

NOV 10 1981

Docket  
Files  
DCS-016

Docket Nos. 50-322/341/358/373/387/397/458/461

MEMORANDUM FOR: James R. Miller, Chief  
Standardization & Special Projects Branch, DL

FROM: H. J. Faulkner, Project Manager  
Standardization & Special Projects Branch, DL

SUBJECT: SUMMARY OF MEETING WITH LRG I AND LRG II ON OCTOBER 29, 1981

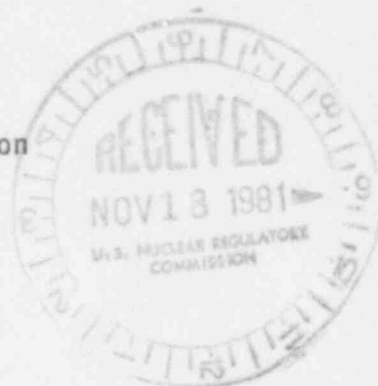
On October 29, 1981, a meeting was held in Bethesda, Maryland, between the NRC staff and representatives of LRG I, LRG II and their consultants to discuss in-core thermocouples for BWR's. General Electric Co., as contractor to the LRG groups, discussed and presented results of a risk assessment study utilizing in-core thermocouples. An attendance list is provided as Enclosure 1.

A copy of the view graphs highlighting the GE presentation is provided as Enclosure 2. The conclusions of the risk assessment study performed by GE re:

\*It will cost a minimum of \$600,000 and 100 manrem per plant (assuming installation after power operation) to install in-core thermocouples. Subsequent maintenance will require about 15 manrem per year.

\*There is minimal benefit arising from the negligible reduction in core melt probability and the negligible reduction in radiation exposure to the public for incorporating in-core thermocouples.

\*Utilizing the safety goal cost-benefit criterion that is currently being advocated by the ACRS, the cost-benefit consideration does not justify the use of in-core thermocouples in BWR's.



The staff indicated that they would like to receive a formal submittal including details and results of this study. LRG indicated that this could be provided in about 1 month. Additionally, LRG stated that the more general study of utilizing in-core thermocouples in BWR's, that is being performed by S. Levy Associates, will be provided to the staff in about 1 month.

OFFICE							
SURNAME	B111230170	B11110					
DATE	PDR	ADOCK	05000322				
	A		PDR				

NOV 10 1981

Mr. Rubenstein indicated that there is a draft letter to applicants currently before the Commission for review requesting them to analyze numbers, location, etc., for placement of in-core thermocouples. He indicated that the industry will have an opportunity to present their case on this subject to the ACRS.

Currently, SER's are being written for BWR/4, /5 and /6 plants with a license condition to incorporate in-core thermocouples into the ICC monitoring system prior to June 1983. LaSalle and Grand Gulf are the first plants of the BWR near term OLS scheduled for fuel loading. Both plants anticipate fuel loading early in 1982.

ORIGINAL SIGNED BY:

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Projects Branch  
Division of Licensing

Enclosures:

- 1. Attendance List
- 2. Risk Analysis@BWR In-core Thermocouples

cc: See next page

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DATE	11/10/81	11/10/81					

MEETING SUMMARY DISTRIBUTION

LRG I AND LRG II

Docket File  
NRC PDR  
Local PDR  
SSPB Reading  
TERA  
NSIC  
TIC

E. Case  
D. Eisenhr+  
R. Purple  
E. Hughes  
T. Novak  
S. Varga  
T. Ippolito  
R. Clark  
J. Stolz  
R. Tedesco  
B. Youngblood  
A. Schwencer  
F. Miraglia  
E. Adensam  
G. Lainas  
D. Crutchfield  
B. Russell  
P. Vollmer  
R. Mattson  
S. Hanauer  
T. Murley  
J. Knight  
W. Johnston  
D. Muller  
P. Check  
W. Kreger  
L. Rubenstein  
F. Schroeder  
M. Ernst  
ACRS (16)  
I&E (3)  
OSD (7)  
OELD  
V. Moore

I&E Region I  
I&E Region II  
I&E Region III  
I&E Region IV  
I&E Region V  
H. Faulkner  
H. Williams  
D. Houston  
R. Perch  
J. Miller  
SSPB LA/M. Service  
R. Boyd, KMC

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Perry  
River Bend  
GESSAR II  
LaSalle  
Fermi 2  
Shoreham  
Susquehanna  
WNP-2  
Zimmer

A. Bournia  
L. Kintner  
J. Wilson  
R. Stark  
R. Auluck  
I. Peltier  
M. Rushbrook  
C. Berlinger  
L. Phillips

LRG/NRC MEETING  
OF  
OCTOBER 29, 1981  
In-Core Thermocouple Risk Analysis

<u>NAME</u>	<u>REPRESENTING</u>
Pat Powell	Washington Public Power Supply System
John Rigert	Long Island Lighting Company
Roger S. Boyd	KMC, Inc.
Eileen Buzzelli	Cleveland Electric Illuminating Co.
Larry E. Schuerman	Detroit Edison
J. E. Slider	NUS (Detroit Edison)
D. J. Cardinale	PP&L
Dale L. Holtzscher	Illinois Power Company
John Catlin	Bechtel (Miss. Power & Light)
Lesley England	Gulf States Utilities
M. J. Anciaux	GE (LRG II)
D. J. Robare	GE (LRG I)
Carl H. Berlinger	NRC/NRR/CPB
H. Faulkner	NRC/DL
L. S. Rubenstein	NRC/NRR
Larry Phillips	NRC/NRR/CPB
Anthony Bournia	NRC/DL

GENERAL ELECTRIC COMPANY

RISK ANALYSIS

BWR CORE THERMOCOUPLES

DB:GGT:RF/105L1  
10/15/81

## OUTLINE

- o BACKGROUND
  
- o RISK ASSESSMENT
  - METHODOLOGY
  - QUANTIFICATION
  - RESULTS
  
- o COST BENEFIT ANALYSIS
  
- o CONCLUSION

## BACKGROUND

- o TMI
- o NUREG 0737/R.G. 1.97
- o LRG AND BWROG
- o LRG APPEAL MEETING
- o ACRS MEETINGS
- o NRC LETTER
- o ACRS LETTER
- o GE RISK ANALYSIS

DB:GGT:RF/105L3  
10/14/81

THERMOCOUPLE RISK ASSESSMENT

- PURPOSE: (1) DETERMINE THE OVERALL BENEFIT DERIVED FROM THERMOCOUPLES AS INDICATED BY ANY REDUCTION IN RISK TO THE PUBLIC WHICH CAN BE ATTRIBUTED TO THERMOCOUPLE OPERATION.
- (2) DETERMINE THE COST EFFECTIVENESS OF THERMOCOUPLES BY COMPARING THEIR OVERALL COST WITH THEIR EVALUATED BENEFIT



## BWR PROBABILISTIC RISK ASSESSMENT

- o TYPICAL BWR/4 MK II PRA
- o ACCIDENT SEQUENCE PROBABILITIES
  - EVENT TREES (ET) - TOOL TO DISPLAY ACCIDENT SEQUENCES TO ESTIMATE PROBABILITIES
  - FAULT TREES (FT) - DIAGRAMS TO SHOW OPERATOR AND EQUIPMENT FAULTS TO ESTIMATE SYSTEM FAILURE PROBABILITY
  - CORE MELT PROBABILITY
- o ACCIDENT SEQUENCE CONSEQUENCES
  - CATEGORIZE ACCORDING TO CORE MELT/CONTAINMENT FAILURE SEQUENCES
  - EARLY/LATENT DEATHS
- o RISK TO PUBLIC
  - PROBABILITY OF ACCIDENT X CONSEQUENCE OF ACCIDENT

DB:RF/105L11  
10/15/81

## METHODOLOGY

- o DETERMINED BENEFIT
  - EVALUATED ALL SEQUENCES INVOLVING OPERATOR ACTION
  - QUANTIFIED CHANGE IN OPERATOR ERROR INPUT PROBABILITIES
  - TAKES CREDIT FOR IMPROVED PERFORMANCE DUE TO THERMOCOUPLE INDICATION
  - CALCULATED RESULTS OF CHANGE
  - COMPARED TO TYPICAL BWR PRA RESULTS
- o DETERMINED COST
  - INITIAL INSTALLATION
  - SUBSEQUENT TO INSTALLATION
- o COMPARED TO SAFETY GOAL CRITERION

## QUANTIFICATION

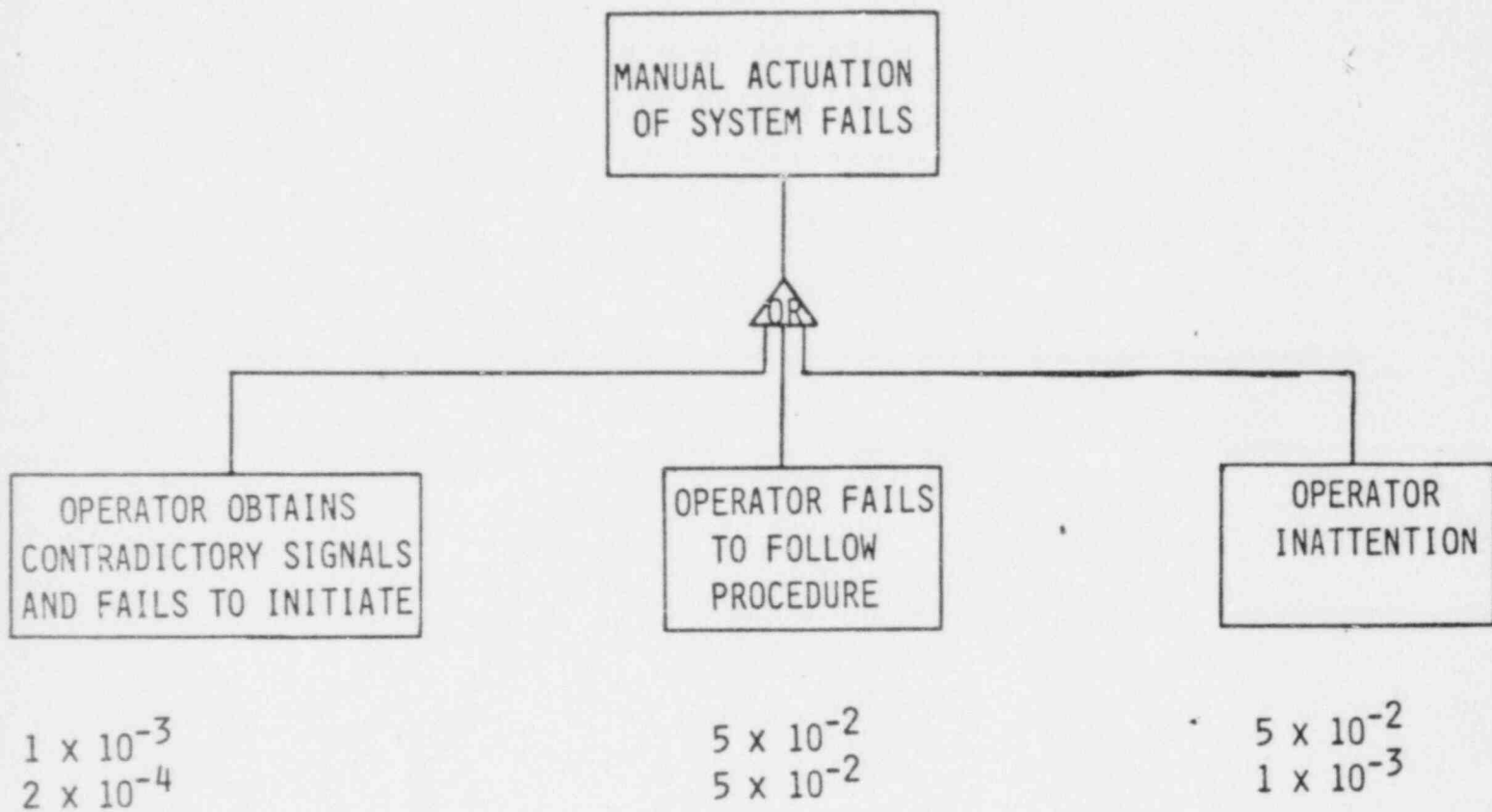
- o SINGLE FAILURE EVENTS (ECCS SYSTEMS)
  - CONTRADICTIONARY OR CONFUSING SIGNALS  
1.0 x 10<sup>-3</sup> CHANGED TO 2.0 x 10<sup>-4</sup>
  - OPERATOR INATTENTION  
5.0 x 10<sup>-2</sup> CHANGED TO 1.0 x 10<sup>-3</sup>
  - FAILURE TO FOLLOW PROCEDURE  
5.0 x 10<sup>-2</sup> STAYS 5.0 x 10<sup>-2</sup>
  
- o ADS (MANUAL INITIATION)
  - OPERATOR FAILS TO INITIATE  
2 x 10<sup>-3</sup> CHANGED TO 1 x 10<sup>-3</sup>
  
- o COMMON MODE FAILURE EVENTS
  - MISCALIBRATION OF WATER LEVEL INSTRUMENTATION  
MODERATE - 2 x 10<sup>-5</sup> CHANGED TO 2 x 10<sup>-6</sup>  
SMALL - 2 x 10<sup>-3</sup> STAYS 2 x 10<sup>-3</sup>

DB:GGT:RF/105L5

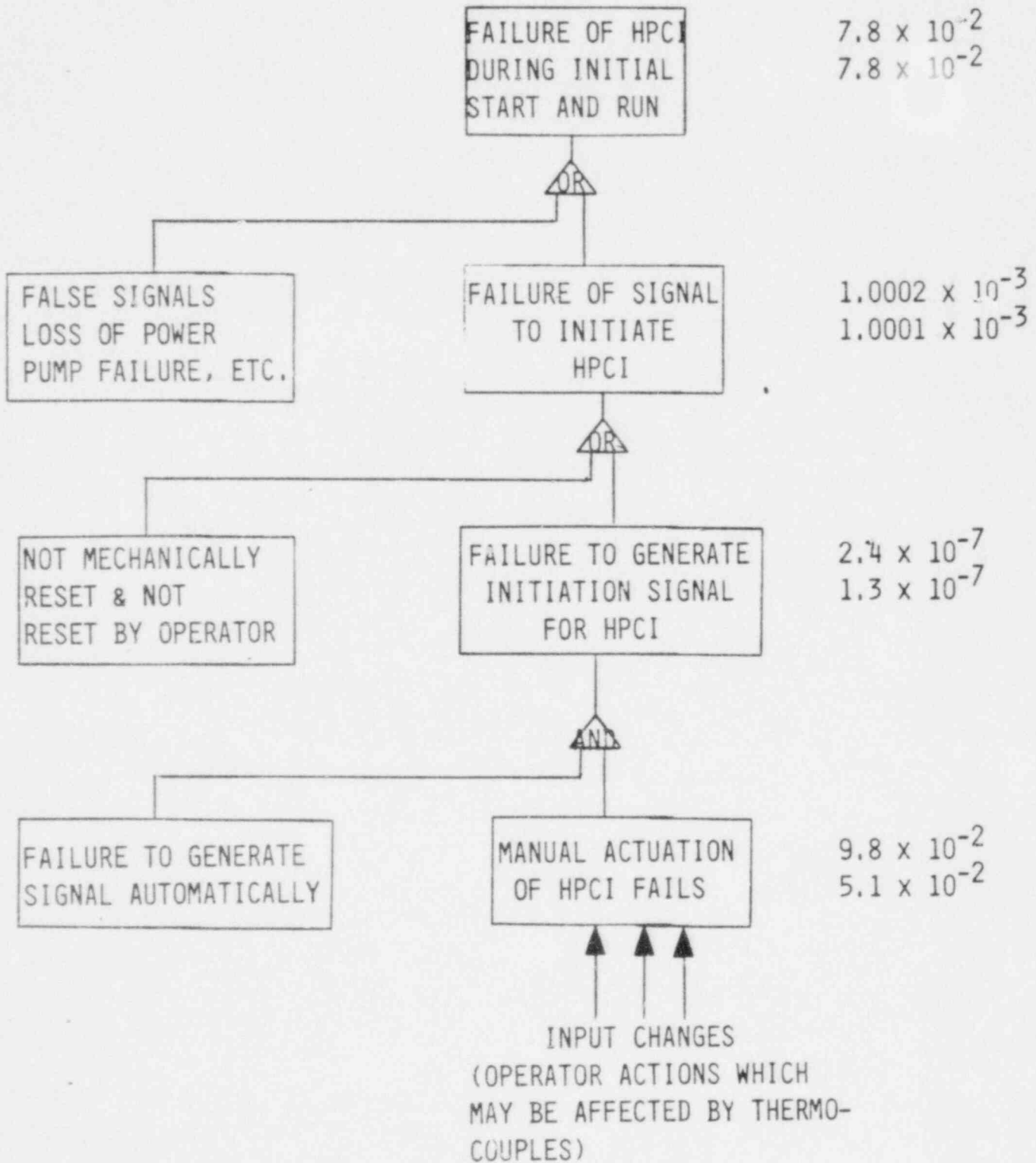
10/14/81



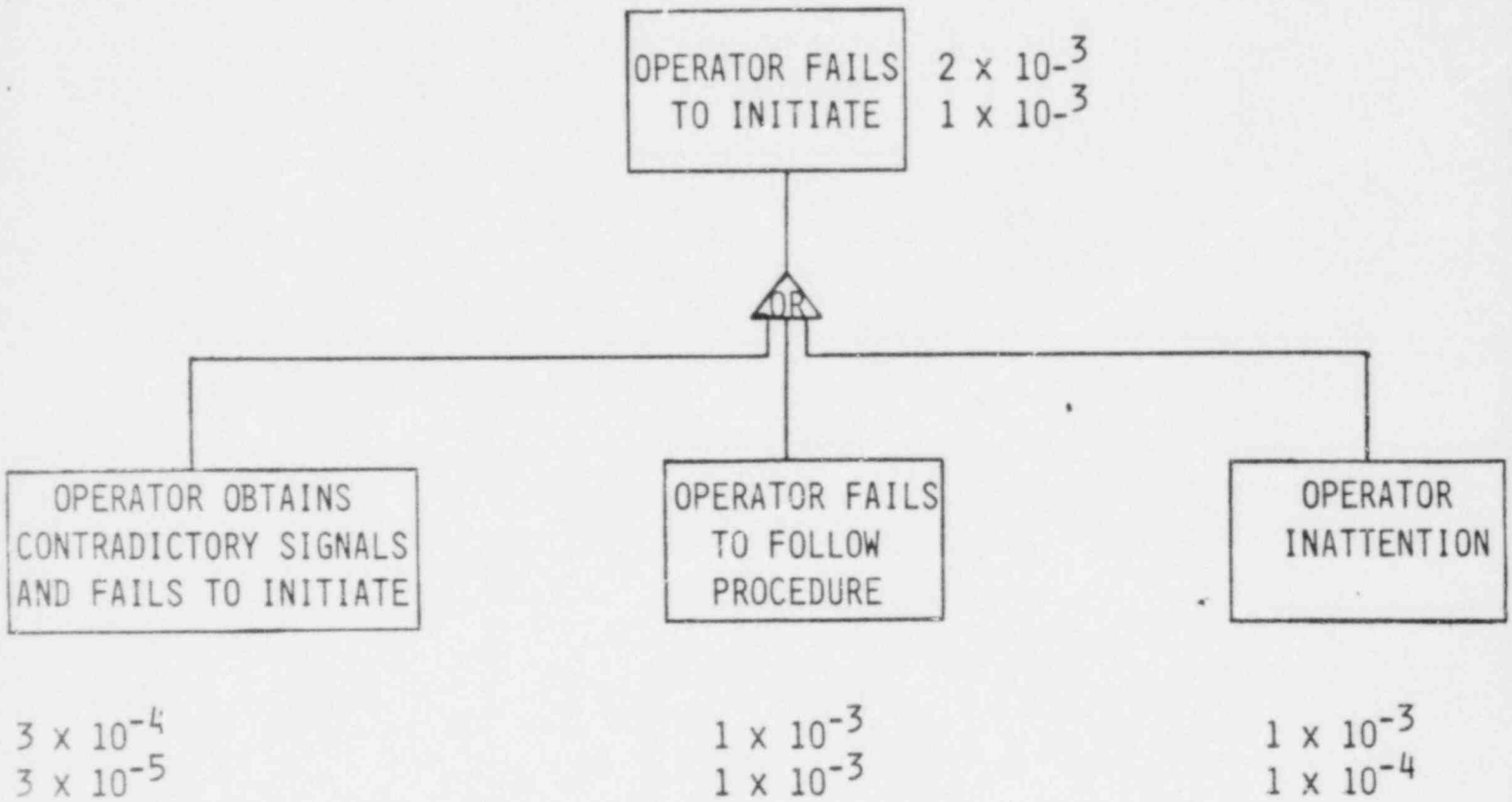
EXAMPLE OF INPUT TO FAULT TREE



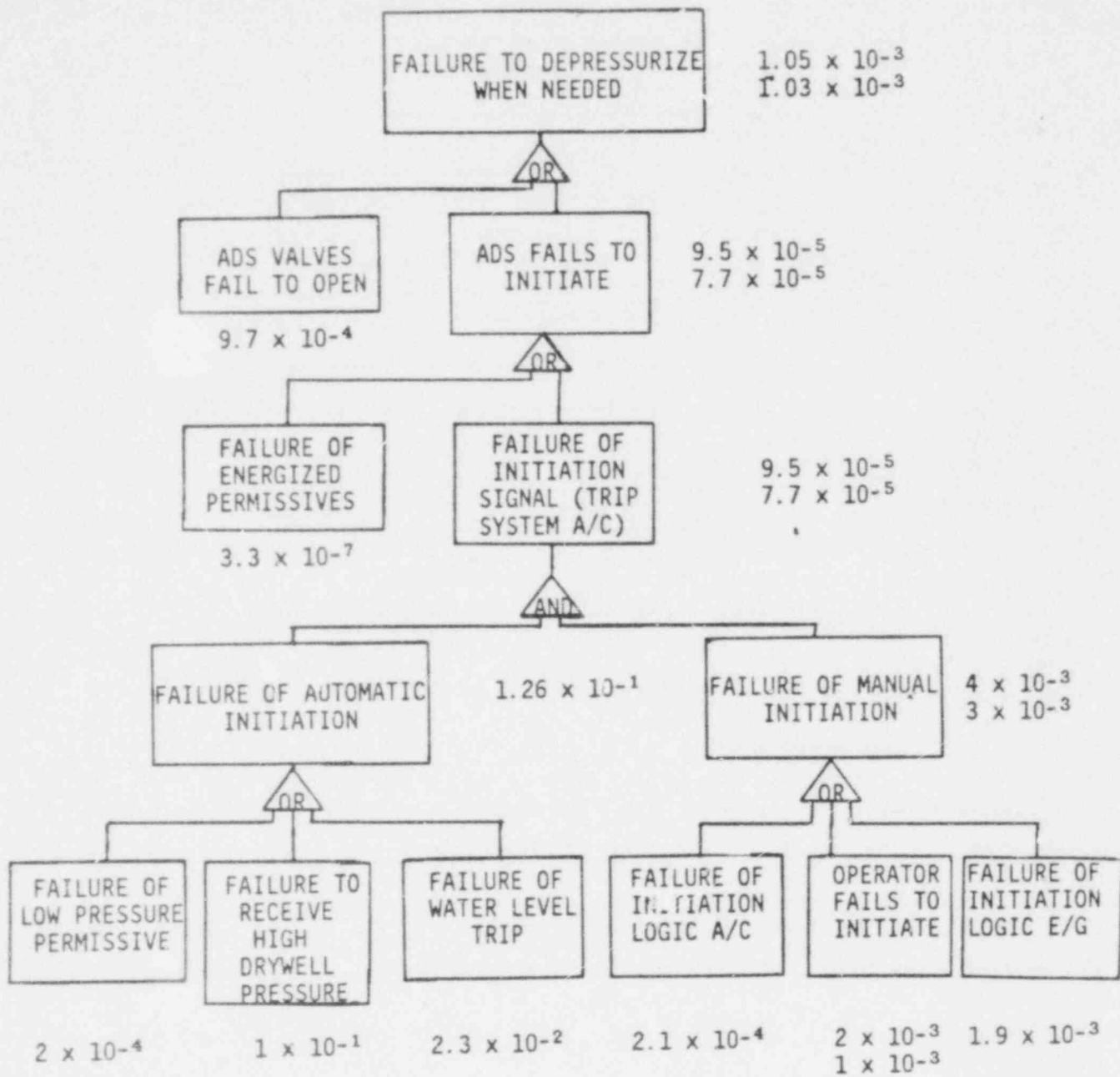
SIMPLIFIED FAULT TREE SHOWING THERMOCOUPLE EFFECT (HPCI)



INPUT TO ADS TREE



SIMPLIFIED FAULT TREE FOR ADS



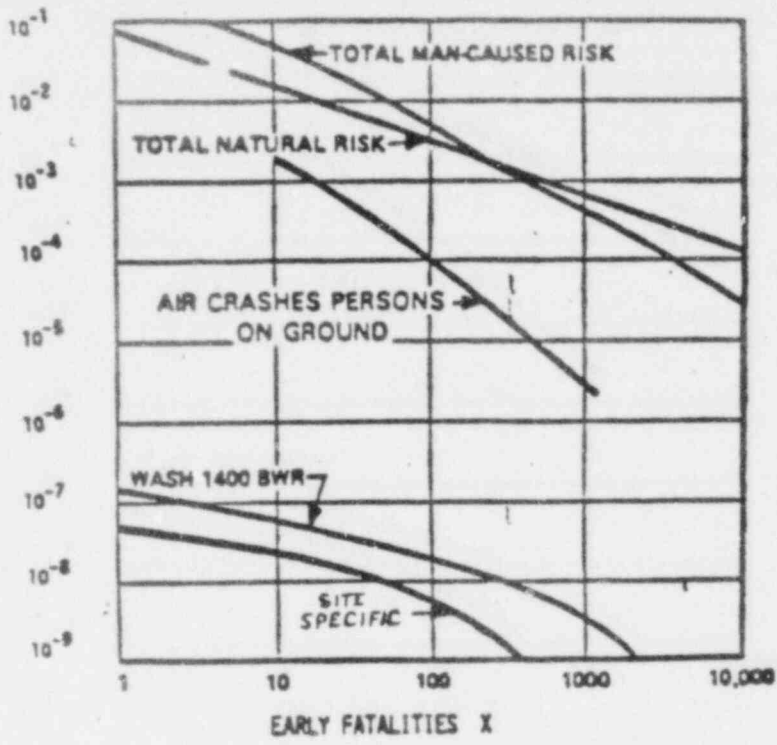


## RESULTS

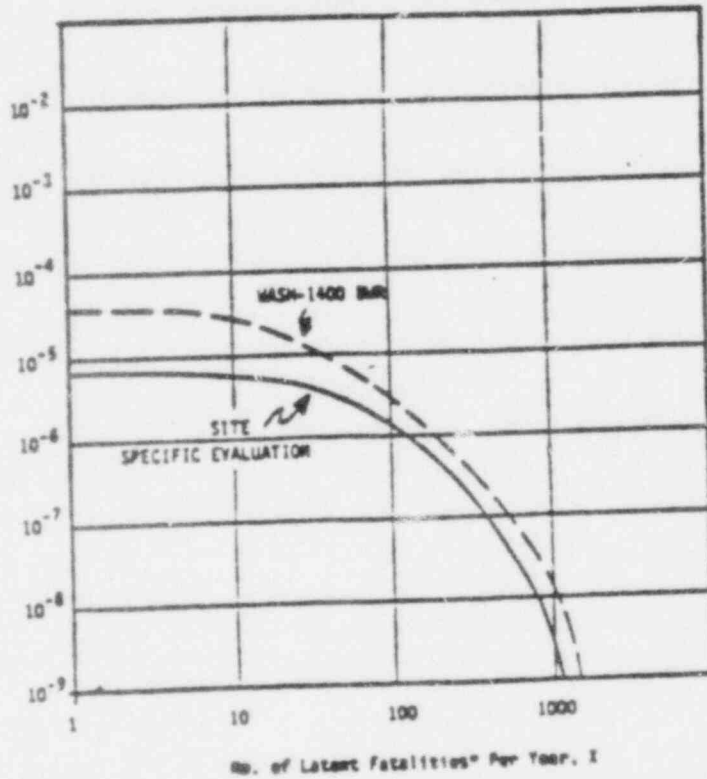
- o EVALUATED ALL PRA SEQUENCES WITH OPERATOR ACTION
  - NEGLIGIBLE OR NO EFFECT AT SYSTEM LEVEL
- o HARDWARE FAILURE PATHWAYS MOST LIMITING
  - OPERATOR IS BACKUP TO AUTOMATIC FUNCTIONS
  - OPERATOR RELIABILITY IMPROVED THROUGH TRAINING AND EMERGENCY PROCEDURE GUIDELINES
- o NEGLIGIBLE EFFECT ON FINAL CORE MELT PROBABILITY
  - $9.5 \times 10^{-6}$  WITHOUT THERMOCOUPLES
  - $9.3 \times 10^{-6}$  WITH THERMOCOUPLES
- o NEGLIGIBLE EFFECT ON RADIATION EXPOSURE TO PUBLIC
  - NO EFFECT ON EARLY FATALITIES
  - 2% DECREASE IN LATENT FATALITIES ( .01 LIFE)

DB:GGT:RF/105L9  
10/14/81

FREQUENCY (Events/Year),  $\geq X$



FREQUENCY (EVENTS/YEAR),  $\geq X$



\* Latent Fatalities due to Core Melt Accident Sequences

## CONCLUSIONS

### o BWR THERMOCOUPLES COST

- INITIAL (GE MINIMUM ESTIMATES)  
\$600K  
100 MANREM
- SUBSEQUENT  
MAINTENANCE  
FORCED OUTAGES  
15 MANREM/YEAR

### o BWR THERMOCOUPLE BENEFIT

- NEGLIGIBLE EFFECT ON CORE MELT PROBABILITY
- NEGLIGIBLE EFFECT ON RADIATION EXPOSURE TO  
PUBLIC

### o SAFETY GOAL COST BENEFIT CRITERION

- ACRS - \$5 MILLION PER EARLY DEATH AVERTED
- \$1 MILLION PER LATENT DEATH AVERTED

### o COMPARISON

- EARLY - \$600K COST WITH NO BENEFIT
- LATENT - \$600K COST WITH LESS THAN .01 LIFE  
SAVED

COST BENEFIT DOES NOT JUSTIFY THERMOCOUPLES IN BWR

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