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

NOV 1 ° 1983

CT 11

Docket No. 50-601

MEMORANDUM FOR: Cecil O. Thomas, Chief
Standardization & Special Project Branch
Division of Licensing, NRR

FROM: James G. Partlow, Acting Director
Division of Quality Assurance,
Safeguards, and Inspection Programs, IE

SUBJECT: QA BRANCH ACCEPTANCE REVIEW, RESAR SP/90

D. G. Eisenhut's memorandum of November 7, 1983 notes the distribution of Westinghouse's application for PDA of RESAR SP/90 and requests that each review branch conduct an acceptance review with comments provided by COB, November 22, 1983. This memorandum is in response to that request.

The QA Branch has reviewed the application and believes that it is significantly deficient in the area of QA. It appears that QA is not scheduled for submittal, as we understand the application, until 2/85. Our position is that the ongoing design work should be controlled in accordance with the pertinent requirements of Appendix B to 10 CFR Part 50. Any testing that may be done to support the design and all other safety-related activities should also have QA applied. Westinghouse should provide such a commitment with or before its next module submittal. An acceptable reference for docketing would be Revision 9 of WCAP 8370.

The QA program for RESAR SP/90 will be reviewed against the acceptance criteria in the latest standard review plan (SRP, NUREG-0800). WCAP 8370 has not been reviewed against the latest version of the SRP. Therefore, Westinghouse should be requested to revise their QA program description for RESAR SP/90 and submit it to the NRC within a reasonable time frame (within 5-6 months). This could be done as a revision to WCAP 8370 or as Section 17 of the PDA application.

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If you, your staff, or Westinghouse have any questions on the above, contact the QA Branch reviewer, Jack Spraul, on x24530.

James G. Partlow, Acting Director
Division of Quality Assurance,
Safeguards, and Inspection Programs
Office of Inspection and Enforcement

cc: D. G. Eisenhut, NRR
G. Meyer, NRR

Westinghouse Electric Corporation **Water Reactor Divisions**

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230

CT13

June 3, 1983

NS-EPR-2776

Project No. 668

Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Phillips Building
7920 Norfolk Avenue
Bethesda, Maryland 20014

SUBJECT: Advanced Control Room Meeting Slides

Dear Mr. Eisenhut:

Members of the NRC staff visited Westinghouse on May 17, 1983 to continue their review of the design process for the Advanced Control Room (ACR). This review activity is underway to support the overall NRC review of the Westinghouse Advanced Pressurized Water Reactor (WAPWR). The viewgraphs used for the May 17, 1983 meeting are attached.

Keypoints

1. Part of the documentation for this ACR review will be in the form of Chapter 18 from the Standard Review Plan; however, Chapter 18, as now structured, is not well suited for a first-time control room design. Therefore, Westinghouse proposed an approach for re-structuring Chapter 18 into a format more suitable for review of the ACR. The NRC was in general agreement with the need for a new format, and accepted a short-term action item to develop a detailed outline for Chapter 18 including consideration of the Westinghouse proposed structure.

2. It is necessary to define the scope of this review in order to identify the required NRC resources, i.e., the extent of involvement of the Instrumentation and Control Branch, the Reactor Systems Branch, etc. The staff suggested that the appropriate review focus at this time should be the task analysis.

3. It was proposed that the next review meeting be held in Monroeville in late July or early August to discuss the interpretation and application of the results of the task analysis.

Very truly yours,

for E. P. Rahe, Jr., Manager
Nuclear Safety Department

JWM/kk
Attachment

PEO1
1/1

~~8306270855 830603~~
PDR PROJ
668 PDR

Westinghouse Electric Corporation
Water Reactor Divisions

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230

CT14

NS-EPR-2724

February 25, 1983

Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Phillips Building
7920 Norfolk Avenue
Bethesda, MD 20014

Subject: Advanced Control Room Schedule and Meeting Slides
Project Number 668

Dear Mr. Eisenhut:

Attached are the overheads used at our February 1, 1983 meeting on the Advanced Control Room Design for the APWR. As indicated in the future action slide, we would like to establish a plan for NRC review in this area leading to an approval of the overall control room design process, the functional design bases, the functional requirements for the NSSS portion of the plant and the detailed hardware design process. In order to make this review more manageable, we suggest it be conducted in three phases:

Phase I: Review of the process using NUREG-0700 Appendix B as a reference but updated to reflect accumulated experience. This review would include review of the task analysis tools and the functional design bases.

Phase II: Review of functional requirements for the NSSS portion of the plant and the hardware implementation plan.

Phase III: Application of the entire process.

Our preliminary schedule for Phases I & II is attached. Assuming a mutually agreed upon review plan and schedule are established, we suggest the next meeting be held in Pittsburgh in May or June, 1983 to review the task analysis tools and their application.

Very truly yours,

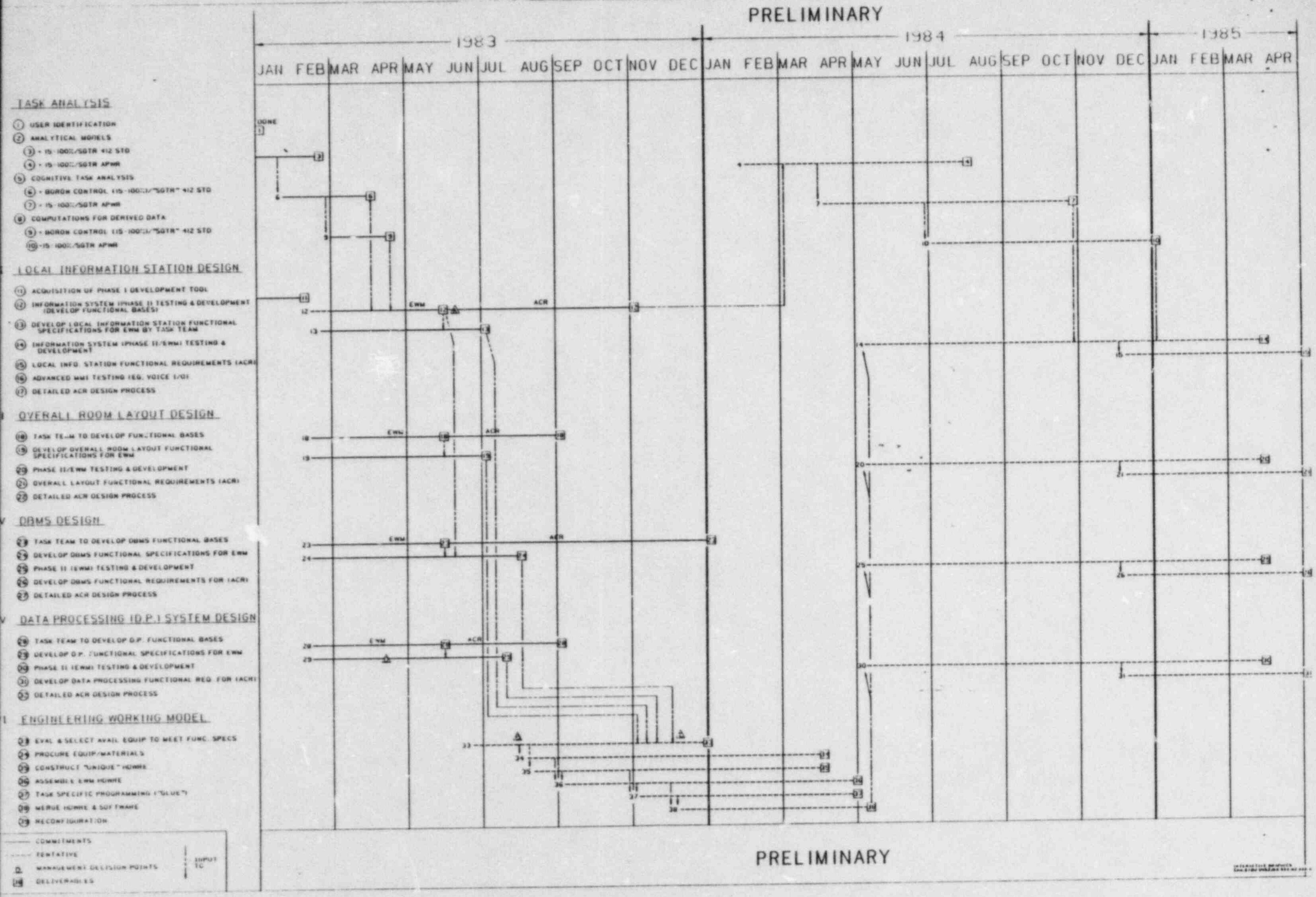
E. P. Rahe, Manager
Nuclear Safety Department

Attachment

cc: F. Miraglia
C. Thomas
G. Meyer

~~8303080127 830225~~
PDR PROJ
P-668 PDR

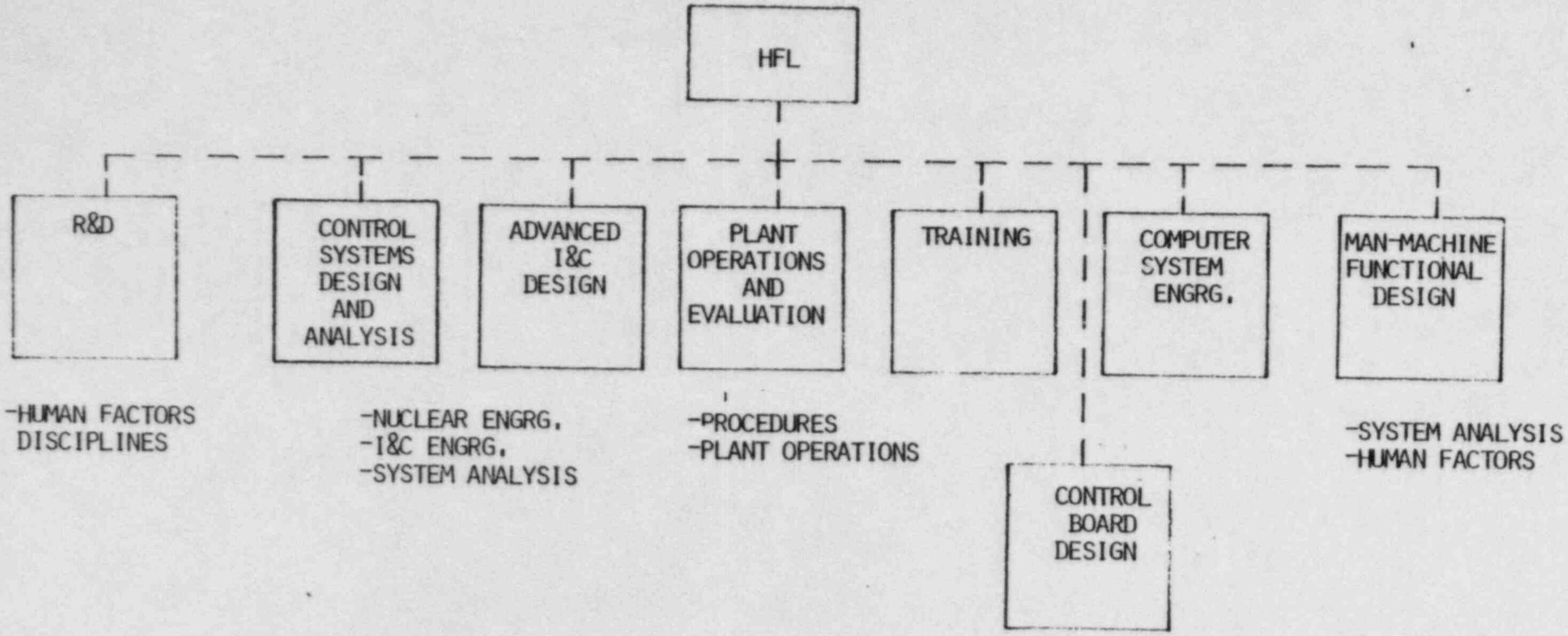
E001


PRELIMINARY
1983
1984
1985
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR
TASK ANALYSIS
1 USER IDENTIFICATION
2 ANALYTICAL MODELS
3 - 15-100%/SGTR 412 STD
4 - 15-100%/SGTR APWR
5 COGNITIVE TASK ANALYSIS
6 - BORON CONTROL (15-100%)/"SGTR" 412 STD
7 - 15-100%/SGTR APWR
8 COMPUTATIONS FOR DERIVED DATA
9 - BORON CONTROL (15-100%)/"SGTR" 412 STD
10 - 15-100%/SGTR APWR
LOCAL INFORMATION STATION DESIGN
11 ACQUISITION OF PHASE I DEVELOPMENT TOOL
12 INFORMATION SYSTEM (PHASE I) TESTING & DEVELOPMENT (DEVELOP FUNCTIONAL BASES)
13 DEVELOP LOCAL INFORMATION STATION FUNCTIONAL SPECIFICATIONS FOR EWM BY TASK TEAM
14 INFORMATION SYSTEM (PHASE II/EWM) TESTING & DEVELOPMENT
15 LOCAL INFO. STATION FUNCTIONAL REQUIREMENTS (ACR)
16 ADVANCED MMI TESTING (EG. VOICE I/O)
17 DETAILED ACR DESIGN PROCESS
OVERALL ROOM LAYOUT DESIGN
18 TASK TEAM TO DEVELOP FUNCTIONAL BASES
19 DEVELOP OVERALL ROOM LAYOUT FUNCTIONAL SPECIFICATIONS FOR EWM
20 PHASE II/EWM TESTING & DEVELOPMENT
21 OVERALL LAYOUT FUNCTIONAL REQUIREMENTS (ACR)
22 DETAILED ACR DESIGN PROCESS
DBMS DESIGN
23 TASK TEAM TO DEVELOP DBMS FUNCTIONAL BASES
24 DEVELOP DBMS FUNCTIONAL SPECIFICATIONS FOR EWM
25 PHASE II (EWM) TESTING & DEVELOPMENT
26 DEVELOP DBMS FUNCTIONAL REQUIREMENTS FOR (ACR)
27 DETAILED ACR DESIGN PROCESS
DATA PROCESSING (D.P.) SYSTEM DESIGN
28 TASK TEAM TO DEVELOP D.P. FUNCTIONAL BASES
29 DEVELOP D.P. FUNCTIONAL SPECIFICATIONS FOR EWM
30 PHASE II (EWM) TESTING & DEVELOPMENT
31 DEVELOP DATA PROCESSING FUNCTIONAL REQ. FOR (ACR)
32 DETAILED ACR DESIGN PROCESS
ENGINEERING WORKING MODEL
33 EVAL & SELECT AVAIL EQUIP TO MEET FUNC. SPECS
34 PROCURE EQUIP/MATERIALS
35 CONSTRUCT "UNIQUE" HDWRE
36 ASSEMBLE EWM HDWRE
37 TASK SPECIFIC PROGRAMMING ("GLUE")
38 MERGE HDWRE & SOFTWARE
39 RECONFIGURATION
COMMITMENTS
TENTATIVE
MANAGEMENT DECISION POINTS
DELIVERABLES
INPUT TO
DONE
EWM
ACR
PRELIMINARY

AGENDA

- OVERVIEW
- W ORGANIZATION FOR HUMAN FACTORS DESIGN OF APWR
- HUMAN FACTORS INTRODUCTION
- HUMAN FACTORS IN THE FLUID/MECHANICAL SYSTEMS
- COGNITIVE SYSTEMS ENGINEERING
- W PROGRAM/DESIGN PROCESS FOR CONTROL ROOM
- ANALYTICAL MODELLING OF PLANT FUNCTIONS
- COGNITIVE TASK ANALYSIS
- SUMMARY - FUTURE ACTIVITIES

HUMAN FACTORS LABORATORY RESOURCE AVAILABILITY



OPERATOR ACTION
CONSIDERATIONS
IN DESIGN

- REVIEW AVAILABLE DATA

  OPERATING EXPERIENCE (LER)

  REGULATORY REQUIREMENTS

  R&D ACTIVITIES

- ESTABLISH SYSTEM/COMPONENT DESIGN CRITERIA OR GOALS

- EVALUATE DESIGNS IN DESIGN REVIEW PROCESS

FLUID SYSTEMS DESIGN

GOAL

"THE POTENTIAL FOR COMMON MODE OPERATOR ERROR SHOULD BE MINIMIZED BY IMPROVING THE HUMAN ENGINEERING OF THE PLANT WITH CONSIDERATION FOR NON-CONTRADICTORY INSTRUMENTATION, CONTROL BOARD ARRANGEMENT, AND SYSTEMS WHOSE OPERATION DOES NOT CHALLENGE THE SAFETY OF THE PLANT."

EXAMPLES

- LIMIT ON HHSI TO PROHIBIT LIFTING OF PORV.
- EWST INSIDE CONTAINMENT TO ELIMINATE INJECTION TO RECIRCULATION MANUAL ACTIONS.
- DESIGN OF HHSI AND AFW PUMPS WITH CONSIDERATION FOR MINIFLOW AT EXTENDED OPERATION TIMES.
- DESIGN OF SECONDARY SIDE COOLING SYSTEMS TO PREVENT OVERCOOLING POTENTIAL ON REACTOR TRIP AND ELIMINATE S.G. OVERFILL POTENTIAL.
- INCORPORATION OF AUTOMATIC PROTECTION ON HIGH SECONDARY RADIATION SIGNAL.

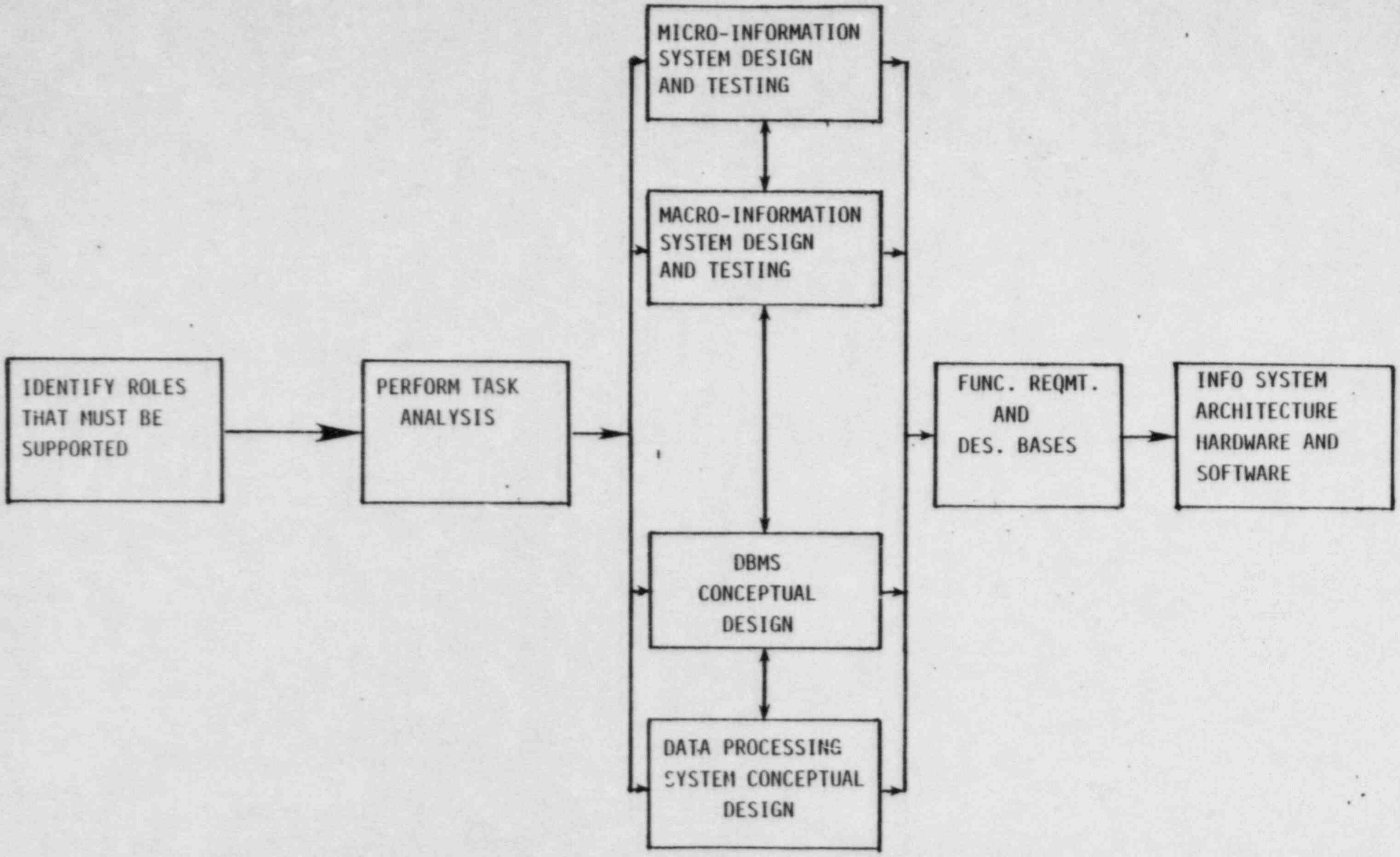
FUTURE ACTIONS

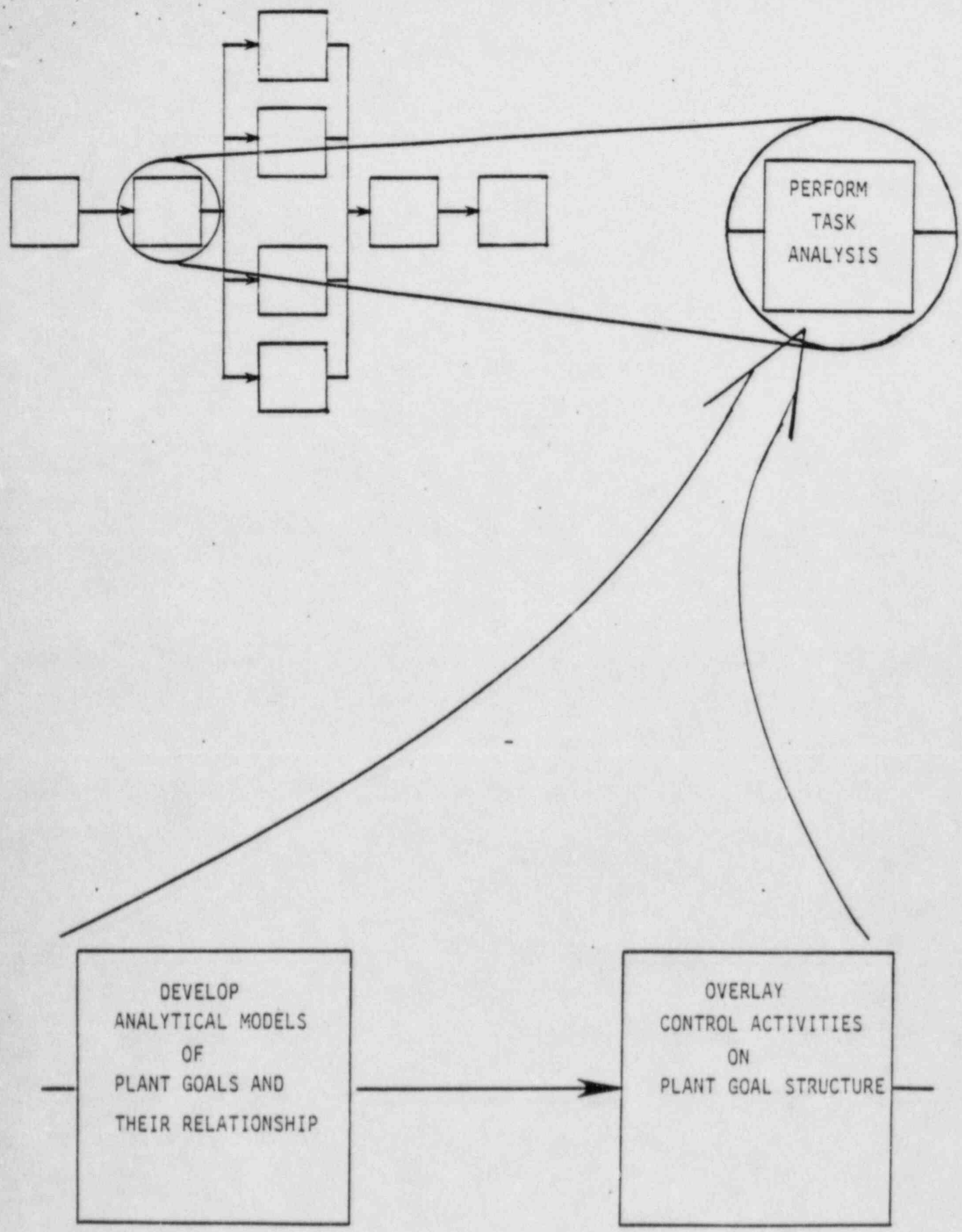
- DOCUMENTATION REQUIREMENTS
  - DETAIL
  - COMPLETENESS
  - CONTENT

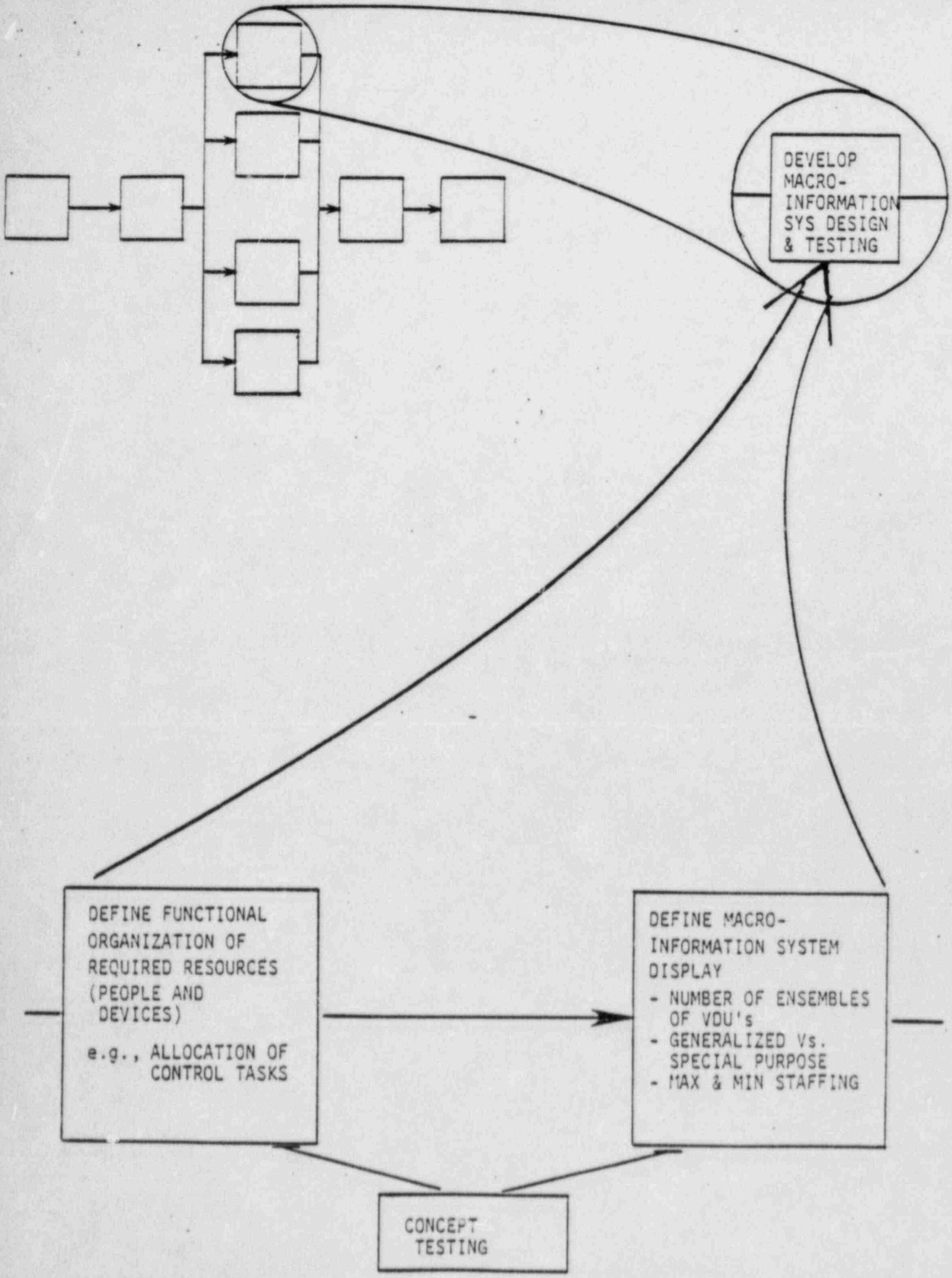
- NRC REVIEW PROCESS
  - AUDIT APPROACH

- INTERNATIONAL ACTIVITIES

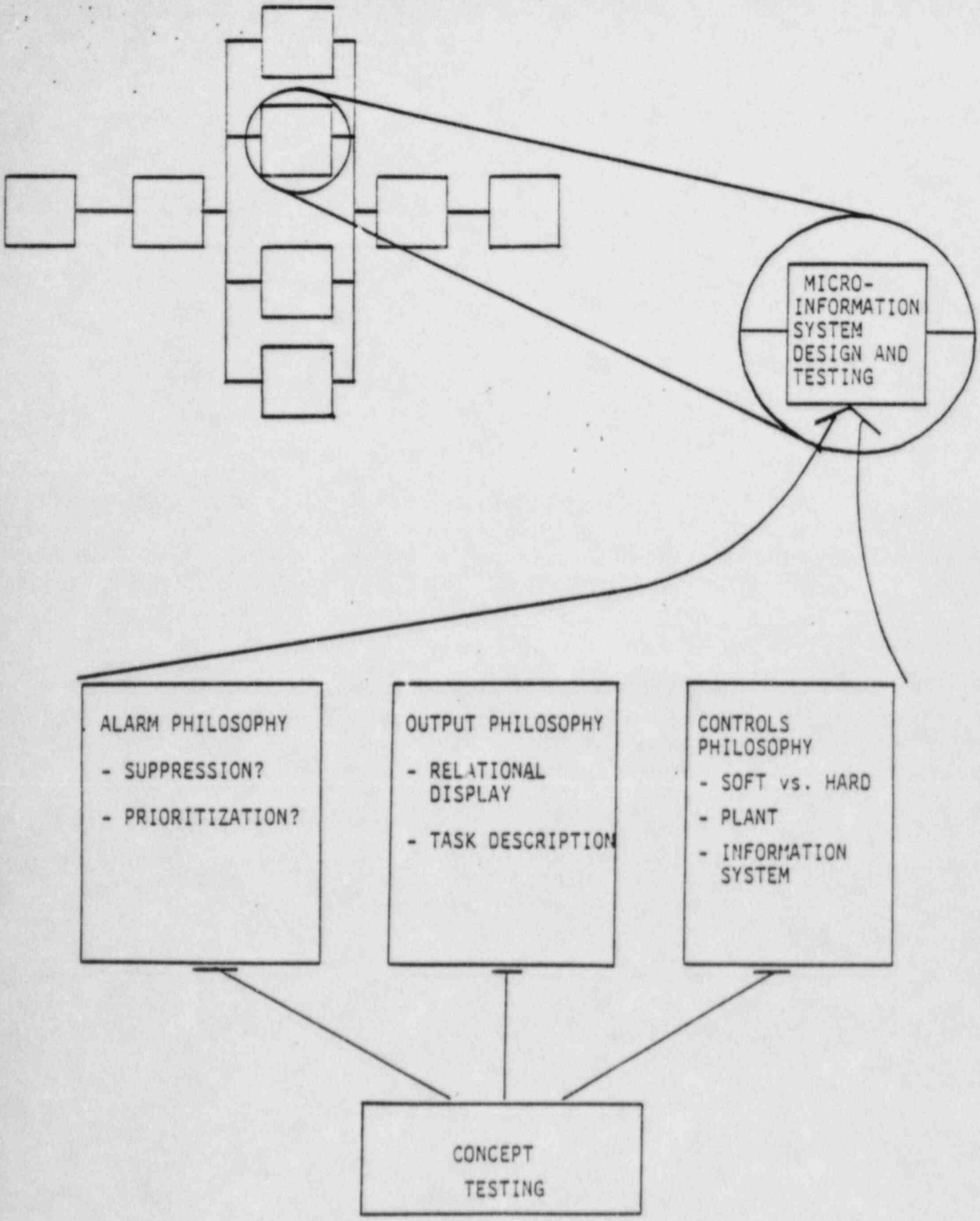
- FURTHER DEVELOPMENT AREAS
  - W PROGRAMS
  - NRC PROGRAMS
  - OTHERS


IDENTIFY ROLES THAT MUST BE SUPPORTED
PERFORM TASK ANALYSIS
MICRO-INFORMATION SYSTEM DESIGN AND TESTING
MACRO-INFORMATION SYSTEM DESIGN AND TESTING
DBMS CONCEPTUAL DESIGN
DATA PROCESSING SYSTEM CONCEPTUAL DESIGN
FUNC. REQMT. AND DES. BASES
INFO SYSTEM ARCHITECTURE HARDWARE AND SOFTWARE


PERFORM
TASK
ANALYSIS
DEVELOP
ANALYTICAL MODELS
OF
PLANT GOALS AND
THEIR RELATIONSHIP
OVERLAY
CONTROL ACTIVITIES
ON
PLANT GOAL STRUCTURE



DEVELOP MACRO-INFORMATION SYS DESIGN & TESTING
DEFINE FUNCTIONAL ORGANIZATION OF REQUIRED RESOURCES (PEOPLE AND DEVICES)
e.g., ALLOCATION OF CONTROL TASKS
DEFINE MACRO-INFORMATION SYSTEM DISPLAY
- NUMBER OF ENSEMBLES OF VDU's
- GENERALIZED Vs. SPECIAL PURPOSE
- MAX & MIN STAFFING
CONCEPT TESTING



MICRO-
INFORMATION
SYSTEM
DESIGN AND
TESTING
ALARM PHILOSOPHY
- SUPPRESSION?
- PRIORITIZATION?
OUTPUT PHILOSOPHY
- RELATIONAL DISPLAY
- TASK DESCRIPTION
CONTROLS PHILOSOPHY
- SOFT vs. HARD
- PLANT
- INFORMATION SYSTEM
CONCEPT TESTING

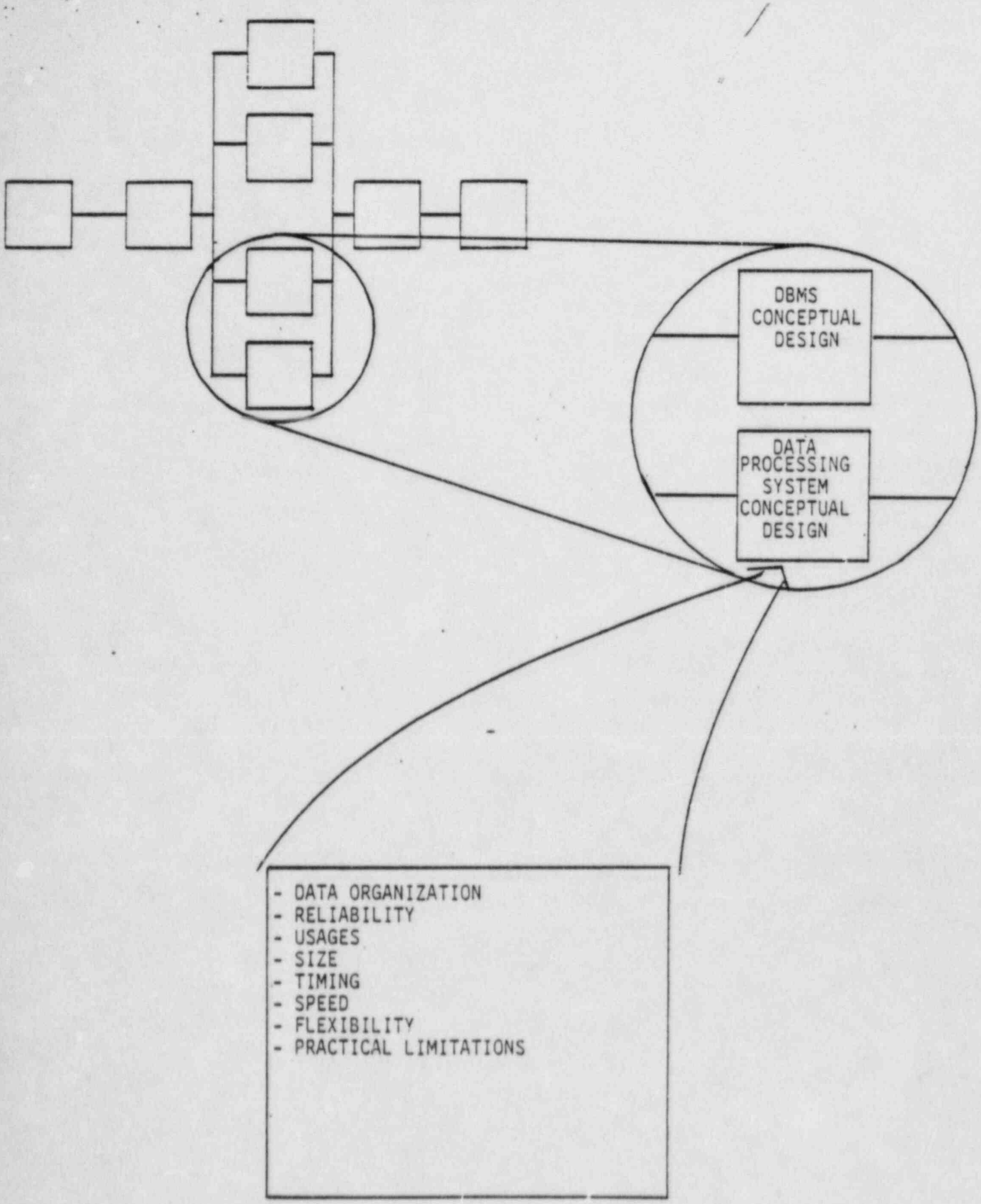
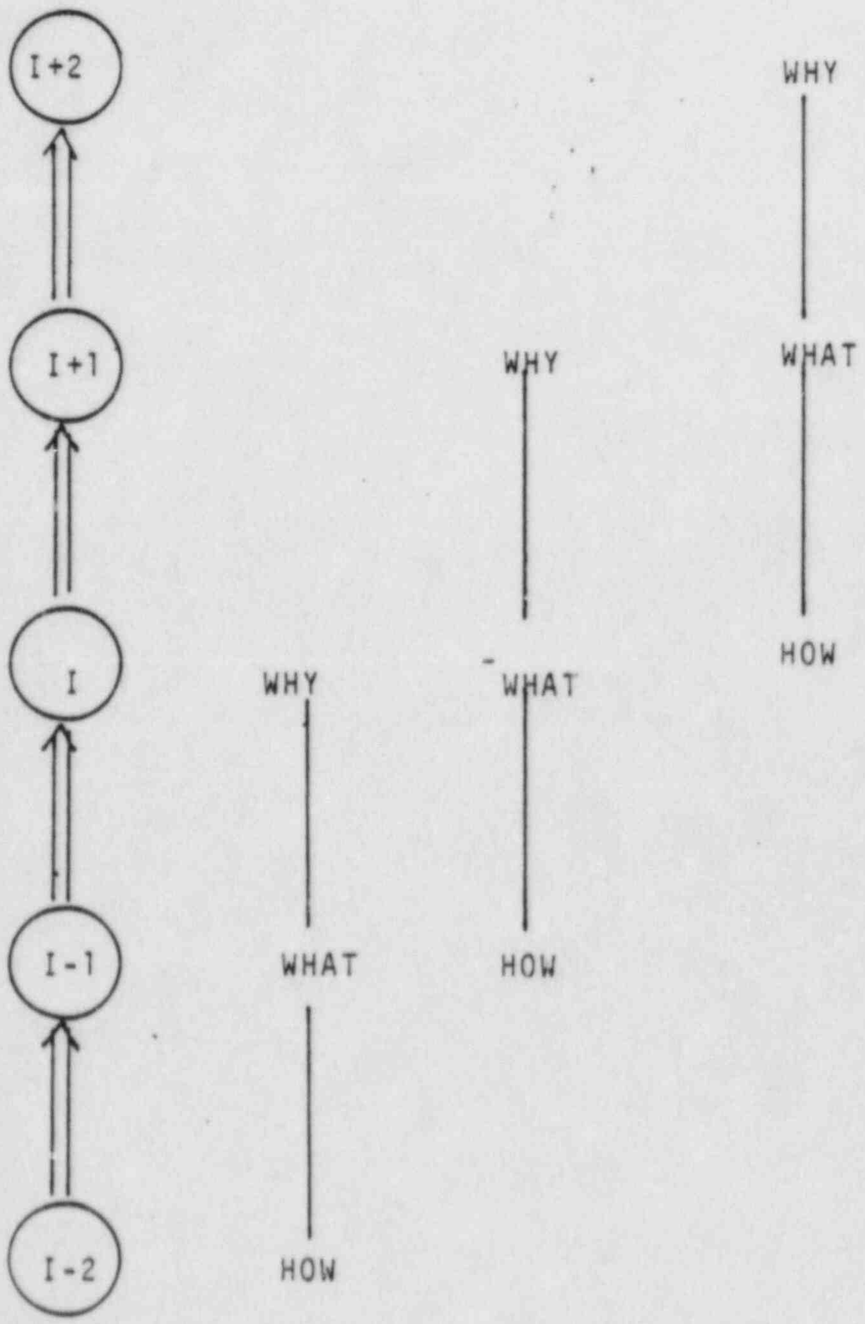
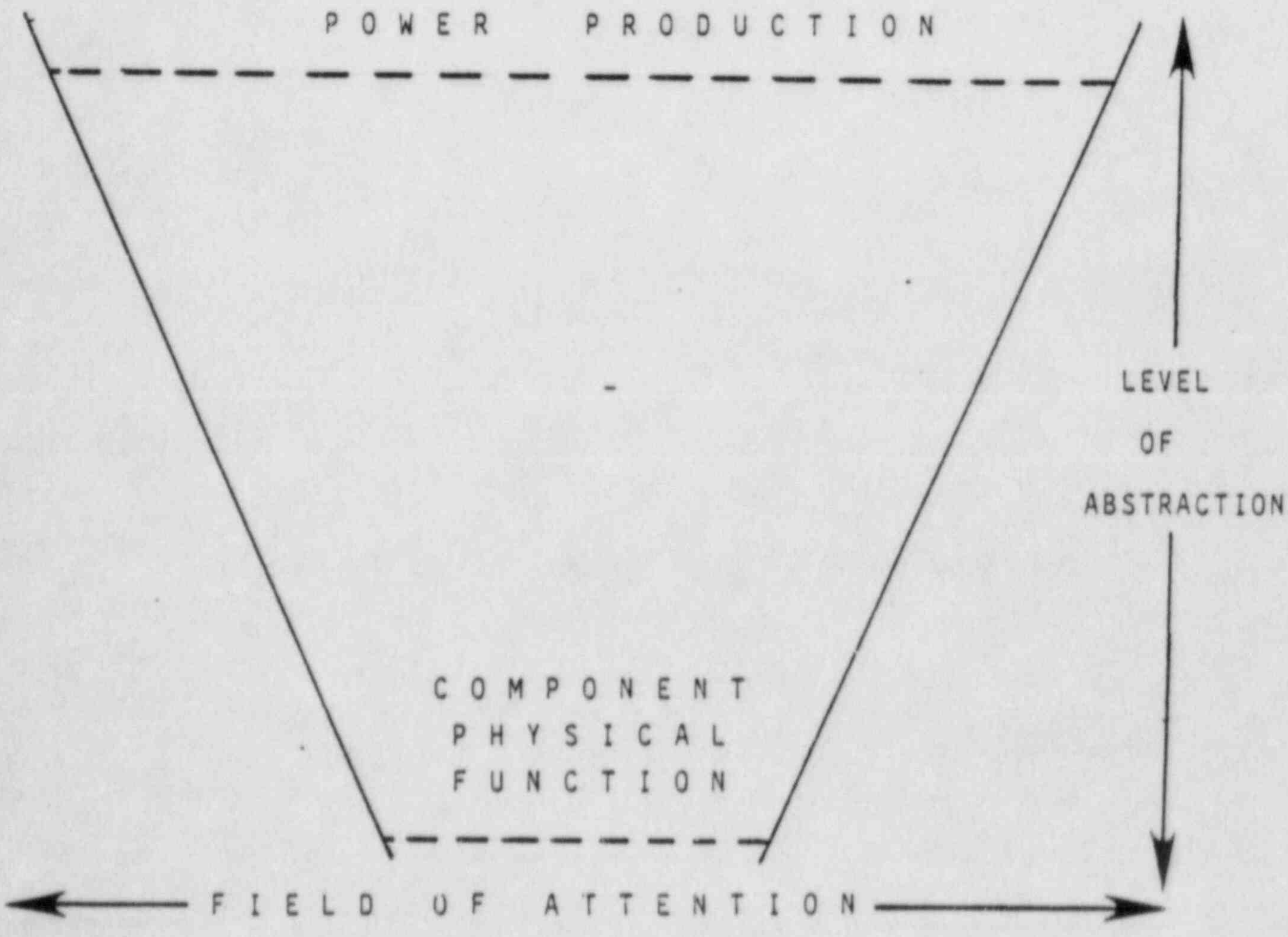

DBMS CONCEPTUAL DESIGN
DATA PROCESSING SYSTEM CONCEPTUAL DESIGN
- DATA ORGANIZATION
- RELIABILITY
- USAGES
- SIZE
- TIMING
- SPEED
- FLEXIBILITY
- PRACTICAL LIMITATIONS

ILLUSTRATION OF RECURSION IN THE HIERARCHY



TYPICAL COUPLING BETWEEN
AGREGATION AND ABSTRACTION



GOAL OF PROCESS	
CONTROL TASK	INFO REQ'D
MONITOR	
CHOICE	
CONTROL	
MODEL # X-XX	

ILLUSTRATION OF GENERIC CONTROL ACTIVITIES

D86-105

Mistakes – Errors In The Formation Of An Intention

Slips – Errors In The Execution Of An Intention

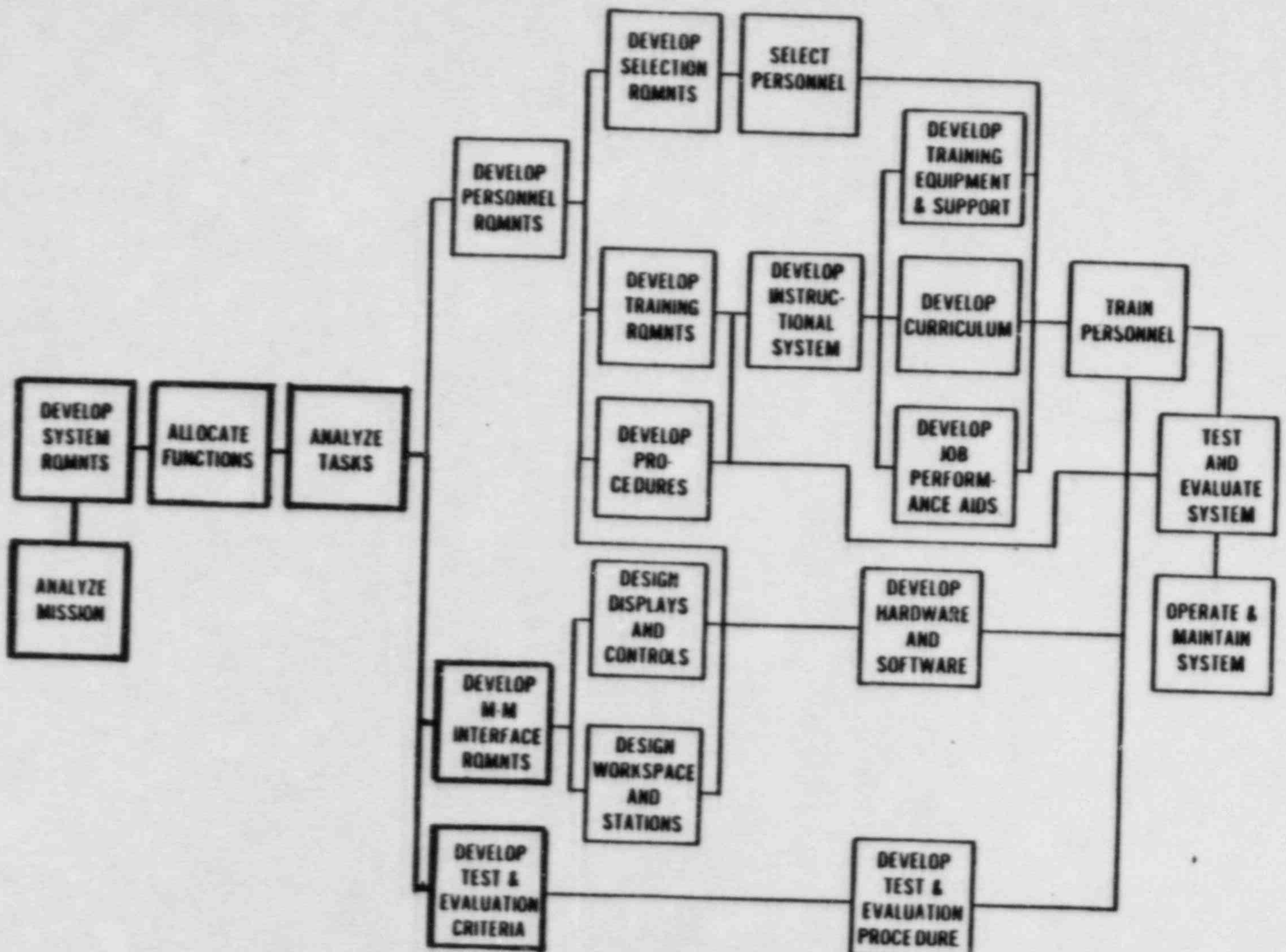


FIGURE 1. IDEAL HUMAN FACTORS SYSTEM APPROACH TO NPP DESIGN.

- HAS SYSTEM, ITS PURPOSES AND BOUNDARIES BEEN IDENTIFIED?
- HAVE FUNCTIONS RELEVANT TO PURPOSE BEEN IDENTIFIED?
- HAVE ROLES(S) OF OPERATORS WITHIN FUNCTIONAL STRUCTURE BEEN IDENTIFIED?
- HAS INFORMATION AND CONTROL NEEDS RELEVANT TO ROLES BEEN IDENTIFIED?
- VERIFICATION OF FUNCTIONAL ANALYSIS?

- EXTENSION OF W SPDS DESIGN PROCESS
  - MIL SPEC H-46855/IEE SC 7, WG 7.1
- SUPPORT FOR ACTION EXECUTION
  - RELEVANT ERGONOMIC GUIDELINES AND PRACTICE
- SUPPORT FOR ACTION SELECTION -- COGNITIVE PERFORMANCE
  - ANALYSIS OF DECISION/CONTROL REQUIREMENTS
  - HUMAN ROLE AS PRIMARILY SUPERVISORY CONTROL
  - APPLY MODELS/PRINCIPLES OF MAN-MACHINE INTERACTION
- CONCEPTUAL TESTING AS AN INTEGRAL PART OF THE DESIGN PROCESS
  - SERVES AS PART OF THE VERIFICATION TASK

HUMAN PERFORMANCE RELIABILITY SHOULD BE MAXIMIZED

THE ACR SHOULD MINIMIZE ERRORS OF EXECUTION

Discussion:

In order to minimize errors of execution, ergonomic principles must be incorporated into all aspects of the physical design of the ACR. This is specifically aimed at errors during the actual execution of an action, not in how that action was determined.

THE ACR SHOULD MINIMIZE ERRORS IN DECISION MAKING

Discussion:

In order to minimize errors of decision making (errors occurring during the thought process), cognitive design principles must be included in both the information content of the ACR, and the structure of the content.

THE CONCEPTS OF HUMAN COGNITIVE DIVERSITY, ERROR CORRECTIVENESS, MAN-MACHINE SYSTEM FAULT TOLERANCE, AND ERROR PREVENTION WILL BE USED TO IMPROVE HUMAN PERFORMANCE

Discussion:

The ACR should allow the user to detect and correct his own errors. In other words, defense-in-depth must be provided with respect to human actions in the same manner as it is for machines. ~~In addition,~~

AGENDA
FOR
NRC MEETING ON THE ADVANCED CONTROL ROOM

MAY 17, 1983

I.	OBJECTIVES (R. J. SERO)	10:00 AM
	A. REVIEW PROGRAM STATUS	
	B. DISCUSS FUTURE ACTIVITIES	
II.	ACR PROGRAM (R. J. SERO/J. A. RUMANCIK)	10:15 AM
III.	TECHNICAL TOPICS	10:30 AM
	A. REVIEW TASK ANALYSIS (W. C. ELM)	
	B. INFORMATION SYSTEM STRUCTURE (J. R. EASTER)	
IV.	FUTURE ACTIVITIES	12:00 NOON
	A. REVIEW CRITERIA (J. M. GALLAGHER)	
	B. TOPICS FOR NEXT MEETING (J. A. RUMANCIK)	
LUNCH		
V.	TOUR R&D FACILITIES	2:30 PM

CT 15

DESIGN OBJECTIVES INCLUDE

- REDUCED UTILITY FINANCIAL RISK, ENHANCED SAFETY MARGINS
  PLANT ARRANGEMENT PRECLUDES SMALL LOCA CORE UNCOVERY
  REDUCED ACCIDENT DOSE RELEASE

- MORE FORGIVENESS, SIMPLICITY
  PASSIVE SECONDARY HEAT REMOVAL
  ADVANCED CONTROL ROOM
  LOWER POWER DENSITY

- REDUCED POWER COSTS
  LARGER CORE
  SPECTRAL SHIFT

DESIGN PROCESS INCLUDES

CT 14

NUCLEAR POWER BLOCK

- SINGLE SOURCE CONTROL
  - QA
  - CONFIGURATION MANAGEMENT
- IMPORTANCE TO SAFETY DESIGN APPROACH
- ALLOWS SYSTEMS INTERACTION DESIGN APPROACH
- ENHANCED LICENSABILITY
- LOWER CONSTRUCTION COSTS

PROBABILISTIC RISK ASSESSMENT

- USED AS DESIGN TOOL
- REGULATORY ARBITER ON DESIGN ADEQUACY

LICENSED SITING ENVELOPE

CT 17

WESTINGHOUSE COMMITTMENT

- 4 YEARS OF CONCENTRATED DESIGN EFFORT
- HIGH INVESTMENT
- JOINT AGREEMENT WITH FOREIGN VENDOR
- FOREIGN UTILITY INTEREST

CT18

NEED FOR REVIEW

MAINTAIN U.S. TECHNOLOGY LEADERSHIP

- DESIGN
- LICENSING
- STANDARDS

MAINTAIN CADRE OF GOOD TECHNICAL PERSONNEL

MAINTAIN/ENHANCE THE NUCLEAR OPERATION

INTEGRATE OPERATING EXPERIENCE/LESSONS LEARNED INTO DESIGN PROCESS, I.E., FRESH APPROACH

MAINTAIN U.S. INFLUENCE IN INTERNATIONAL MARKET

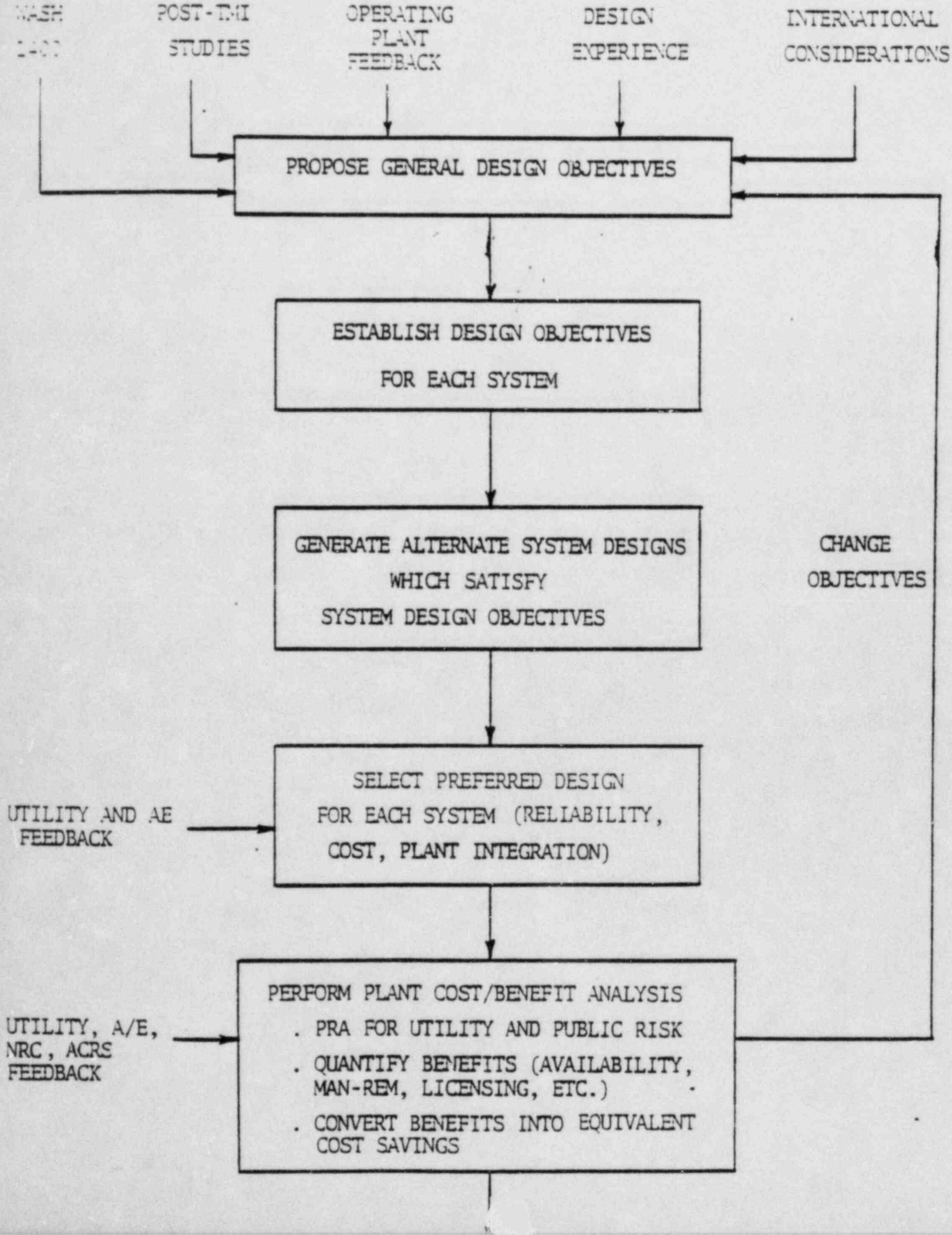
CT 19

WESTINGHOUSE REQUESTS

- ACRS COMMITMENT TO REVIEW ON CONTINUING BASIS
- FAVORABLE LETTER REQUESTING NRC REVIEW PRIORITY CONSISTENT WITH PROPOSED END DATES

CT20

WESTINGHOUSE APPROACH TO PLANT OPTIMIZATION
CONCEPTUAL DESIGN STAGE



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LESSONS LEARNED FOR PLANT DESIGN OPTIMIZATION

- WASH-1400
  - OPERATOR ERROR
  - SMALL LOCA
  - TRANSIENTS (LOSS OF FEEDWATER, LOSS OF OFFSITE POWER, ETC.)
  - SYSTEM TESTABILITY
- POST-TMI
  - MAN-MACHINE INTERFACE
  - TRANSIENTS
  - TRANSPORT OF HIGHLY RADIOACTIVE FLUIDS OUTSIDE OF CONTAINED AREAS
- OPERATING PLANT FEEDBACK
  - PLANT AVAILABILITY
  - OCCUPATIONAL RADIATION EXPOSURE
  - IMPACT OF AUXILIARY FEEDWATER SYSTEM ON PLANT OPERATION
- DESIGN EXPERIENCE
  - INTERACTION OF SYSTEM DESIGN AND PLANT LAYOUT

C(2v

GENERAL DESIGN OBJECTIVES (PUBLIC AND FINANCIAL RISK)

- Reduce the probability of fuel or equipment damage following the more frequent initiating events:
  - Loss of offsite power
  - Loss of main feedwater
  - Spurious reactor trip
- Specifically, ensure adequate core cooling following:
  - Loss of offsite and onsite A.C. power
  - Loss of main and auxiliary feedwater
- Reduce the probability of fuel damage following small LOCA's
- Minimize the potential for radioactive releases outside contained areas
  - Fuel damage plus leaking steam generator tubes
  - Steam generator tube rupture accident
  - Post-LOCA recirculation spills outside containment
  - Breaks in high energy, recirculation lines outside containment

ct 23

GENERAL DESIGN OBJECTIVES (NUCLEAR POWER ECONOMICS)

- Reduce "hard-dollar" power generation cost
  - Fuel cost
  - Plant efficiency
  - Plant cost
- Improve plant availability
  - Longer fuel cycles
  - Component reliability/maintainability
- Reduce man-rem
  - Component reliability/maintainability
  - Plant/equipment layout

CT 24

<u>A-PWR DESIGN FEATURES (OVERVIEW)</u>

- o REACTOR
  - LOW CORE POWER DENSITY
  - MODERATOR CONTROL
- o **FLUID SYSTEMS**
  - INTEGRATED SAFEGUARDS SYSTEMS (PRIMARY SIDE)
  - SECONDARY SIDE SAFEGUARDS SYSTEMS
  - AUXILIARY FLUID SYSTEMS
- o PLANT INTEGRATED CONTROL CENTER
  - PROTECTION SYSTEM
  - CONTROL SYSTEM
  - ADVANCED CONTROL ROOM
- o PRIMARY SYSTEM COMPONENTS
- o AUXILIARY FLUID SYSTEMS

CT 25

LOW POWER DENSITY DESCRIPTION

Parameter	A	B Low Power Density	B/A
Core Thermal Power (MWT)	3800	3800	1.00
Fuel Assemblies	193	193	
Fuel Rods Per F/A	264	303	
Total Fuel Rods	50,952	58,479	
Fuel Rod O.D. (in.)	0.360(1)	0.374(2)	
Core Loading (MTU)	95.4	119.4	1.25
Equivalent Core Diameter (in.)	133	154	1.16
Active Core Length (in.)	168	168	1.00
Average Linear Power (kw/ft)	5.19	4.52	0.87
Average Specific Power (kw/kg)	39.8	31.8	0.80
Average Heat Flux (BTU/hr-ft^2)	187,900	157,600	0.84

(1) Optimized fuel rod

(2) Standard fuel rod

CT26

16695-51

LOW POWER DENSITY
SUMMARY OF ADVANTAGES

- 6% reduction in fuel cost[1]
- 9% reduction in uranium requirements[1]
- 250°F (139°C) reduction in peak clad temperature for large break LOCA
- DNB margin equivalent to 15°F (8°C) in core inlet temperature

(1) Assumes 36,000 MWD/MTU discharge burnup, 18 month cycles and 75% capacity factor

CT 27

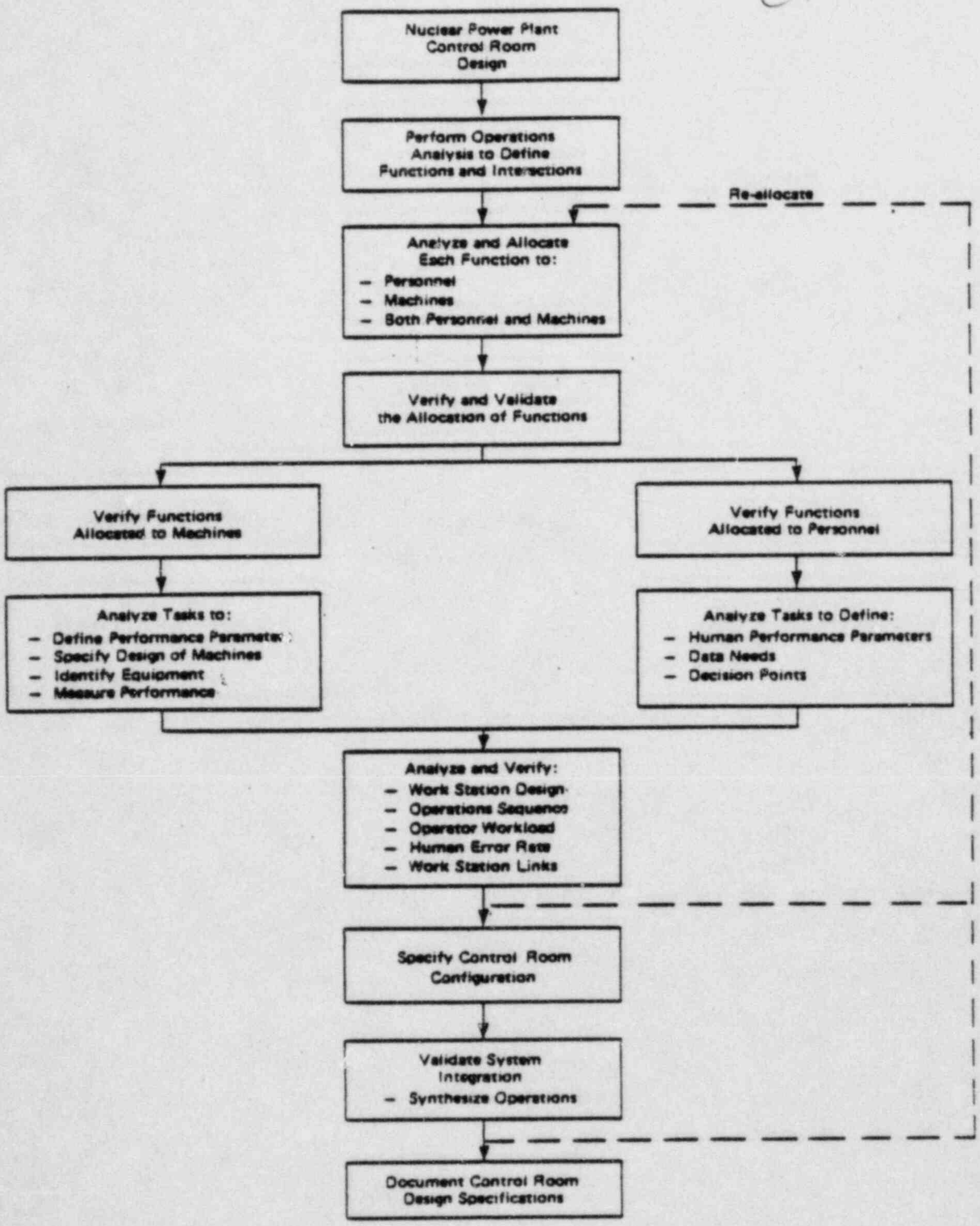
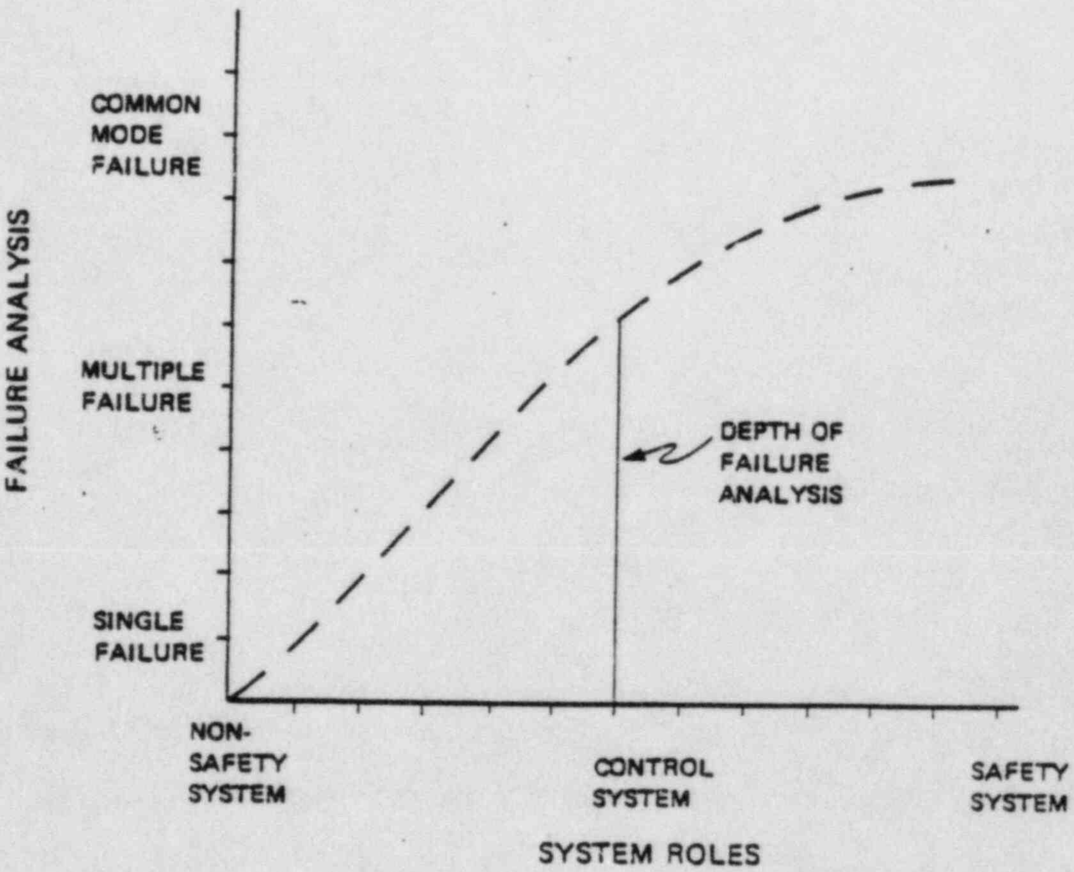


Exhibit B-1. Proposed structure for control room design.

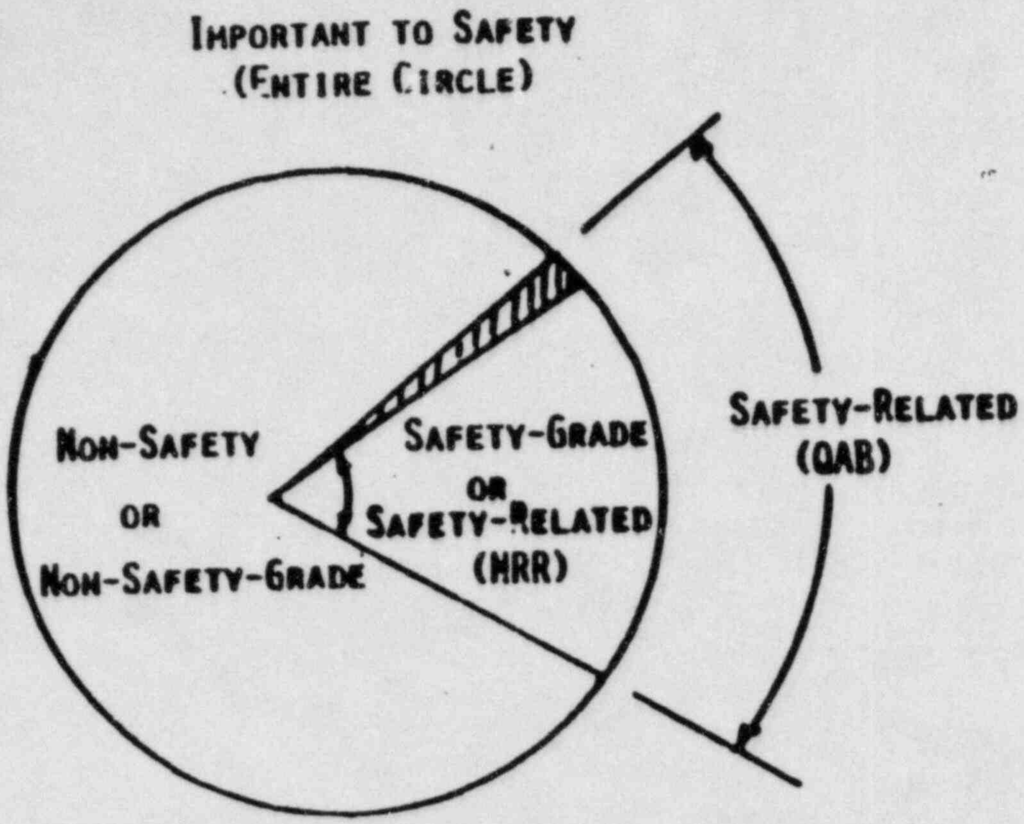
CT-28



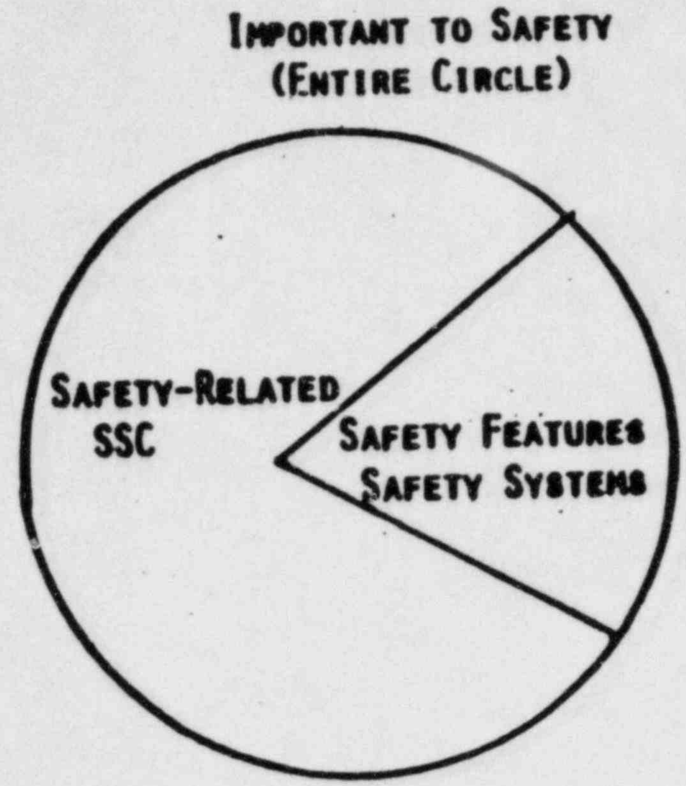
COMMON MODE FAILURE
MULTIPLE FAILURE
SINGLE FAILURE
FAILURE ANALYSIS
DEPTH OF FAILURE ANALYSIS
NON-SAFETY SYSTEM
CONTROL SYSTEM
SAFETY SYSTEM
SYSTEM ROLES

(2)

SAFETY CLASSIFICATIONS
NRC vs IAEA



NRR/QAB



IAEA

ct 29

(ω)

IAEA SG-D8

FIGURE 1

EXAMPLES OF I&C SYSTEMS IMPORTANT TO SAFETY

CT 30