

52-001

REGULATORY AND ANALYSIS SERVICES  
San Jose, California

RELIABILITY ENGINEERING SERVICES

May 21, 1992

cc: J. D. Duncan  
A. E. Rogers  
S. Visweswaran

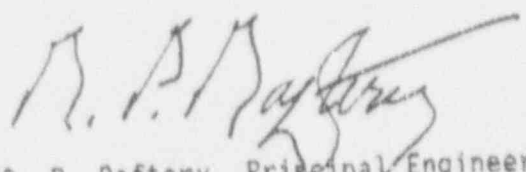
To: J. W. Fox

From: R. P. Raftery

Subject: Requantification of ABWR Level 1 PRA

Attached is a draft summary of ABWR Level 1 PRA updated results to be transmitted to the NRC (Glenn Kelly). Included are a tabular breakdown of core damage frequency by initiating event and accident class, the event trees used to produce these values, and a brief summary of changes and additions made to the Level 1 PRA since it was originally submitted.

The table replaces Table 19D.4-1 and the trees replace Figures 19D.4-1 through 19D.4-15 of Chapter 19D.4 of the SSAR. Also attached are marked up copies of Tables 19.3.1 and 19D.3-1 indicating modifications made to initiating event frequencies. These changes were made and incorporated into the PRA models to comply with SER Staff correction S-2 which required a value of 0.1 for the IORV initiating event frequency.



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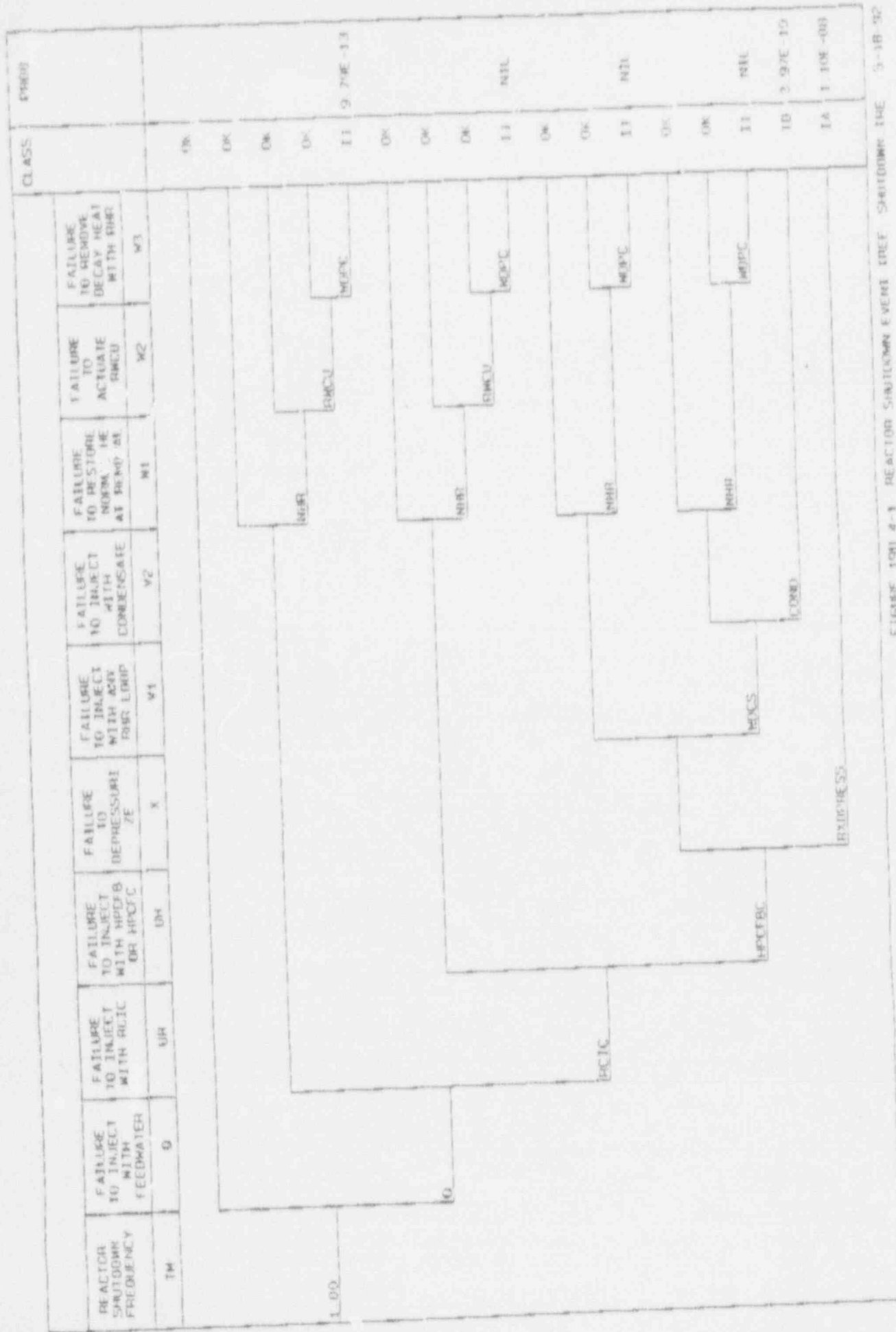


FIGURE 150 4-1 REACTOR SHUTDOWN EVENT TREE SHUTDOWN IHE 3-18-92

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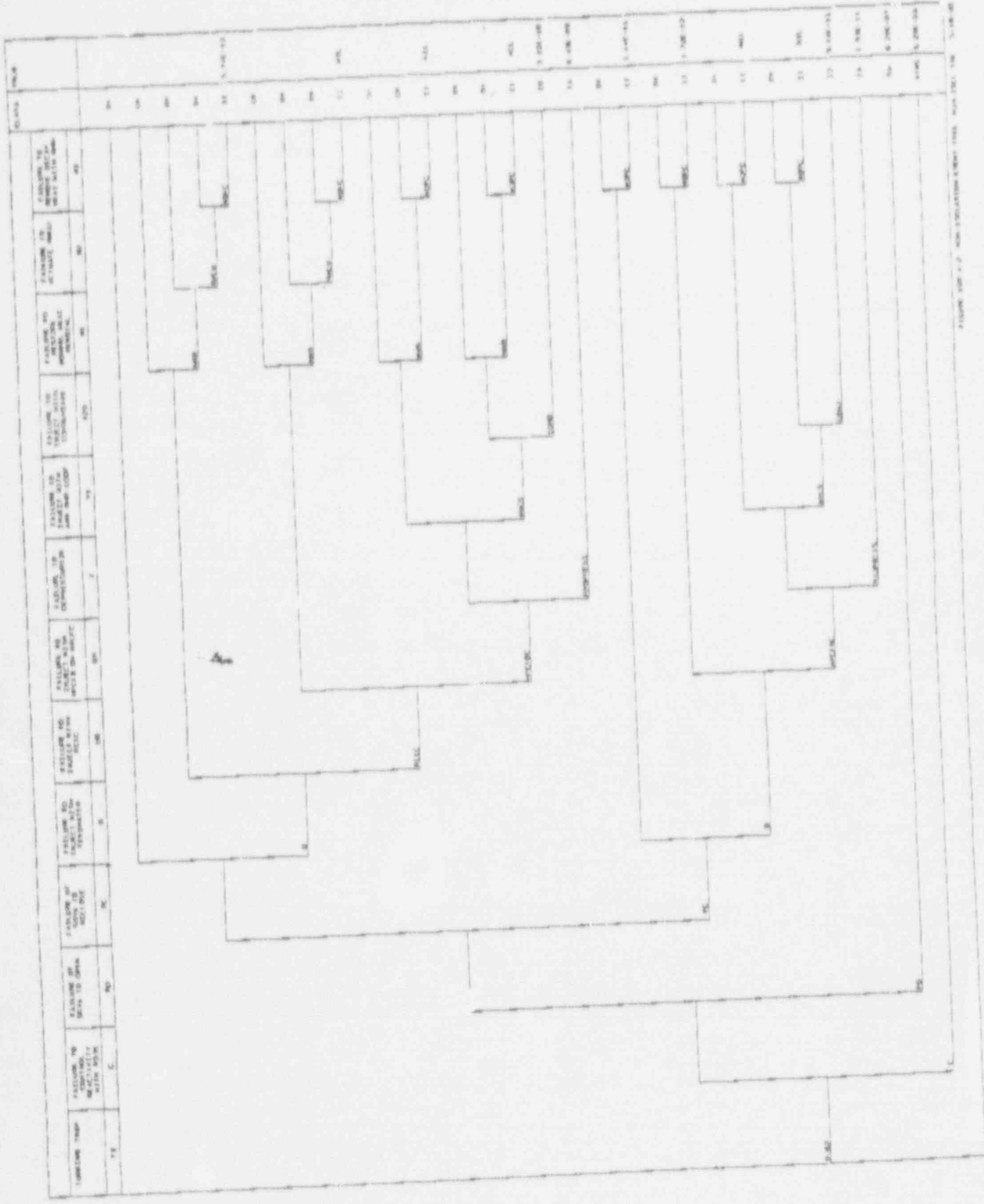


FIGURE 406-9251C07 - 406-9251C07-1000, MAY 1991, 1000 31-10-91

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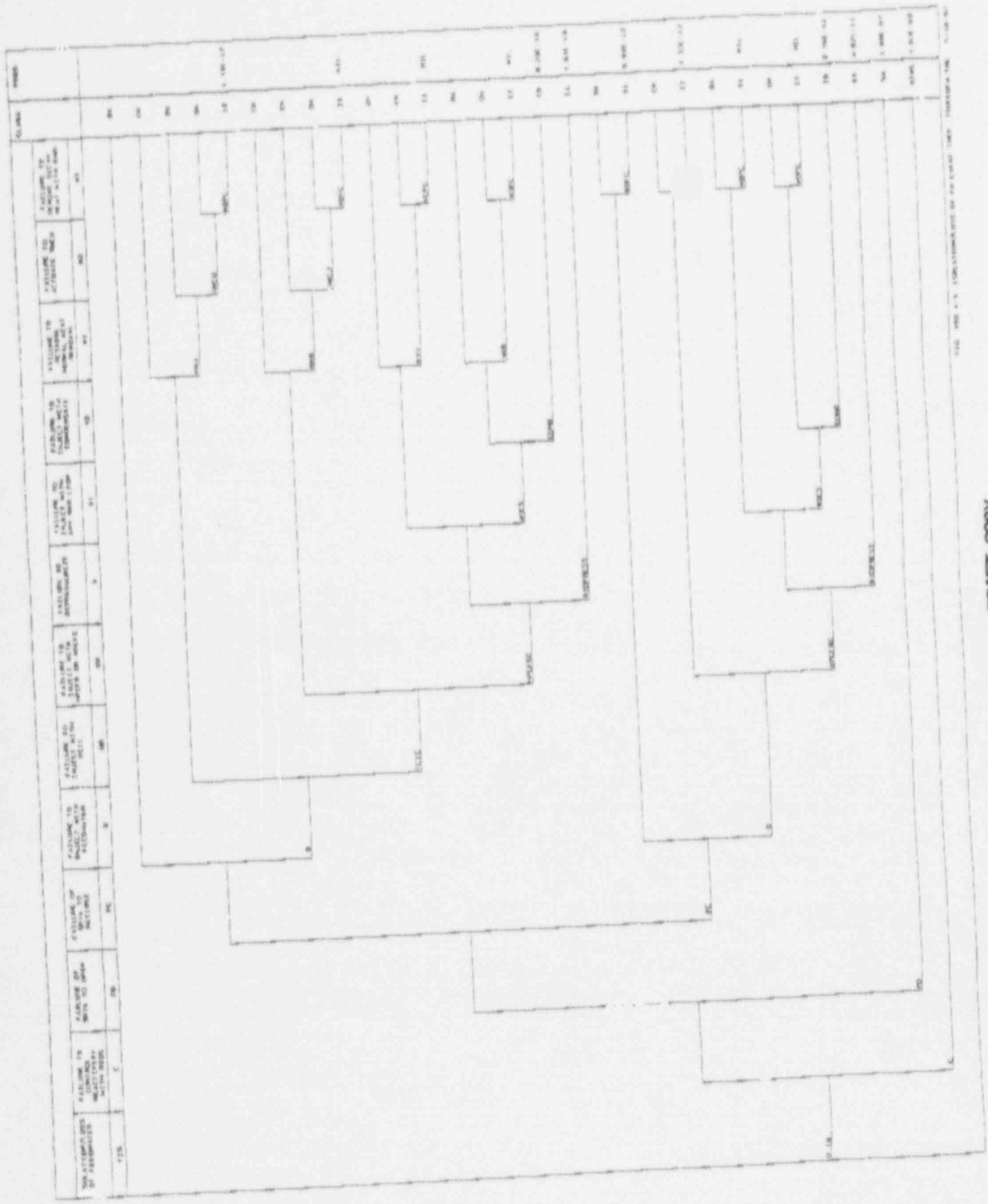


FIG. 100-1-1. CONTINUATION OF FIG. 100-1-1. TORQUE-TIME

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				CLASS	PROB
SBO FROM 0.5 TO 2 HOURS	FAILURE TO INJECT WITH RCIC	FAILURE TO REMOVE DECAY HEAT WITH RHR	FAILURE TO DEPRESSURIZE THE REACTOR		
BE2	UR	W3	X		
2.44E-05	WDCS			OK	
	RCIC			II	NIL
	RXDPRESS			IO	6.67E-08
				IA	1.56E-12

FIGURE 19D.4-8 SBO (0.5<T<2 HR) EVENT TREE SBOLT2HR.TRE 5-18-92

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DESCRIPTION	CLASS	PROB.
SBD FROM 2 TO 8 HOURS		
SRVS FAIL TO RECLOSE		
FAILURE TO INJECT WITH PCIC		
FAILURE TO INJECT WITH HPCFB OR HPCIC		
FAILURE TO DEPRESSURIZE THE REACTOR		
FAILURE TO INJECT WITH ANY RHR LOOP		
FAILURE TO REMOVE DECAY HEAT WITH RHR		
BFB	OK	NIL
PC	11	NIL
PC	OK	NIL
PC	11	NIL
PC	10	NIL
PC	14	NIL
PC	1B-1	2.44E-00
PC	1B-1	1.34E-09

FIGURE 190.4-9 SBD (DIRECT-DHRI) EVENT TREE S602-BHRI PRE 5-18-92

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		CLASS	PROB.
S30 FOR MORE THAN 8 HOURS	SRVS FAIL TO RECLOSE	UR	1.62E-08
	FAILURE TO INJECT WITH RCIC		
BEO	PC	UR	8.85E-10
	RCIC		
3.23E-07	IPC	UR	4.85E-11

FIGURE 19E.4-10 (OVER 8 HOURS) EVENT TREE SBOOVERB.TRE 5-18-92

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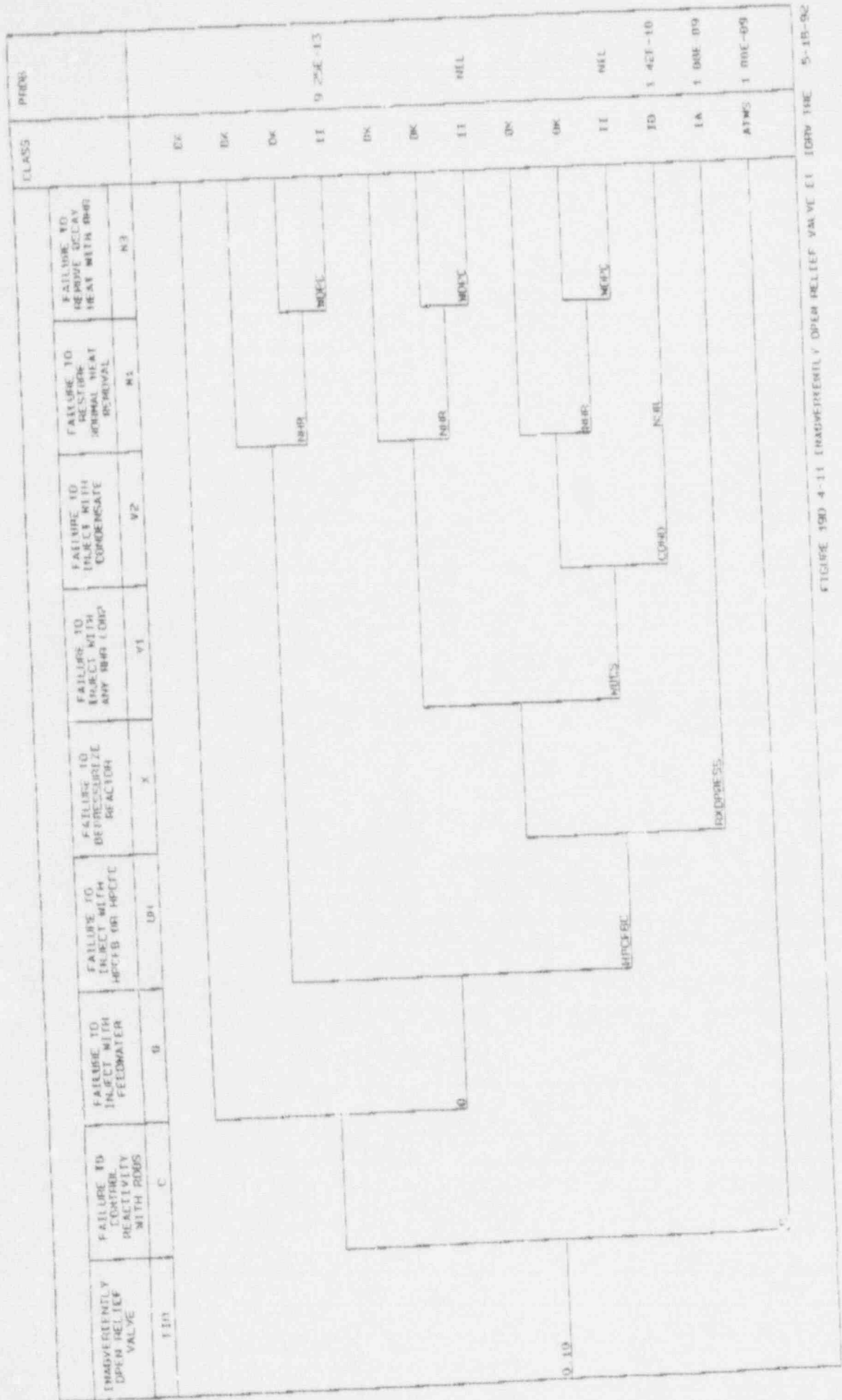


FIGURE 19D 4-11 INADVERTENTLY OPEN RELIEF VALVE ET IGRW 19E 5-15-92

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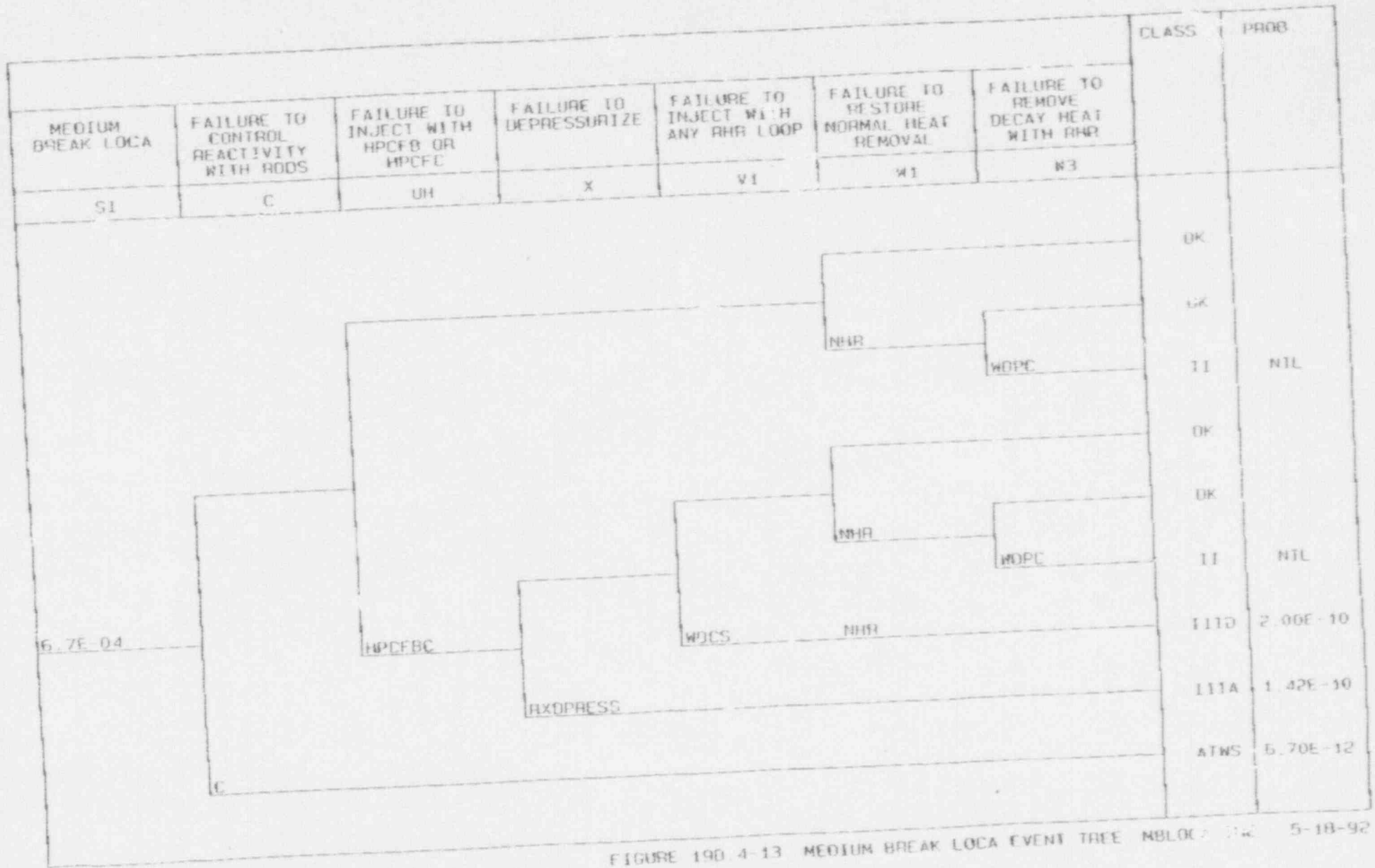


FIGURE 190.4-13 MEDIUM BREAK LOCA EVENT TREE MBLOC: 72 5-18-92

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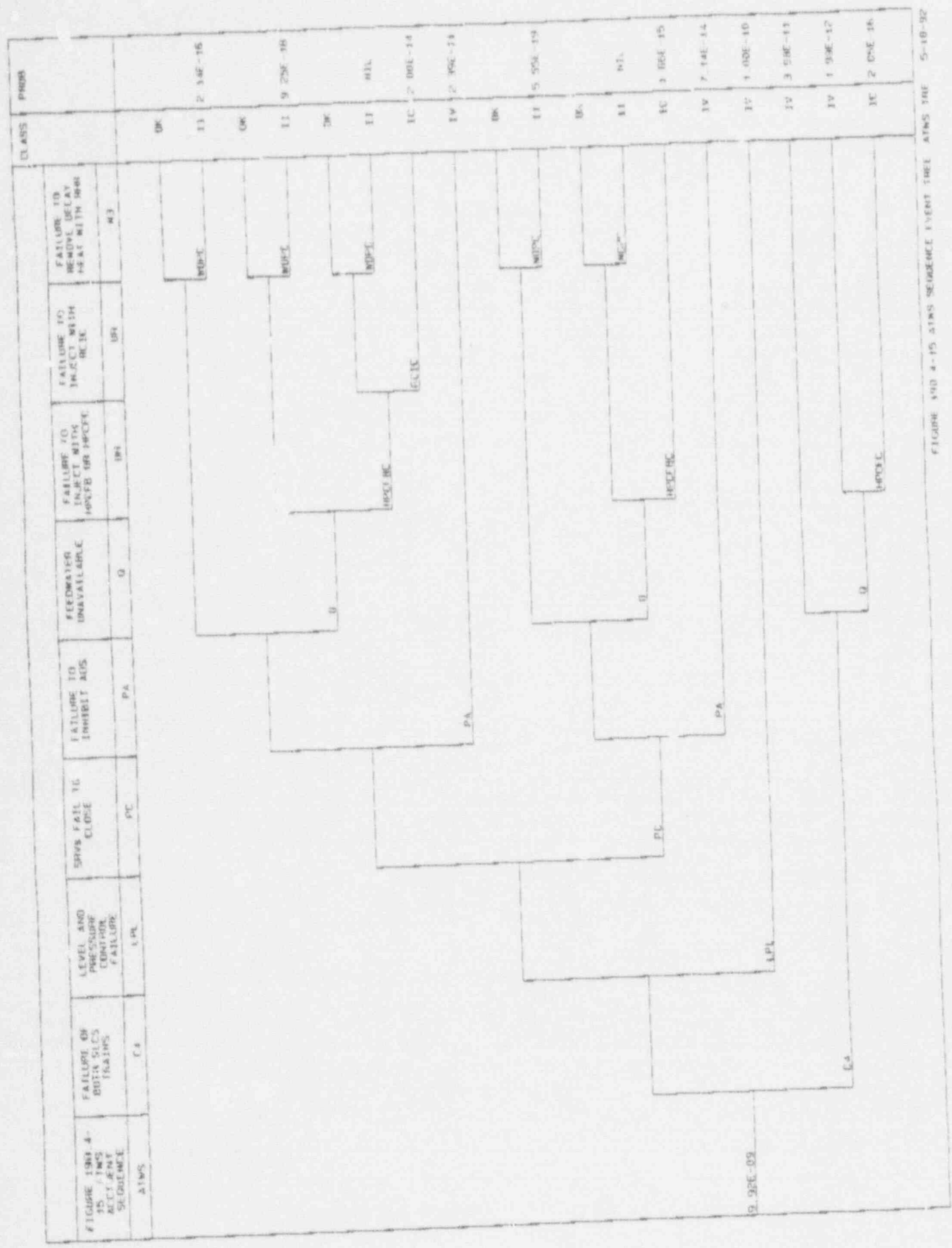


FIGURE 190-4-15 ATWS SEQUENCE EVENT TREE ATWS TRE 5-10-92

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## SUMMARY OF CHANGES INCORPORATED IN REQUANTIFICATION OF ABWR LEVEL 1 PRA

Since initially submitting the ABWR Level 1 PRA in 1989, GE has made a number of changes and improvements in the ABWR design. To the extent possible, these have been incorporated into the current requantification of the Level 1 PRA. In addition, some adjustments have been made in assumed test and maintenance unavailabilities to support Technical Specification flexibility.

In order to develop the detailed information required by the Staff, requantification was performed by evaluating each sequence for each event tree to obtain a comprehensive tabulation of cutsets. Consequently, the event trees originally submitted in Chapter 19D.4 of the SSAR were expanded so that only like systems are represented by a single branch. The detailed sequences which were evaluated to obtain cutsets and CDF contributions are illustrated in revised event tree Figures 19D.4-1 through 19D.4-15.

The following list summarizes modifications made to the updated PRA (excluding the addition of ECCS system design detail as it evolved) which have impact on overall core damage frequency as well as its distribution by accident class:

- o A drywell high pressure signal bypass timer was included in the ADS automatic initiation logic to account for this design change.
- o Automatic SLCS initiation logic was incorporated in ATWS sequences to reflect the current design.
- o Automatic ADS inhibit logic was incorporated in ATWS sequences to reflect the current design.
- o Initiating event frequencies were adjusted to accommodate the Staff requirement of a value of 0.1 for the IORV initiating event frequency. (Resolution of Staff SER open item S-2)
- o Test and maintenance unavailabilities for all ECCS systems (RCIC, HPCFB, HPCFC, RHRA, RHRB, and RHRC) have been increased to two percent to support Technical Specification flexibility. (Resolution of Staff SER open item C-4)
- o Control and instrumentation equipment and logic were modeled in considerably greater detail than in the original submittal, since much additional design information is now available. Modifications reflect dependency of manual system initiation signals on the multiplexing networks, as well as more detailed breakdown of components and common cause failures. In addition, failure rates of components within the envelope of the self test system are based upon a 95% probability of automatic detection of

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equipment failures with the self test feature, with the remaining 5% being detected through quarterly surveillance testing.

- o A hard-wired manual initiation capability was incorporated for HPCFB, providing a diverse backup to the multiplexing network.
- o Impact of random HVAC failure was explicitly included in the requantification, based on the the premise that divisional loss would result in overheating and failure of electrical switchgear supporting the ECCS equipment of that division. Loss of control room HVAC as an initiating event was also investigated and results are being reported separately in the GE response to Staff SER open item O-2 which evaluates impact of support system failures on plant trips.

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TABLE 19.3-1  
INITIATING EVENT FREQUENCIES

<u>Initiating Event</u>	<u>Frequency Per Reactor Year</u>
Manual Shutdown	1.0
Isolation/Loss of Feedwater	<del>0.25</del> 0.18
MSIV Closure	0.04
Loss of Condenser Vacuum	<del>0.05</del> 0.05
Press. Reg./Bypass Valves Closed	0.01
Loss of Feedwater	<del>0.05</del> 0.05
Non-Isolation Event (Trip with bypass)	<del>0.65</del> 0.62
Inadvertent (Stuck) Open Relief Valve	<del>0.05</del> 0.10
Loss of Offsite Power	0.10
Less than 30 minutes	0.0579
30 Minutes to 2 Hours	0.0246
2 to 8 Hours	0.0158
Greater than 8 Hours	0.0017
Small LOCA	0.0012
(Liquid Break < 0.00545 ft <sup>2</sup> ) (Steam Break < 0.3 ft <sup>2</sup> )	
Medium LOCA	0.00067
(Liquid Break 0.00545 ft <sup>2</sup> to 0.3 ft <sup>2</sup> )	
Large LOCA	0.00021
(Liquid Break 0.3 ft <sup>2</sup> or greater) (Steam Break 0.3 ft <sup>2</sup> or greater)	

Table 19D.3-1  
Initiating Event Frequencies

Initiating Event	Frequency Per Reactor Year
Manual Shutdown	0.0
Isolation/Loss of Feedwater	<del>0.20</del> 0.18
MSIV Closure	0.04
Loss of Condenser Vacuum	<del>0.05</del> 0.05
Press. Reg./Bypass Valves Closure	0.01
Loss of Feedwater	<del>0.09</del> 0.08
Non-Isolation Event (Trip with bypass)	<del>0.68</del> 0.67
Inadvertent (Stuck) Open Relief Valve	<del>0.01</del> 0.10
Loss of Offsite Power	0.10
Less than 30 Minutes	0.0579
30 Minutes to 2 Hours	0.0246
2 to 8 Hours	0.01
Greater than 8 Hours	0.0017
Small LOCA	0.0012
(Liquid Break < 0.00545 ft <sup>2</sup> )	
(Steam Break < 0.3 ft <sup>2</sup> )	
Medium LOCA	0.00067
(Liquid Break 0.00545 ft <sup>2</sup> to 0.3 ft <sup>2</sup> )	
Large LOCA	0.00021
(Liquid Break 0.3 ft <sup>2</sup> or greater)	
(Steam Break 0.3 ft <sup>2</sup> or greater)	