Dockets Nos. 50-269, 50-270
and 50-287

LICENSEE: Duke Power Company

FACILITY: Oconee Nuclear Station, Units 1, 2 and 3

SUBJECT: SUMMARY OF MEETING WITH DUKE POWER COMPANY ON COST/BENEFIT EVALUATION OF THE REACTOR VESSEL COOLANT INVENTORY TRACKING SYSTEM FOR THE OCONEE NUCLEAR STATION, UNITS 1, 2 AND 3

Duke Power Company (the licensee) requested to meet with the staff to present a new risk analysis relating to the cost/benefit evaluation of reactor vessel coolant inventory tracking system for the Oconee Nuclear Station. The staff met with the licensee on November 7, 1984 and the list of participants is included as Enclosure 1. Enclosure 2 lists the agenda which the licensee followed to make his presentation and Enclosure 3 is a copy of the viewgraphs presented during the meeting. On January 17, 1985, the NRC staff wrote the licensee a letter stating that "the generic requirement for reactor coolant inventory monitoring system was established after an extensive NRC review which included interaction with the industry during the decision process. Implementation of this requirement has been substantially completed on a majority of pressurized water reactors. A request for plant - specific deviation from this generic requirement must be supported by a comprehensive safety analysis and a probalistic risk assessment..."

Helen Nicolaras, Project Manager
Operating Reactors Branch #4
Division of Licensing

Enclosures:
As Stated

cc w/enclosures:
See next page

ORB#4:DL
HNicolaras;cr
7/24/85

MEETING SUMMARY DISTRIBUTION

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Docket File
NRC PDR
L PDR
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Project Manager -HNicolaras
JStolz
BGrimes (Emerg. Preparedness only)
OELD
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PMorriette
NRC Meeting Participants:
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GLainas
JStolz
THuang
LPhillips
AThadani
EChelliah
JShea

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

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As Stated

cc w/enclosures:
See next page

Enclosure 1

MEETING WITH DUKE POWER COMPANY ON

REACTOR VESSEL INVENTORY TRACKING SYSTEM

NOVEMBER 7, 1984

NAME	TITLE	AFFILIATION
Helen Nicolaras	Project Manager	NRC/NRR/DL
Bud Gerling	Jr. Engr.	PRA/DUKE
Bob Bernero	Dir. DSI, NRR	NRC/NRR/DSI
L. S. Rubenstein	AD, Core/Plant Supt.	NRC/NRR/CPS
K. S. Canady	Manager, Nuclear Engr.	Duke Power Co.
Paul Guill	Assoc. Eng./Lic.	Duke Power Co.
G. B. Swindlehurst	Nuclear Engineer	Duke
R. C. Jones	Nuclear Engineer	NRC/NRR/DSI/RSB
R. K. Frahm	Section Leader	RRAB/DST/NRC
Hulbert C. Li	Reactor Engineer	NRC/DSI/ICSB
Jan Kozyra	Licensing Engineer	CP&L
Gus Lainas	AD/Operating Reactor	NRC/NRR/DL
John F. Stolz	B/C ORB#4/DL	NRC/NRR/DL
Tai Huang	Nuclear Engineer	NRC/NRR/DSI/CPB
Larry Phillips	Section Leader	NRC/NRR/DSI/CPB
Larry Reed	Sup. Pra	Duke Power
Ashok Thadani	Branch Chief	NRC/DST/RRAB
Erulappa Chelliah	Nuc. Sy. Eng.	NRC/DST/RRAB
Jim Shea	Project Manager	NRC/DL/ORB5

Enclosure 2

AGENDA

INTRODUCTION

PROGRESS REPORT ON CONFORMANCE TO THE ORDER ON ICC INSTRUMENTATION IMPLEMENTATION

OBJECTIVE & APPROACH OF ANALYSIS

OVERVIEW OF ICC INSTRUMENTATION SYSTEM

CORE DAMAGE SEQUENCE EVALUATION

QUANTIFICATION OF SEQUENCES

ASSESSMENT OF AVERTED DOSE

RESULTS & CONCLUSIONS

PRESENTATION

PRA EVALUATION OF REACTOR COOLANT INVENTORY MONITORING SYSTEM

OCONEE NUCLEAR STATION

NOVEMBER 7, 1984

WASHINGTON, DC

11-6-84

AGENDA

INTRODUCTION	K. S. CANADY
OBJECTIVE & APPROACH OF ANALYSIS	L. A. REED
OVERVIEW OF ICC INSTRUMENTATION SYSTEM	L. A. REED
CORE DAMAGE SEQUENCE EVALUATION	R. J. GERLING
QUANTIFICATION OF SEQUENCES	L. A. REED
ASSESSMENT OF AVERTED DOSE	L. A. REED
RESULTS & CONCLUSIONS	L. A. REED

DEFINITION

ICC

- o SUBCOOLED
- o CORE EXIT TEMP
- o RC INVENTORY TRACKING
  - + RC PUMP CURRENT
  - + LEVEL

RCIMS
- LOOPS (A&B)
- VESSEL

OBJECTIVE

TO DETERMINIME THE SAFETY BENEFIT, USING PRA TECHNIQUES, OF IMPLEMENTING RCIMS

APPROACH

- o UTILIZED OCONEE PRA STUDY
  - TO IDENTIFY ACCIDENT SEQUENCES WHERE THE RCIMS COULD CHANGE THE COURSE OF A CORE DAMAGE SEQUENCE
  - TO QUANTIFY POSSIBLE CHANGES IN THE FREQUENCIES OF AFFECTED SEQUENCES BECAUSE OF RCIMS
  - TO DETERMINE THE AVERTED DOSE TO THE PUBLIC BECAUSE OF RCIMS
- o APPLIED THE PROPOSED NRC COST/BENEFIT GUIDELINE TO ESTIMATE THE $ BENEFIT DERIVED FROM RCIMS

OCONEE PRA

- A PRA STUDY JOINTLY SPONSORED BY DUKE AND NSAC.
- THE STUDY WAS COMPLETED IN 1983 AND PUBLISHED IN JUNE, 1984.
- IN THE TERMINOLOGY OF NUREG/CR-2300, THE OCONEE PRA IS A LEVEL 3 WITH ANALYSES OF EXTERNAL EVENTS.

ICC INSTRUMENTATION

1. CONTROL BOARDS: PARAMETER BASED
2. SPDS: FUNCTION BASED
3. ICC: PARAMETER BASED

CONTROL BOARD
INSTRUMENTATION

- o INDICATION
  - SUBCOOLED MARGIN (RC LOOPS & CORE EXIT)
  - CORE EXIT THERMOLCOUPLES
  - PRESSURIZER LEVEL/RC PRESSURE

SPDS

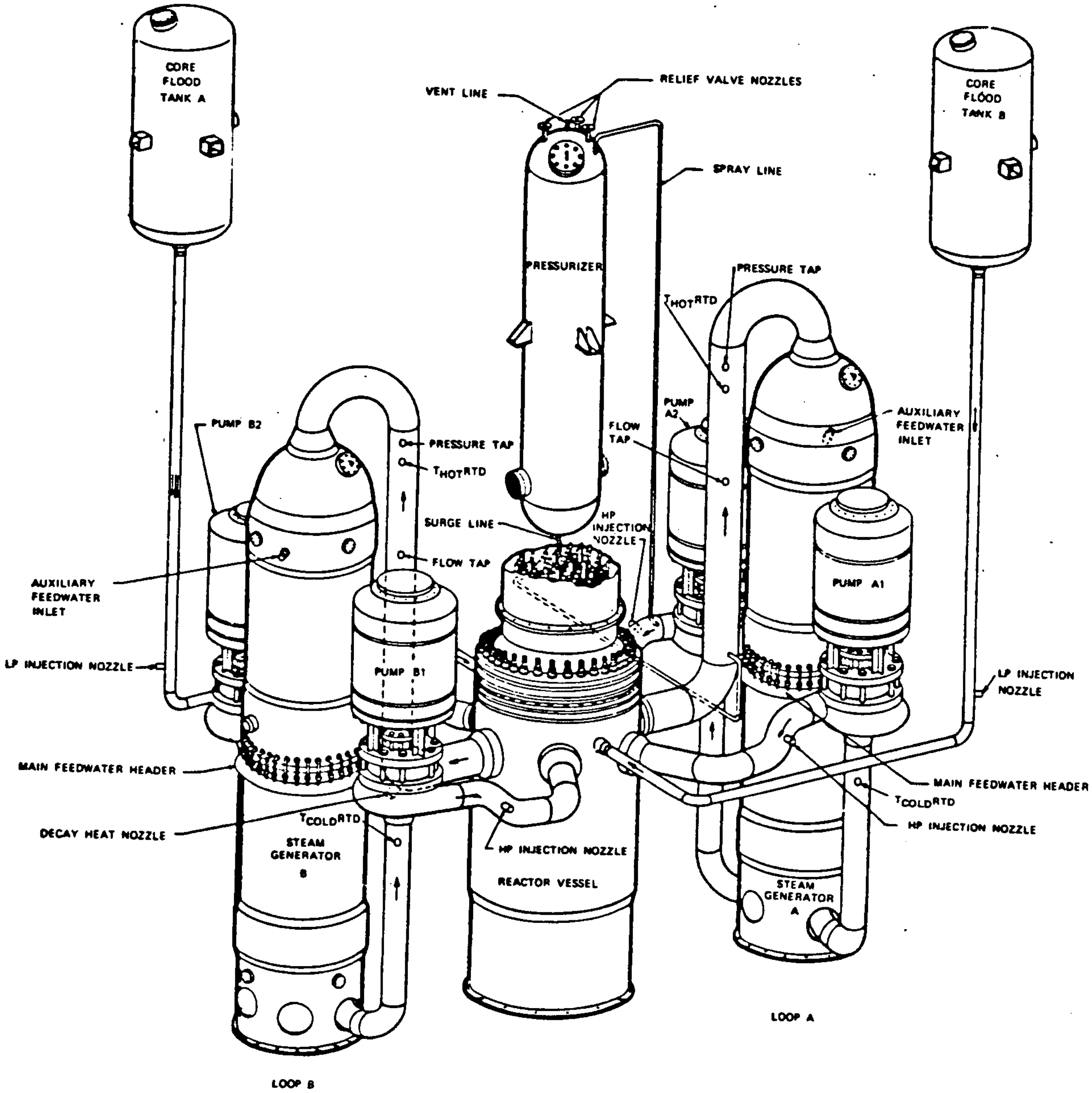
- o FUNCTIONS
  - SUBCRITICALITY
  - ICC
  - HEAT SINK
  - RCS INTEGRITY
  - CONTAINMENT INTEGRITY
  - RCS INVENTORY
- o COLOR GRAPHIC DISPLAYS VIA PLANT COMPUTER
- o DISPLAY IS GENERATED FROM ON-LINE DATA THAT HAS BEEN PROCESSED VIA A LOGIC NETWORK

ICC

- INDICATION
  - SUBCOOLED MARGIN
  - CORE EXIT THERMOCOUPLES
  - INVENTORY TRACKING

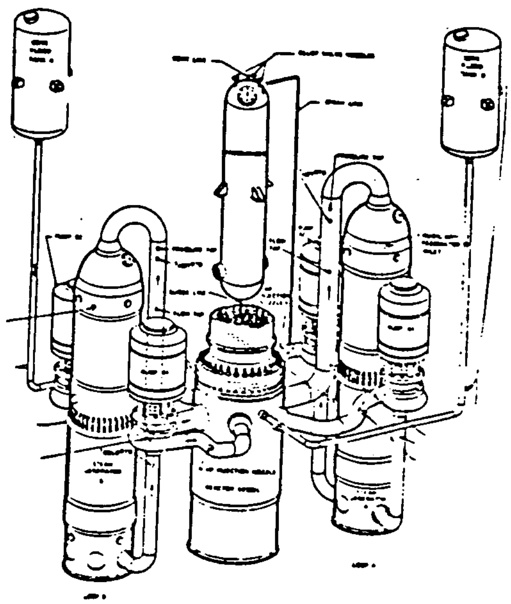
    RCIMS
  - RCP CURRENT
- DEDICATED PLASMA DISPLAY (1 FOR EACH OF TWO TRAINS)
- DIRECT INPUT TO READOUTS FROM SENSORS VIA MICRO PROCESSOR

OCONEE PRIMARY SYSTEM



CONTROL BOARD

SMM	CETS	L/P



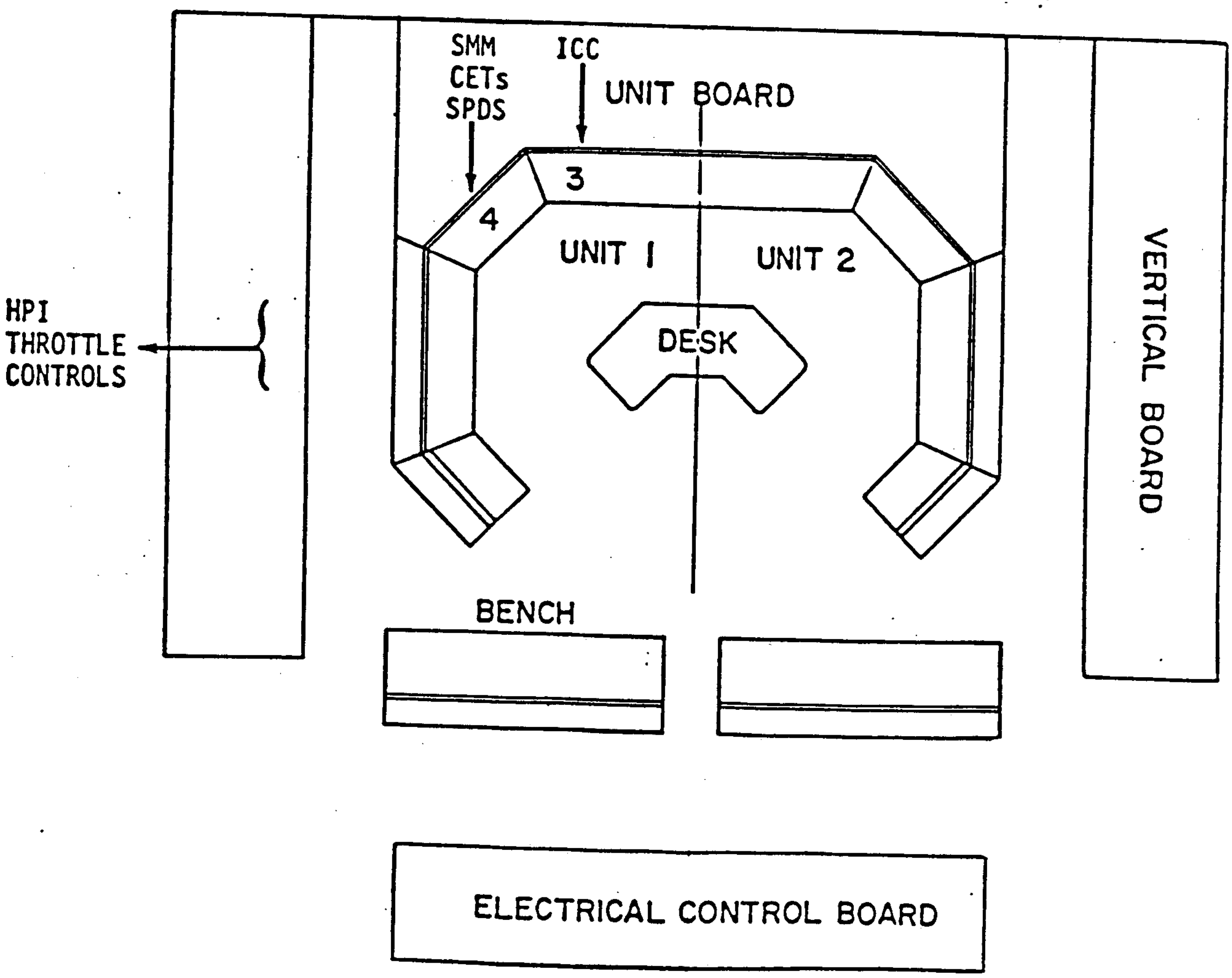
SPDS

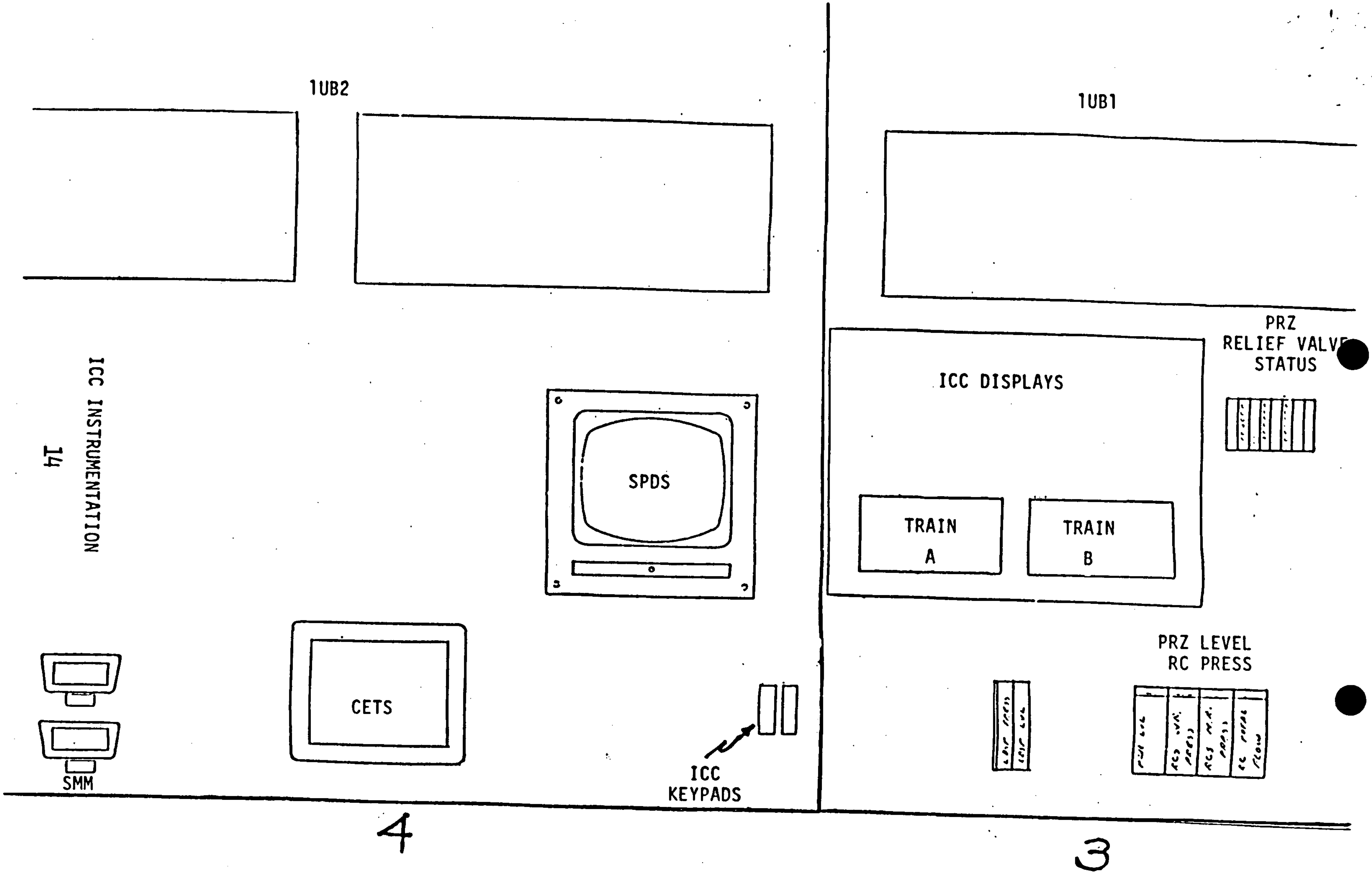
SUBCRITICAL
ICC
RC INTEGRITY
HEAT SINK
RC INVENTORY
CONTAINMENT INTEGRITY

ICC

SMM
CETS
RCIMS
RPM

CONTROL ROOM LAYOUT




1UB2
1UB1
ICC INSTRUMENTATION
14
SPDS
ICC DISPLAYS
PRZ
RELIEF VALV
STATUS
TRAIN
A
TRAIN
B
CETS
SMM
ICC
KEYPADS
PRZ LEVEL
RC PRESS
4
3

SEQUENCE SELECTION

o EXAMINED THE MINIMAL CUT SETS THAT COMPRISE THE CORE-MELT SEQUENCES.

o THESE MINIMAL CUT SETS ARE DUE TO VARIETY OF INITIATING EVENTS, COMPONENT FAILURES, HUMAN ERRORS.

o CATEGORIZED MINIMAL CUT SETS INTO GROUPS ON THE BASIS POTENTIAL EFFECT BY RCIMS.

INITIATING - EVENT DESCRIPTION
(INTERNAL)

	A	LARGE LOCA
+	R	SG TUBE RUPTURE
	RPVRUPTURE	REACTOR-VESSEL RUPTURE
+	S	SMALL LOCA
+	T (ALL)	SUMMATION OF ALL TRANSIENT FREQUENCIES
	T (NO LOFW)	SUMMATION OF TRANSIENT FREQUENCIES NOT INVOLVING LOSS OF FEEDWATER AS AN INITIATOR.
+	T2	LOSS OF MFW
	T3	PARTIAL LOSS OF MWF (ASSUMED TO BE LOSS OF 1 TRAIN)
+	T4	LOSS OF CONDENSER VACUUM
+	T5FEEDF	FAILURE OF OFFSITE POWER DUE TO GRID OR FEEDER FAILURE
	T5SUBF	FAILURE OF OFFSITE POWER DUE TO 230-kV SUBSTATION FAILURE (BOTH BUSES)
+	T6	LOSS OF IA
+	T8	SPURIOUS ES ACTUATION SIGNAL
	T9	STEAMLINE BREAK
+	T10	LARGE FEEDLINE BREAK
+	T11	LOSS OF ICS POWER FROM BUS KI
	T12	LOSS OF LPSW
	T12	LOSS OF LPSW BY THE TRANSFER OF LPSW-108
	T12	LOSS OF LPSW BY FAILURES OTHER THAN LPSW-108
+	T13	SPURIOUS LOW PRESSURIZER PRESSURE SIGNAL
	T14	LOSS OF 4-kV SWITCHGEAR 3TC

+ATWS

NOTE:

\+ APPEARS IN THE SEQUENCES SELECTED FOR QUANTIFICATION

INITIATING EVENTS (CONT)
(EXTERNAL)

EARTHQUAKES

EXTERNAL FLOODS

TORNADOES

+ FIRES

+ INTERNAL FLOODS

NOTE:

+ APPEARS IN THE SEQUENCES SELECTED FOR QUANTIFICATION

SEQUENCE SELECTION (CONT)

GROUP 1 INITIATING EVENTS OR SYSTEM FAILURES ARE SUCH THAT RCIMS WILL HAVE NO EFFECT

EXAMPLE: RV RUPTURE, EXTERNAL FLOODING, LARGE LOCA WITH FAILURE OF SUMP RECIRCULATION

GROUP 2 COMPRISED OF THOSE SEQUENCES WHERE RCIMS IS EXPECTED TO PROVIDE AN ADDITIONAL OPPORTUNITY FOR POSSIBLE RECOVERY

EXAMPLE: SEQUENCES WHERE OPERATORS FAILED TO INITIATE-HPI

GROUP 3 COMPRISED OF THOSE SEQUENCES WHERE THE IMPACT OF RCIMS IS UNCLEAR AND REQUIRED ADDITIONAL INVESTIGATION

EXAMPLE: NATURAL CIRCULATION COOLDOWN, OVER THROTTLING OF HPI --- SMALL BREAK EVENTS, OVER THROTTLING OF LPI --- LARGE BREAK LOCA EVENTS, OVERCOOLING EVENTS.

SEQUENCES SELECTION (CONT)

- o THE SEQUENCES THAT WERE RETAINED WERE THOSE WHERE THE OPERATOR COULD AFFECT THE OUTCOME
  - THROTTLE HPI
  - INITIATE HPI

SEQUENCE SELECTION (CONT)

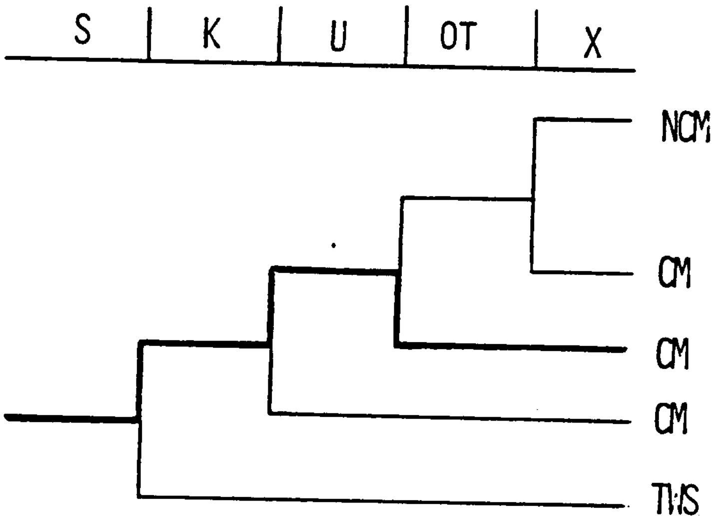
- NUMBER OF CUTSETS CONSIDERED

  IN THE HUNDREDS

- NUMBER OF CUTSETS RETAINED

  62

SBLOCA EVENT TREE

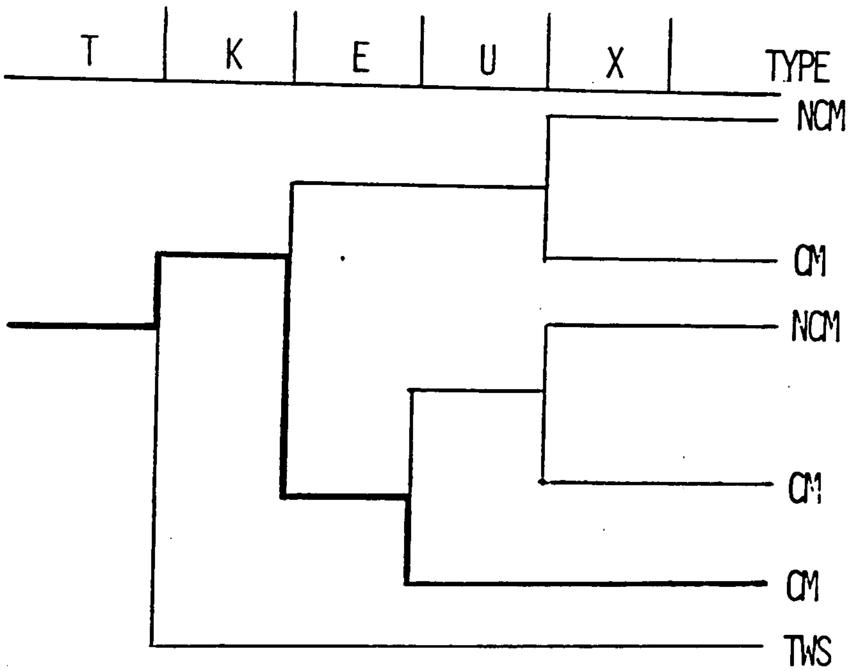


S = SB LOCA INITIATOR
K = REACTOR TRIP
U = INITIATION OF HPI
OT = THROTTLE OF HPI
X = LONG TERM COOLING

EXAMPLE CUTSET

S* HPTH * RECOVERY

TRANSIENT EVENT TREE



T = TRANSIENT INITIATOR
K = REACTOR TRIP
E = EMERGENCY FW
U = INITIATION OF HPI
X = LONG TERM COOLING

EXAMPLE CUTSET

T_2* EFW * UTHPIH * RECOVERY

SEQUENCE SELECTION

RESULTING CUTSETS

CATEGORY 1 SMALL BREAK LOCA, HPI AVAILABLE, HPI OVERTHROTTLED

21 CUTSETS

CATEGORY 2 SEQUENCES WHERE LOSS OF ALL FEEDWATER OCCURRED, FAILS TO INITIATE HPI.

41 CUTSETS

SEQUENCE QUANTIFICATION

- o OPERATOR/SEQUENCE INTERFACE
  - INSTRUMENTATION/CONTROLS
  - PROCEDURES
  - OPERATING SHIFT STRUCTURE
  - TRAINING & EXPERIENCE

- o ASSIGN PROBABILITIES
  - OVERTHROTTLED (OT)
  - FAIL TO RECOVER FROM AN OT CONDITION (X3W/LM)
  - FAIL TO INITIATE HPI SYSTEM (X3W/LM)

QUANTIFICATION (CONT)

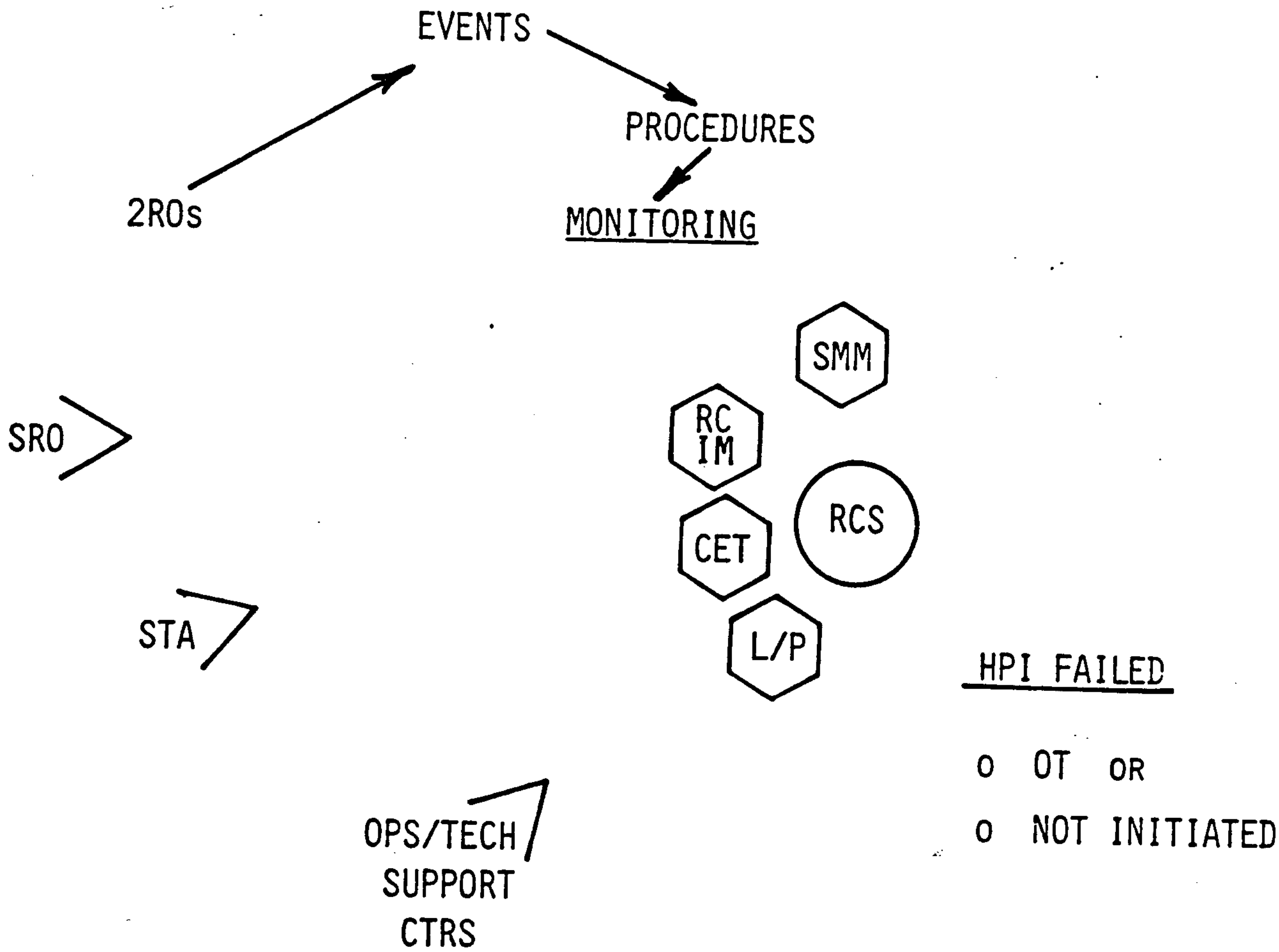
o A TASK OF DETERMINING HUMAN RELIABILITY

SMM	CET	LM	L/P

- ESSENTIALY DETERMINING THE WORTH OF AN ADDITIONAL READOUT

- DIANOSIS NOT IMPORTANT

- USED THE HR HANDBOOK I.E. TASK ORIENTED


EVENTS
PROCEDURES
MONITORING
2ROs
SRO
STA
OPS/TECH SUPPORT CTRS
SMM
RC IM
RCS
CET
L/P
HPI FAILED
o OT OR
o NOT INITIATED

QUANTIFICATION (CONT)

CATEGORY I (THROTTLE)

[ ]*[OT]*[R/WO]=

[ ]*[OT]*[R/W]=

CATEGORY II (INITIATE)

[ ]*[R/WO]=

[ ]*[R/W]=

CONSEQUENCES ANALYSIS

DEFINITIONS

- o CORE DAMAGE   CORE MELT
  - SUSTAINED CORE UNCOVERY

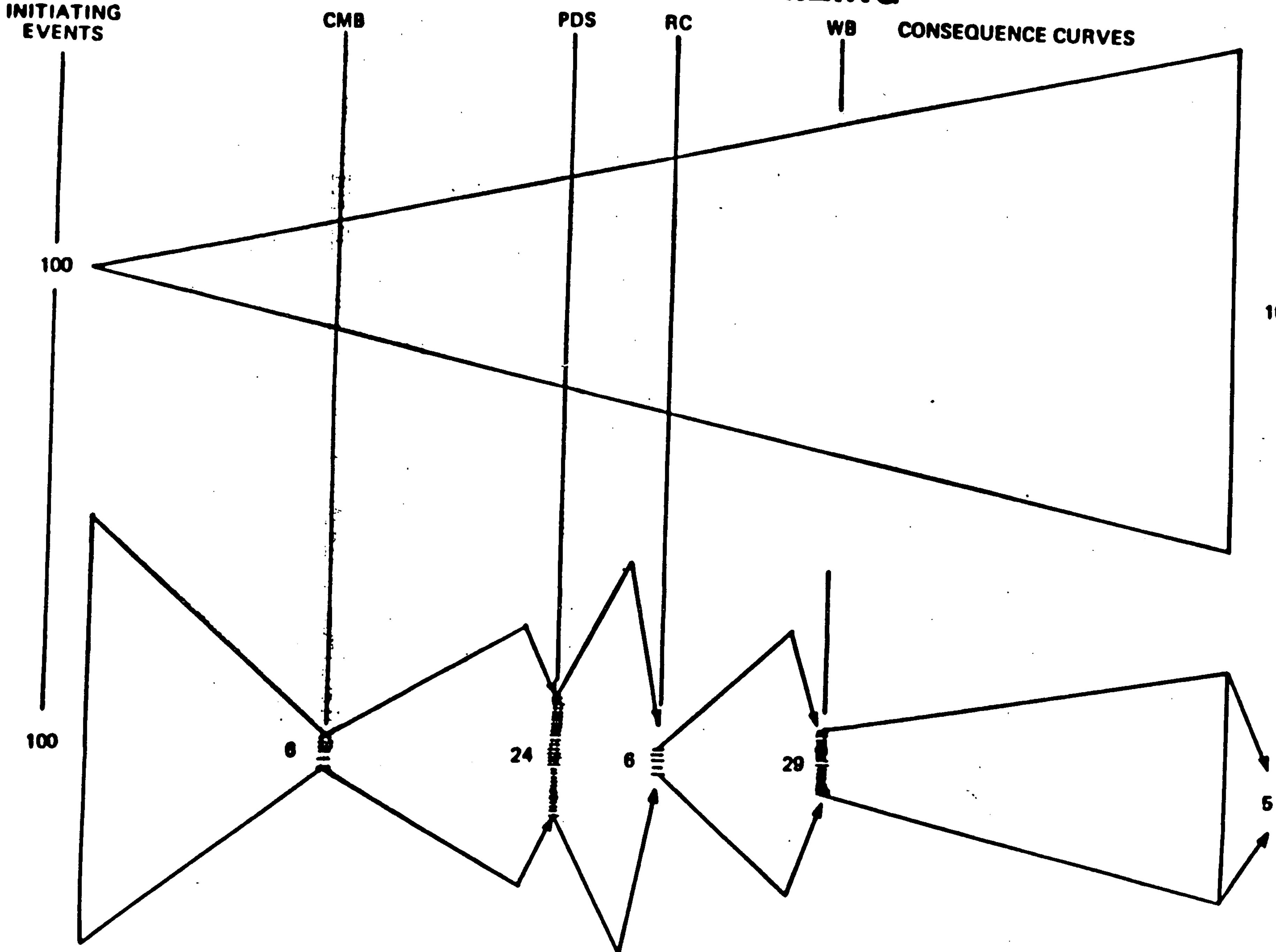
- o CORE MELT BINS (CM)
  - A CATEGORIZATION OF SIMILAR CONTAINMENT EFFECTS INTO GROUPINGS CALLED BINS. ACCIDENT SEQUENCES ARE REVIEWED AND PLACED IN THE APPROPRIATE BIN

    FOR EXAMPLE: ALL SEQUENCES THAT RESULT IN A CORE MELT IN < 2 HOURS AND RC PRESS OF < 400 PSIG ARE GROUPED INTO BIN 1

- o PLANT DAMAGE STATES (PDS)
  - A CATEGORIZATION OF PLANT DAMAGE CONDITIONS INTO "STATES" THAT HAVE VERY SIMILAR CHARACTERISTICS IN TERMS OF A PARTICULAR RELEASE CATEGORY

    FOR EXAMPLE: ALL CM BIN 1 SEQUENCES W/O REACTOR BLD. SPRAY BUT REACTOR BLD. COOLING UNIT IS AVAILABLE ARE GROUPED INTO THE PDS 1B

THE NEED FOR CATEGORIZING

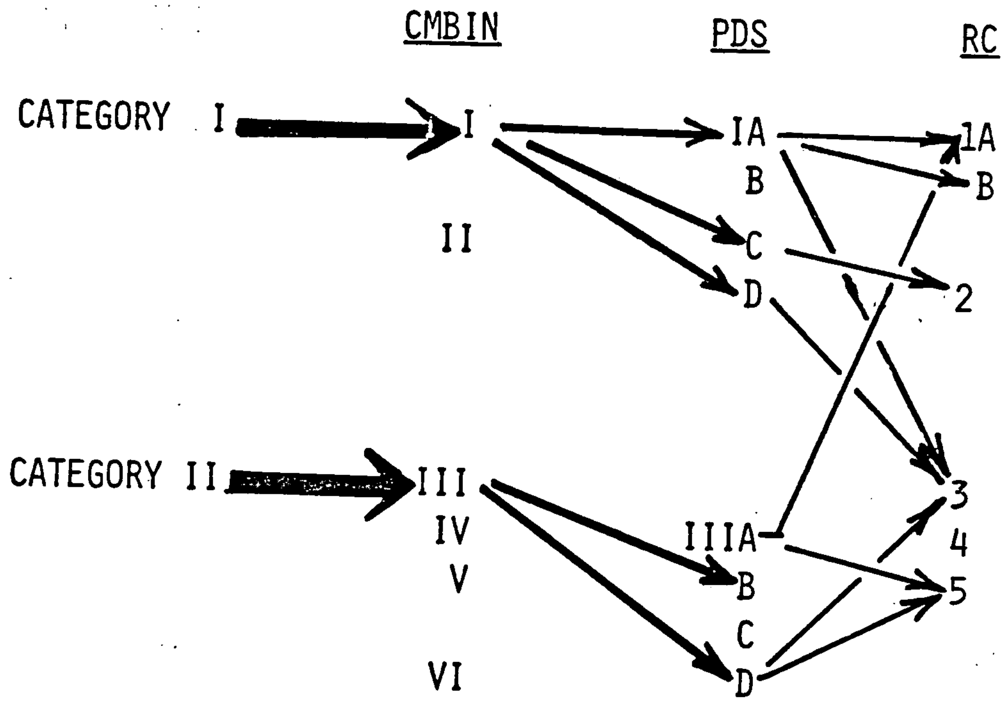


RC–1B

CONSEQUENCE ANALYSES

- o PARTITION ΔFs INTO CORE DAMAGE BINS THEN INTO PLANT DAMAGE BINS
- o CALCULATE THE (F) REDUCTION IN EACH OF THE SIX RELEASE CATEGORIES (RC)
- o DETERMINE MREM AVERTED FOR EACH RC
- o TOTALED MREM AVERTED FROM ALL RC's

CONSEQUENCE (CONT)



RESULTS

- REDUCTION IN CORE DAMAGE FREQUENCY ATTRIBUTABLE TO RCIMS IS 1.4 % OR 3.7×10^{-6}/YR

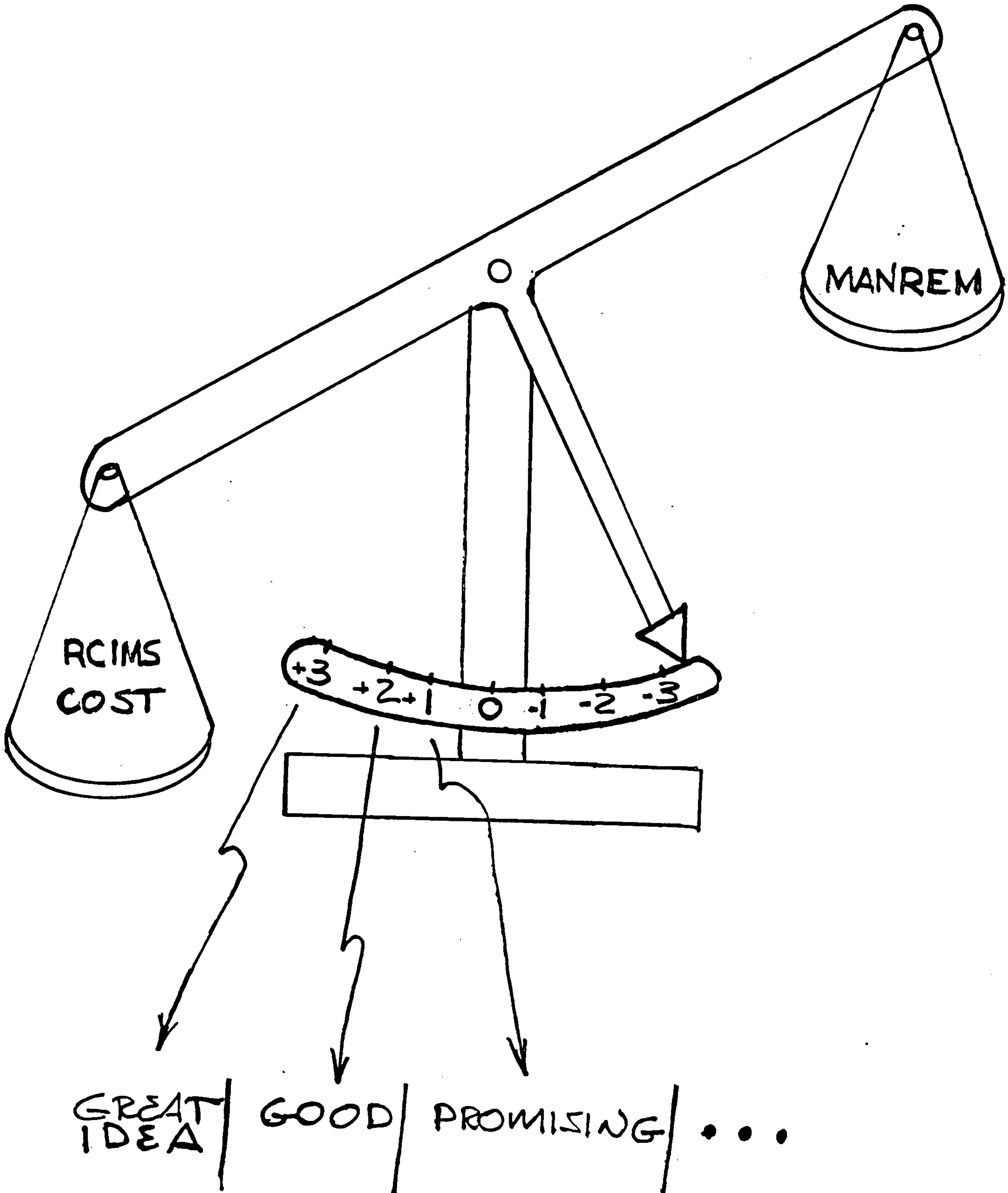
- AVERTED POPULATION ROSE ATTRIBUTABLE TO RCIMS IS 0.11% OR 0.14 MREM/YR

CONCLUSIONS

- NO SIGNIFICANT REDUCTION IN OVERALL CORE DAMAGE FREQUENCY CAN BE ATTRIBUTED TO RCIMS
- AVERTED PUBLIC DOSE RESULTING FROM THE IMPLEMENTATION OF RCIMS IS NEGLIGIBLE
- APPLICATION OF COST BENEFIT PERSPECTIVE SUGGESTS THAT THE COST OF THE SYSTEM IS OVERWHELMING COMPARED TO THE BENEFIT AND CANNOT BE JUSTIFIED ON THIS BASES

CONCLUSIONS (CONT)

- o OTHER PERSPECTIVES
  - NOT USEFUL WHEN RCPs ARE RUNNING OR RC VENTS ARE OPEN
  - EQUIPMENT/CONTROL ROOM SPACE IS AT A PREMIUM
  - THE RCIM SYSTEM IS PARASITIC IN THAT IT USES PLANT RESOURCES AND OPERATOR TIME WITHOUT PROVIDING AN EQUITABLE RETURN


MANREM
RCIMS COST
+3 +2 +1 0 -1 -2 -3
GREAT IDEA
GOOD
PROMISING
. . .

STATUS

- IMPLEMENTATION SCHEDULE PROVIDED BY 9/6/84 LETTER
- CURRENTLY ON SCHEDULE
- FINAL DESIGN DESCRIPTION - JULY, 1985
- EOP TECHNICAL GUIDELINES
  - DUKE SUBMITTAL - MARCH, 1986
  - NRC APPROVAL - JULY, 1986
- IMPLEMENTATION LETTER
  - UNIT 1 - NOVEMBER, 1986
  - UNIT 2 - MARCH, 1987
  - UNIT 3 - MARCH, 1986
- INSTALLATION COMPLETED - JUNE, 1987

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BBernero
LRubenstein
RJones
HLi
GLainas
JStolz
THuang
LPhillips
AThadani
EChelliah
JShea

CONCLUSIONS (CONT)

- o OTHER PERSPECTIVES
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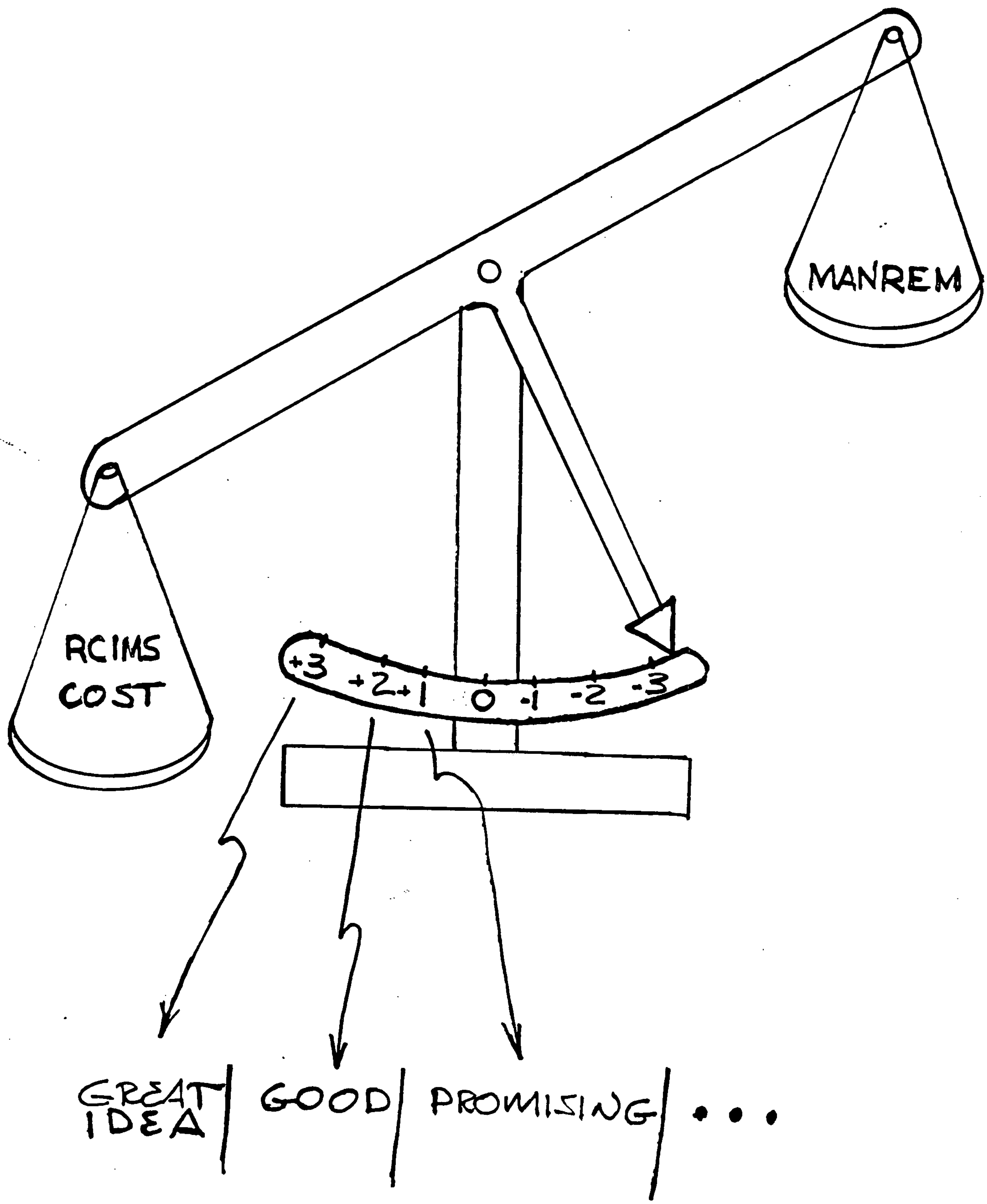
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