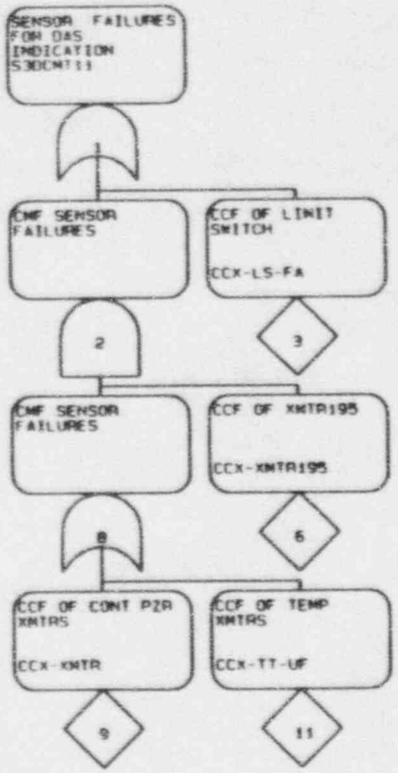
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - S11CMT11



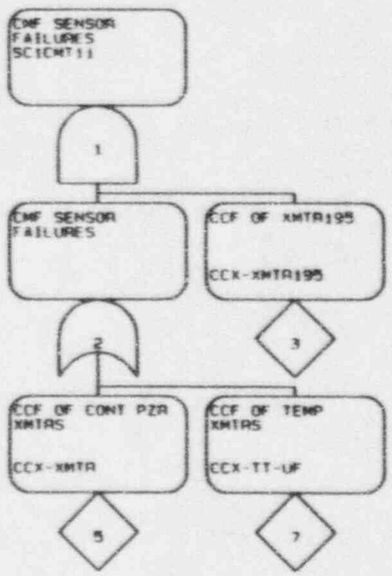
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - S3DCMT11



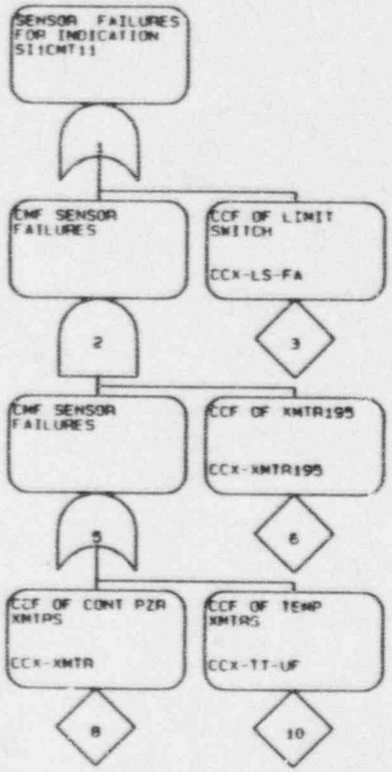
PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - SC1CMT11



PRA I&C ANALYSIS - AVAILABILITY RESULTS

- CM2SL - SI1CMT11



PRA I&C ANALYSIS - MODELING CHANGES

- I&C modeling removed from system level trees
- Modular I&C sub-tree construction
- Probability of fault detection assigned on a board by board basis, supported by results of FMEA and FBA.

PRA I&C ANALYSIS - DESIGN CHANGES

- Separate sensors for DAS and PMS
- CCF of sensors between DAS and PMS still considered
- PMS System assignment assumptions
  - ADS, CIS, CMT, CVS, IRWST, PCS, PRHR, RNS, RPT, SGS
- PLS System assignment assumptions
  - CAS, CCS, CDS, CVS, ECS, MFW, MSS, RCS, SFW, SWS, TCS, VLS, VWS

Westinghouse Electric Corporation

AP600 Senior Management Meeting

Issue Closure Process

John Butler

February 9, 1995
Monroeville, PA

Issue Closure Process

Schedule

- The AP600 Design Certification Schedule calls for responses to all DSER open items by May 31, 1995
- Mutual agreement on closure of open items by September 30, 1995

Issue Closure Process

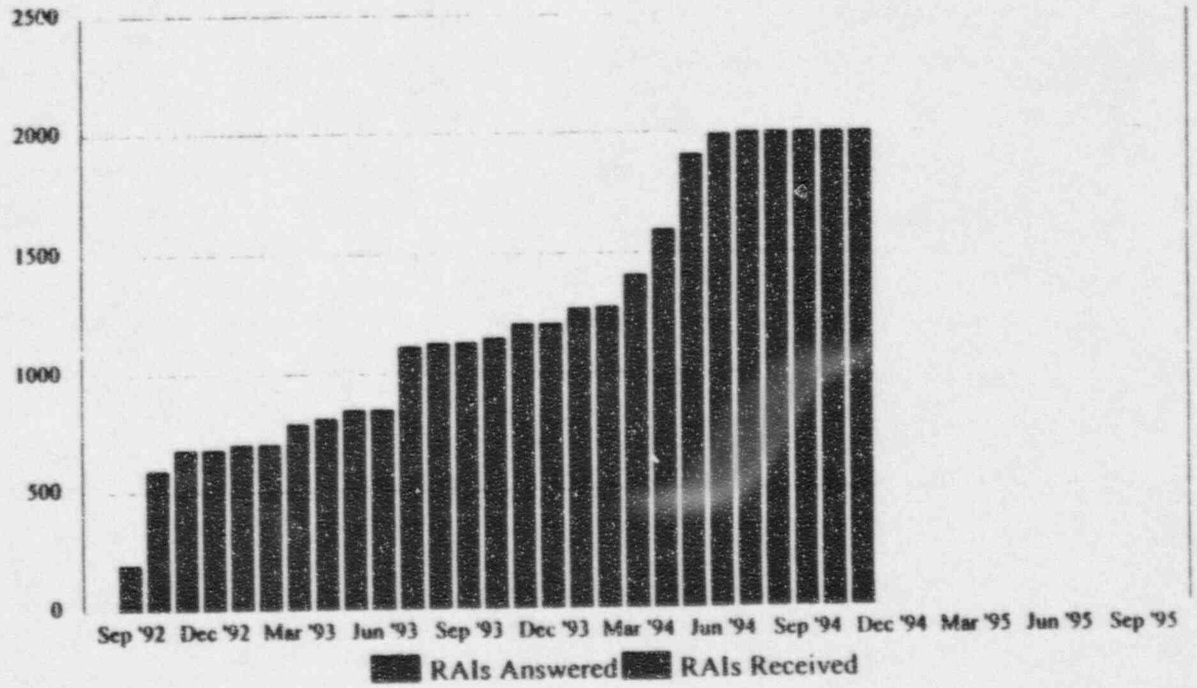
Number and Types of Open Items

DSER open items	*1149*
DSER confirmatory items	*66*
DSER COL items	*165*
RAI open items	*76*
Meeting open items	*529*
Teleconference open items	*4*
Total:	*1989*

- *Total will continue to grow as broad open items are focused via meetings and telecons*

Issue Closure Process

- Time available for issue closure is much shorter than available for responding to RAIs while the total number is essentially the same



Issue Closure Process

- *The formal RAI process resulted in inefficiencies*
- *Changes are required in the way issues are addressed and closed*
- *Need for an increased reliance on less formal communications (e.g., meetings and teleconferences)*
- *This will foster the faster and clearer communications needed to quickly address and close issues*

Issue Closure Process

Process Changes Introduced By Westinghouse

- **Tiered Single Point Responsibility for Each Open Item**
  - **Individual Responsibility for Each Open Item**
  - **Chapter Leaders**
  - **Individual Coordinators for "global" issues**

- **Chapter Leaders and Licensing Group develop an "issue closure path" which briefly identifies the technical approach for closure**

- **The "issue closure path" is provided for management approval and guidance**

- **Chapter Leaders and Licensing Group are then empowered to work toward issue closure**

- **Monthly Senior Management meetings serve to assist resolution and break roadblocks**

Issue Closure Process

Open Item Tracking

- **An Open Item Tracking Database is utilized to assist the management and tracking of open items**

- **Database includes:**

  - **Description of open item**
  - **Issue Closure Path**
  - **Responsibility assignments**
  - **Schedule for resolution**
  - **Main NRC Branch**
  - **References**
  - **Current Status**

Issue Closure Process

- **Progress is tracked and provided to NRC regularly to support their internal tracking and to confirm progress on issues**

Inactive	-	**No current discussion of issue**
Active	-	**Discussions between NRC staff and Westinghouse are on-going**
Proposed	-	**A proposed resolution has been provided by Westinghouse for NRC staff consideration**
Action W	-	**Discussions have identified a need for additional information or documentation for NRC staff review**
Action N	-	**Discussions have identified a need for clarification or additional information from NRC staff to support continued discussions**
Resolved	-	**Discussions have resulted in technical resolution. Closure requires submittal of agreed upon documentation/SSAR revision**
Closed	-	**Issue is resolved with no additional action from Westinghouse or NRC staff needed**

AP600 Open Item Tracking System Database: Executive Summary

Selection: [DSER Section] like '5.4.11*' Sorted by Item #

Item No.	Branch	DSER Section/ Question	Type	Title/Description	(W) Status	NRC Status	Letter No /	Date
178	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-1 (PRESSURIZER RELIEF DISCHARGE) What are the safety valve relief capacities and the atmospheric dump system (ADS) valve discharge capacities?	Closed	Inactive		
179	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-2 (PRESSURIZER RELIEF DISCHARGE) What is the worst-case load that the system (including the IRWST) will experience? Section 5.4.11 discusses only the gas venting function. Is this the limiting event?	Action N	Inactive		
180	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-3 (PRESSURIZER RELIEF DISCHARGE) Does the IRWST use a spray system?	Closed	Inactive		
181	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-4 (PRESSURIZER RELIEF DISCHARGE) What is the system scope (where does it begin and end)?	Closed	Inactive		
182	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-5 (PRESSURIZER RELIEF DISCHARGE) Section 5.4.11.3 states that the IRWST is sized based on the heat load and steam volume following an actuation of the ADS. Does this include steam, water, and noncondensable gases from all three ADS stages? Provide the analysis.	Closed	Inactive		
183	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-6 (PRESSURIZER RELIEF DISCHARGE) Where are the inspection and testing requirements for the IRWST discussed?	Closed	Inactive		
184	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-7 (PRESSURIZER RELIEF DISCHARGE) Where is the instrumentation for the ADS valve discharge lines discussed?	Resolved	Inactive		
185	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-8 (PRESSURIZER RELIEF DISCHARGE) Provide information that addresses features in the IRWST which prevent tank collapse as a result of vacuum created by the condensation of steam and the cooling of hot water in the tank.	Closed	Inactive		
186	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-9 (PRESSURIZER RELIEF DISCHARGE) Explanation the seismic and class breakdowns shown on the P&IDs.	Closed	Inactive		
187	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-10 (PRESSURIZER RELIEF DISCHARGE) Can the rupture disk become a missile?	Closed	Inactive		
188	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-11 (PRESSURIZER RELIEF DISCHARGE) What happens if an ADS valve fails to close?	Action N	Inactive		
189	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-12 (PRESSURIZER RELIEF DISCHARGE) How are the two divisions of ADS separated?	Resolved	Inactive		

AP600 Open Item Tracking System Database: Executive Summary

Selection: [DSER Section] like '5.4.11*' Sorted by Item #

Item No.	Branch	DSER Section/ Question	Type	Title/Description	(W) Status	NRC Status	Letter No. /	Date
190	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-13 (PRESSURIZER RELIEF DISCHARGE) What is the tank volume and quantity of water initially stored in the tank? It should be such that no steam or water will be released to containment under normal or anticipated abnormal conditions. The initial temperature of water in the tank should be assumed to be no lower than 120 F.	Resolved	Inactive		
191	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-14 (PRESSURIZER RELIEF DISCHARGE) Does the system have an abbreviation?	Resolved	Inactive		
192	NRR/SPLB	5.4.11	MTG-OI	M5.4.11-15 (PRESSURIZER RELIEF DISCHARGE) Is the system SR, RTNSS, or DID?	Resolved	Inactive		
947	NRR/SPLB	5.4.11.4-1	DSER-OI	Westinghouse should provide the safety valve relief capacity and ADS valve discharge capacity.	Closed	Inactive		
948	NRR/SPLB	5.4.11.4-2	DSER-OI	Westinghouse should identify the worse-case load on the pressurizer relief discharge system (including the IRWST).	Action N	Inactive		
949	NRR/SPLB	5.4.11.4-3	DSER-OI	Westinghouse should clarify the scope of the pressurizer relief discharge system.	Closed	Inactive		
950	NRR/SPLB	5.4.11.4-4	DSER-OI	Westinghouse should provide the inspection and testing requirements for the pressurizer relief discharge system.	Closed	Inactive		
951	NRR/SPLB	5.4.11.4-5	DSER-OI	Westinghouse should provide additional information on the instru- mentation associated with the pressurizer relief discharge system.	Resolved	Inactive		
952	NRR/SPLB	5.4.11.4-6	DSER-OI	Westinghouse should address Bulletin 80-05, regarding the susceptibility of the IRWST to vacuum conditions resulting from the cooling of hot water in the tank.	Closed	Inactive		
953	NRR/SPLB	5.4.11.4-7	DSER-OI	Westinghouse should identify seismic and safety classes associated with the pressurizer relief discharge system.	Closed	Inactive		
954	NRR/SPLB	5.4.11.4-8	DSER-OI	Westinghouse should provide information regarding divisional separation and isolation of the redundant, safety-related portions of the pressurizer relief discharge system.	Resolved	Inactive		

Issue Closure Process

Examples

- Two examples where process has been applied successfully
- Meetings with Plant Systems Branch
  - Focused on addressing pre-selected list of open items
  - Result: Of 253 items addressed in meeting, 145 are closed or resolved, a clear resolution path was identified for all but 13 items
  - Next meeting scheduled for February 22-23, 1995
- Bi-weekly phone calls with Containment Systems Branch
  - Bi-weekly phone calls with Reactor Systems Branch and Containment Systems Branch
  - Recent phone call with Containment Systems Branch 20 items
  - Result: 3 items were closed or resolved, a clear resolution path was identified for 11 others

Issue Closure Process

AP600

AP600 Open Item Tracking System

Executive Summary Report

Selection: Full Selection

Status as of : | 2/8/95 |

Open Item Type	Resolution Status (W / NRC)							Total
	Inactive	Active	Proposed	Action W	Action N	Resolved	Closed	
DSER - OI	1064 / 1149	55 / 0	6 / 0	2 / 0	3 / 0	12 / 0	7 / 0	1149 / 1149
DSER - Confirmatory	26 / 66	0 / 0	0 / 0	0 / 0	0 / 0	38 / 0	2 / 0	66 / 66
DSER - COL	165 / 165	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	165 / 165
DSER - OI50	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
RAI - OI	34 / 75	0 / 0	3 / 0	0 / 0	0 / 0	3 / 0	35 / 0	75 / 75
RAI -Confirmatory	1 / 1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	1 / 1
Meeting - OI	262 / 529	14 / 0	4 / 0	84 / 0	9 / 0	87 / 0	69 / 0	529 / 529
Teleconference - OI	3 / 4	0 / 0	0 / 0	1 / 0	0 / 0	0 / 0	0 / 0	4 / 4
Total	1555 / 1989	69 / 0	13 / 0	87 / 0	12 / 0	140 / 0	113 / 0	1989 / 1989