

FINESSE
OVERVIEW/SCOPE/APPROACH

MOHAMED A. ABDU
UCLA

KICKOFF MEETING
JANUARY 10-11, 1984

"FINESSE"

FUSION INTEGRAL NUCLEAR EXPERIMENTS
STRATEGY STUDY EFFORT

OR

DEFINITION OF FINESSE:

SKILLFUL HANDLING OF A DIFFICULT SITUATION

OR

JUST A NAME

CREDIT FOR NAME: SAM BERK, DOE/OFE

FINESSE PROJECT MEETINGS

PURPOSE OF KICKOFF MEETING

- GET ACQUAINTED; BECOME FAMILIAR WITH ALL OTHER ELEMENTS OF THE PROJECT

- TECHNICAL:
 - PRESENTATION OF SCOPE OF WORK AND APPROACH
 - PRELIMINARY RESULTS
 - REVIEW OF PREVIOUS WORK RELEVANT TO FINESSE

FUTURE MEETINGS

- PROJECT MEETINGS WILL BE HELD APPROXIMATELY ONCE EVERY SIX WEEKS

- A LIST OF PROPOSED DATES FOLLOWS

- MAKE SUGGESTIONS FOR CHANGES BY THE END OF THIS MEETING

FINESSE KICKOFF MEETING AGENDA

TUESDAY, JANUARY 10

UCLA FACULTY CENTER-SIERRA ROOM

9:00-9:15	OFE REMARKS	HAAS
9:15-10:15	OVERVIEW/SCOPE/APPROACH	ABDOU
10:15-10:30	COFFEE BREAK	
10:30-11:00	REFERENCE (GENERIC EXAMPLES) BLANKETS	MORGAN

PART A: TASKS I AND II (IDENTIFYING AND QUANTIFYING TEST REQUIREMENTS SCOPE, APPROACH, RESULTS, AND REVIEW OF PREVIOUS WORK)

11:00-12:20	HEDL: STRUCTURAL MATERIALS, SOLID BREEDERS, COMPONENT TESTING	HOLMES, ET AL.
12:20-1:30	LUNCH (REDWOOD ROOM)	
1:30-2:10	ANL: SOLID BREEDERS, TRITIUM RECOVERY	LIU, ET AL.
2:10-2:30	SOLID BREEDERS	GIERSZEWSKI
2:30-2:50	SOLID BREEDERS, THERMAL HYDRAULICS	TAGHAVI
	<u>LIQUID METAL BLANKETS</u>	
2:50-3:30	TRW: OVERVIEW, THERMOMECHANICAL	GARNER
3:30-4:00	UCLA: MHD EFFECTS	TILLACK
4:00-4:15	NEUTRONICS, TRITIUM BREEDING	YOUSSEF
4:15-4:30	FAILURE MODE & EFFECT ANALYSIS	GROTZ

PART B: TASK IV (EVALUATION OF TEST FACILITIES) SCOPE, APPROACH, RESULTS, AND REVIEW OF PREVIOUS WORK

4:30-5:45	PPPL/ANL: TOKAMAKS AS TEST FACILITIES	JASSBY, ET AL.
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WEDNESDAY, JANUARY 11
UCLA FACULTY CENTER-CALIFORNIA ROOM

PART B: TASK IV (CONTD.)

8:30-9:00	STATUS OF TFCX <u>MIRRORS AS TEST FACILITIES</u>	SCHMIDT
9:00-10:00	TRW	BERWALD, ET AL.
10:00-10:20	LLNL/TDF	DOGGETT
10:20-10:30	DISCUSSIONS	
10:30-10:45	COFFEE BREAK	
10:45-11:30	EG&G: CHARACTERIZATION AND UTILIZATION OF FISSION REACTORS	DEIS, ET AL.
11:30-11:45	ANL: UTILIZATION OF FISSION BREEDERS	GOLDMAN/BAKER
11:45-12:00	DISCUSSIONS	
12:00-1:30	LUNCH (ADVISORY COMMITTEE MEETS IN SEQUOIA ROOM #2)	

PART C: TASK III (EXPERIENCE FROM OTHER TECHNOLOGIES)

1:30-2:00	ANL: EXPERIENCE FROM FISSION BREEDERS	GOLDMAN/BAKER
2:00-2:20	UCLA: EXPERIENCE FROM OTHER FISSION REACTORS	OKRENT/SZABO
2:20-2:50	MDAC: EXPERIENCE FROM AEROSPACE INDUSTRY	DAVIS

PART D: REVIEW OF OTHER PREVIOUS WORK

2:50-3:20	FED TEST PLAN	BAKER
3:20-3:50	INTOR TESTING EFFORT	ABDOU

PART E: FINAL DISCUSSIONS/WRAP-UP

3:50-5:30	DISCUSSIONS ON SCOPE OF WORK, APPROACH, ACTION ITEMS	
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FINESSE MEETING SCHEDULE

JANUARY 10 - 11, 1984	KICKOFF MEETING
FEBRUARY 27-28, 1984	REGULAR MEETING
APRIL 3 - 4, 1984	REGULAR MEETING
MAY 15-16, 1984	REGULAR MEETING
JULY 10-12, 1984	EXPANDED REVIEW MEETING (UCLA)
AUGUST 13-14, 1984	REGULAR MEETING (JACKSON HOLE)
SEPTEMBER 11-12, 1984	REGULAR MEETING (UCLA)
NOVEMBER 13-15, 1984	COMMUNITY WORKSHOP (UCLA)

FINESSE MILESTONE SCHEDULE

JULY 12, 1984	ISSUE <u>INTERIM</u> REPORT OUTLINE
AUGUST 27, 1984	COMPLETE FIRST DRAFT OF INTERIM REPORT
OCTOBER 22, 1984	ISSUE FINAL <u>INTERIM</u> REPORT
JUNE 1, 1985	ISSUE <u>FINAL</u> REPORT OUTLINE
AUGUST 15, 1985	FIRST DRAFT OF FINAL REPORT DUE
OCTOBER 1, 1985	FINAL DRAFT OF FINAL REPORT DUE

FINESSE OBJECTIVES

GENERAL

INVESTIGATE THE TECHNICAL AND PROGRAMMATIC ISSUES INVOLVED IN THE DEVELOPMENT OF FUSION NUCLEAR COMPONENTS

SPECIFIC

1. DEVELOP THE FOUNDATIONS FOR THE TECHNICAL DISCIPLINE OF FUSION ENGINEERING TESTING:
 - UNDERSTANDING OF THE PROBLEMS/ISSUES OF TESTING
 - QUANTIFY TEST REQUIREMENTS
 - INVESTIGATE THE ISSUES OF ENGINEERING SCALING AND DEVELOP, ON TECHNICAL BASES, ENGINEERING SCALING RELATIONSHIPS
2. EVALUATE THE NEED FOR A FUSION DEVICE DEDICATED TO NUCLEAR TESTING
3. EXPLORE OPTIONS FOR SUCH A DEVICE AND MAKE RECOMMENDATIONS:
 - EMPHASIZE INNOVATIVE IDEAS THAT RESULT IN A DEVICE WITH:
 - LOWER COST
 - BETTER CAPABILITIES TO SATISFY NUCLEAR TESTING REQUIREMENTS

FINESSE PARTICIPANTS

MAJOR ORGANIZATIONS

- UNIVERSITY OF CALIFORNIA, LOS ANGELES
- ARGONNE NATIONAL LABORATORY
- EG&G IDAHO, INC.
- HANFORD ENGINEERING DEVELOPMENT LABORATORY
- TRW, INC.
- McDONNELL DOUGLAS ASTRONAUTICS COMPANY

MAJOR SUPPORT ORGANIZATIONS

- LAWRENCE LIVERMORE NATIONAL LABORATORY
- PRINCETON PLASMA PHYSICS LABORATORY

FUTURE SUPPORT EXPECTED

- LOS ALAMOS NATIONAL LABORATORY (TSTA GROUP)
- EG&G IDAHO, INC. (SAFETY GROUP)
- SANDIA NATIONAL LABORATORY (PMI, HHF PROGRAMS)
- HIGH RISK APPROACH ADVOCATES?

FINESSE ADVISORY COMMITTEE

CHARLES C. BAKER, ANL (CHAIRMAN)

JOHN W. DAVIS, MDAC

JAMES J. HOLMES, HEDL

JAMES A. MANISCALCO, TRW

JOHN A. SCHMIDT, PPPL

KENNETH R. SCHULTZ, GA

THOMAS E. SHANNON, FEDC

KEITH I. THOMASSEN, LLNL

SUGGESTIONS FOR OTHERS?

INTERNATIONAL PARTICIPATION IN FINESSE

MOTIVATION

- ALL WORLD FUSION PROGRAMS FACE THE SAME ISSUES:
 - FINESSE IS A GOOD MECHANISM FOR EXAMINING THESE ISSUES
- POSSIBLE OUTCOME OF THE STUDY IS A RECOMMENDATION FOR A FUSION DEVICE DEDICATED TO NUCLEAR TESTING:
 - SUCH A DEVICE IS A GOOD CANDIDATE FOR INTERNATIONAL COOPERATION

MECHANISM

- SEMI-INFORMAL
- EACH MAJOR INTERNATIONAL FUSION PROGRAM SENDS A TECHNICAL EXPERT TO RESIDE AT UCLA FOR DURATION OF PROJECT AND PARTICIPATE DIRECTLY IN THE TECHNICAL EFFORT

STATUS

- CANADA:
 - AGREEMENT REACHED WITH CANADIAN FUSION FUELS TECHNOLOGY PROJECT
 - TECHNICAL EXPERT IS ALREADY AT UCLA
- WEST GERMANY:
 - AGREEMENT REACHED WITH KFK
 - TECHNICAL EXPERT STARTS AT UCLA ON MARCH 1, 1984

- JAPAN:

JAPANESE UNIVERSITIES

- AGREEMENTS REACHED WITH UNIVERSITIES OF TOKYO AND KYOTO
- KYOTO EXPERT IS ALREADY AT UCLA
- TOKYO EXPERT STARTS AT UCLA ON APRIL 1, 1984
- DISCUSSIONS UNDERWAY WITH TSUKUBA

INTERNATIONAL PARTICIPATION IN FINESSE (CONT.)

JAERI

- DISCUSSIONS UNDERWAY

● OTHERS:

- DISCUSSIONS UNDERWAY WITH NETHERLANDS, ISPRA, SACLAY

- NET PROJECT?

PRINCIPAL TECHNICAL TASKS

- I. IDENTIFICATION OF ISSUES AND REQUIRED NUCLEAR TESTS
- II. QUANTIFYING TEST REQUIREMENTS
- III. EVALUATION OF EXPERIENCE FROM OTHER TECHNOLOGIES
- IV. SURVEY & EVALUATION OF NEUTRON-PRODUCING TEST FACILITIES
 - A. NON-FUSION DEVICES
 - B. FUSION DEVICES
- V. COMPARATIVE EVALUATION OF NON-FUSION AND FUSION DEVICES
- VI. RECOMMENDATIONS ON FUSION NUCLEAR TECHNOLOGY DEVELOPMENT

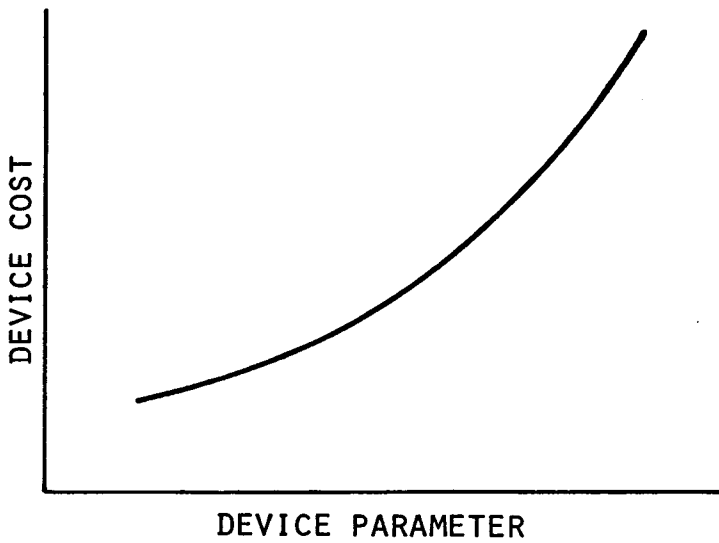
COMMENTS ON APPROACH

IS A FUSION NUCLEAR TESTING DEVICE NEEDED?

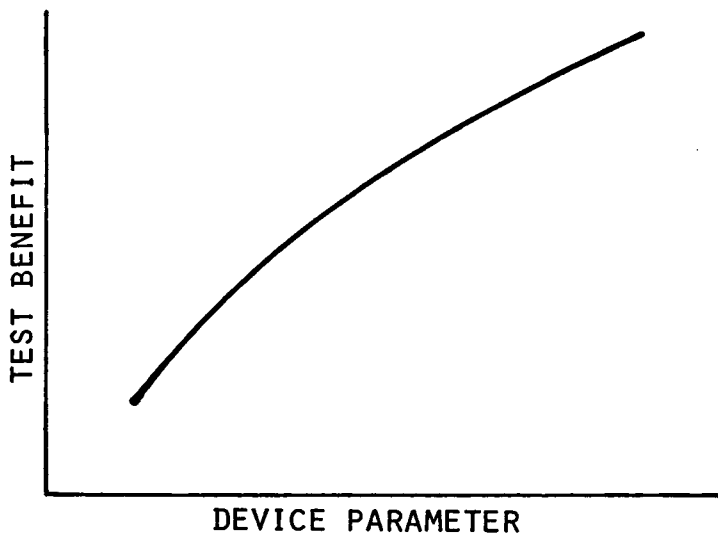
- A NEUTRON-PRODUCING FACILITY IS NEEDED
- THE ONLY SUITABLE FACILITIES ARE:
 - FISSION REACTORS
 - FUSION DEVICES
- EVALUATION OF THE USEFULNESS OF FISSION REACTORS IS CARRIED OUT AS AN (ALMOST) STAND-ALONE TASK BY EG&G, ANL, AND UCLA
- THE REST OF FINESSE TASKS ASSUME, FOR NOW, THAT A FUSION TESTING DEVICE IS NEEDED AND FOCUS ON DEFINING THE REQUIREMENTS OF SUCH A DEVICE

FUSION NUCLEAR ENGINEERING TEST DEVICE
DESCRIPTION OF THE PROBLEM (BACKGROUND)

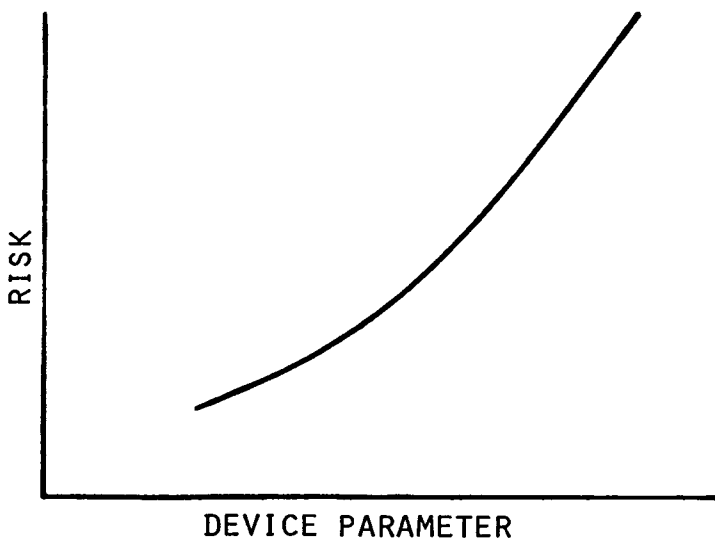
- THE COST OF A FUSION DEVICE SUBSTANTIALLY INCREASES WITH THE MAJOR DEVICE (MAD) PARAMETERS (E.G., WALL LOADING, FLUENCE, SURFACE AREA)
- IDEAL INTEGRATED TESTING OF A COMPONENT REQUIRES DUPLICATION OF THE ENVIRONMENTAL CONDITIONS WITHIN THE TEST MODULE (E.G., POWER DENSITY)
- FOR EXAMPLE, FISSION REACTOR TESTING DID NOT HAVE TO SCALE THE POWER DENSITY (DEVICE POWER IS NOT COUPLED TO POWER DENSITY)
- REALISTIC COST CONSTRAINTS DICTATE THAT FUSION TESTING MUST BE PERFORMED UNDER SCALED ENVIRONMENTAL CONDITIONS
- "LOOK-ALIKE" TEST MODULES ARE ALMOST USELESS UNDER SCALED CONDITIONS
- SERIOUS EFFORT IS REQUIRED TO DEVELOP METHODS FOR ENGINEERING SCALING AND TO PROVIDE GUIDANCE TO THE DESIGN OF A FUSION ENGINEERING TESTING DEVICE
- COST/BENEFIT/RISK ANALYSIS IS A USEFUL "FRAMEWORK"
- TASK II ATTEMPTS TO DEFINE THE BENEFITS AS A FUNCTION OF THE MAJOR DEVICE (MAD) PARAMETERS THAT ARE KEY DRIVERS ON THE COST OF THE TESTING DEVICE
- TASK IV DEVELOPS THE RELATIONSHIP BETWEEN THE COST AND MAJOR PARAMETERS OF THE TESTING DEVICE



COST



BENEFIT



RISK

FUSION REACTOR SYSTEMS

AFFECTED BY THE NUCLEAR ENVIRONMENT

- BLANKET
- SHIELD
- PLASMA-INTERACTIVE AND HIGH HEAT FLUX SUBSYSTEMS:
 - FIRST WALL
 - IMPURITY REMOVAL AND CONTROL
 - SUPPLEMENTARY HEATING
 - VACUUM SYSTEM
- TRITIUM PROCESSING AND CONTAINMENT
- INSTRUMENTATION AND CONTROL
- MAGNETS
- HEAT TRANSPORT AND POWER CONVERSION
- REMOTE MAINTENANCE
- BALANCE OF PLANT

REFERENCE EXAMPLE BLANKET DESIGNS

- TO FACILITATE QUANTIFYING THE TEST REQUIREMENTS AND DEVELOPING ENGINEERING SCALING RELATIONSHIPS, THREE BLANKET DESIGNS HAVE BEEN SELECTED:

BLANKET 1: SELF-COOLED LIQUID LITHIUM
VANADIUM STRUCTURE

BLANKET 2: Li_2O BREEDER
NO MULTIPLIER
HELIUM COOLANT
FERRITIC STEEL STRUCTURE

BLANKET 3: LiAlO_2 BREEDER
BERYLLIUM MULTIPLIER
PRESSURIZED WATER COOLANT
STAINLESS STEEL STRUCTURE

- THIS SELECTION DOES NOT REPRESENT ENDORSEMENT OF ANY OF THE CONCEPTS; THE HOPE IS THAT MOST OF THE GENERIC ISSUES/PROBLEMS ARE REPRESENTED BY THESE CONCEPTS
- DETAILS OF THE REFERENCE BLANKETS ARE DOCUMENTED IN THE BCSS INTERIM REPORT (ANL/FPP-83-1, OCTOBER 1983)
- DAVE MORGAN IS RESPONSIBLE FOR DISSEMINATING AND UPDATING INFORMATION ON THE REFERENCE BLANKET DESIGNS
- UCLA HAS GENERATED SOME OF THE DETAILED INFORMATION FOR THESE BLANKETS (INFORMATION WHICH IS IMPORTANT FOR NUCLEAR TESTING ANALYSIS BUT IS GENERALLY OMITTED FROM BLANKET DESIGN REPORTS, E.G., NEUTRON SPECTRA, HEATING RATE PROFILES, ETC.)

KEY TESTING/COST PARAMETERS

(MAD PARAMETERS)

MAJOR PARAMETERS THAT ARE: - CRITICAL TO SUCCESSFUL TESTING
- DRIVERS ON TESTING DEVICE COST

1. NEUTRON WALL LOAD (POWER DENSITY)
2. SURFACE HEAT LOAD
3. FLUENCE (FLUENCE \sim WALL LOAD X LIFETIME X AVAILABILITY)
4. MINIMUM CONTINUOUS (100% AVAILABILITY) OPERATING PERIOD
5. PLASMA BURN CYCLE (BURN/DWELL TIME)
6. MAGNETIC FIELD STRENGTH
7. SURFACE AREA FOR TESTING: - SURFACE AREA FOR TESTING ELEMENT
- TEST MATRIX
8. VOLUME FOR TESTING: - DEPTH OF TEST ELEMENT
- TEST MATRIX

REFERENCE ASSUMPTIONS ABOUT TYPICAL COMMERCIAL REACTOR CONDITIONS

- STEADY-STATE PLASMA OPERATION

- NEUTRON WALL LOAD:
5 MW/m²

- SURFACE HEAT LOAD:
MIRRORS: 0.1 MW/m²
TOKAMAKS: 0.5 TO 1.0 MW/m²

- HIGHEST MAGNETIC FIELD IN BLANKET REGION:
MIRRORS: 4 TO 5 T
TOKAMAKS: 5 TO 8 T

- BLANKET LIFETIME:
AUSTENITIC AND FERRITIC STEELS: 10 TO 20 MW·Y/m²
ADVANCED ALLOYS: 20 MW·Y/m²
SOLID BREEDERS: ? (10 MW·Y/m²)

- GENERAL REACTOR FRAMEWORK:
MIRRORS: MARS
TOKAMAKS: STARFIRE
(BUT BE CAREFUL; COMMERCIAL REACTORS CAN NEVER BE FIXED)

- AVAILABILITY REQUIREMENTS:
ETR/DEMO: 50%
COMMERCIAL: 75%

RANGE OF MAJOR PARAMETERS

RANGE OF MAJOR PARAMETERS TO BE CONSIDERED IN THE PARAMETRIC STUDIES (GROUPS WILL EXERCISE JUDGMENT IN NOT CONSIDERING THE PORTIONS OF THE RANGE THAT WILL CLEARLY LEAD TO UNACCEPTABLE CONDITIONS)

1. NEUTRON WALL LOAD:
1 TO 5 MW/M²
2. SURFACE HEAT LOAD:
0.1 TO 1.0 MW/M²
3. FLUENCE:
0.1 TO 10 MW·Y/M²
(TEST PERIOD SHOULD BE NO LONGER THAN 10-15 YEARS;
THEREFORE, DEVICE AVAILABILITY IS A STRONG FACTOR)
4. MINIMUM CONTINUOUS (100% AVAILABILITY) OPERATING PERIODS:
CONSIDER A RANGE REALISTIC FOR THE SPECIFIC DEVICE
(GENERALLY A FEW HOURS TO A FEW WEEKS)
5. PULSE LENGTH (BURN/DWELL TIME):
BURN TIME: 10 s, 100 s, 1000 s, STEADY STATE
DWELL TIME: 200 s, 100 s, 20 s, ZERO
6. MAGNETIC FIELD STRENGTH:
MAXIMUM IN THE BLANKET TEST REGION: 3 TO 8 T
7. SURFACE AREA (FOR MAXIMUM FLUX) TESTING:
3 TO 15 M²
8. VOLUME FOR TESTING:
DEPTH (THICKNESS) OF TEST ELEMENT: 0.1 TO 1.0 M

TASK I

IDENTIFICATION OF ISSUES AND REQUIRED NUCLEAR TESTS

- IDENTIFY KEY ISSUES AND TYPES OF TESTS REQUIRED FOR ALL NUCLEAR COMPONENTS: BLANKET, SHIELD, LIMITER/DIVERTOR/HALO SCRAPER, RF, TRITIUM, SAFETY, ETC.
- INDICATE THOSE TESTS THAT REQUIRE NEUTRONS AS PART OF THE TEST ENVIRONMENT
- INITIAL EMPHASIS IS ON THE FIRST WALL/BLANKET; OTHER COMPONENTS ARE TO BE ADDRESSED LATER PER FINESSE SCHEDULE
- DETAILED SPECIFIC TESTS CAN GENERALLY BE CLASSIFIED SIMULTANEOUSLY UNDER TWO CATEGORIES:
 - ENGINEERING FEASIBILITY ISSUE (E.G., FOR BLANKET: ADEQUATE TRITIUM PRODUCTION, ACCEPTABLE TRITIUM RECOVERY, COMPATIBLE MATERIAL COMBINATION, EFFICIENT HEAT RECOVERY, ACCEPTABLE LIFETIME)
 - TECHNICAL DISCIPLINE ISSUE (E.G., NEUTRONICS, THERMOMECHANICAL, MATERIALS, ELECTROMAGNETICS)

ORGANIZATION/SCHEDULE

- ALL ORGANIZATIONS ARE REQUESTED TO PROVIDE INPUT TO THIS TASK
- ALL ORGANIZATIONS MAIL INITIAL LIST TO M. ABDOU BY JANUARY 31 (FOR FIRST WALL/BLANKET)
- COMPLETE WORK AND PRESENT IN FEBRUARY PROJECT MEETING (FOR FIRST WALL/BLANKET)
- OTHER COMPONENTS WILL BE ADDRESSED DURING THE SUMMER OF 1984 PER FINESSE SCHEDULE

TASK II

QUANTIFYING TEST REQUIREMENTS

OBJECTIVE

- QUANTIFY AND PRIORITIZE THOSE TEST REQUIREMENTS THAT HAVE THE LARGEST IMPACT ON THE TESTING DEVICE COST (E.G., WHY IS A NEUTRON WALL LOAD OF 3 BETTER THAN 2 MW/M²? HOW MUCH BETTER? CAN WE DESIGN "ACT-ALIKE" TEST ELEMENTS TO OPERATE AT 2 AND GIVE US THE SAME DATA REQUIRED FOR 3 MW/M²?)

- IDEALLY, THIS OBJECTIVE CAN BE SATISFIED BY GENERATING A QUANTITATIVE RELATIONSHIP BETWEEN:
 - BENEFITS OBTAINABLE IN TESTS
 - MAJOR DEVICE (MAD) PARAMETERS THAT ARE COST DRIVERS

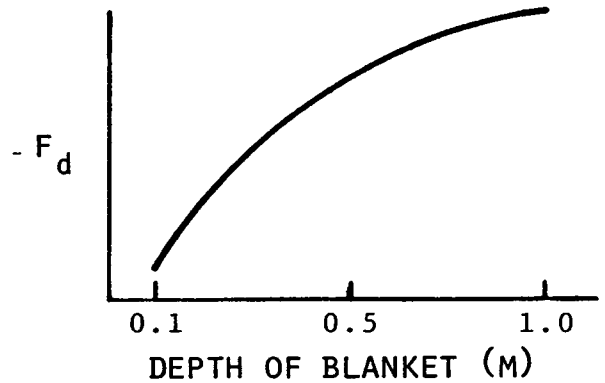
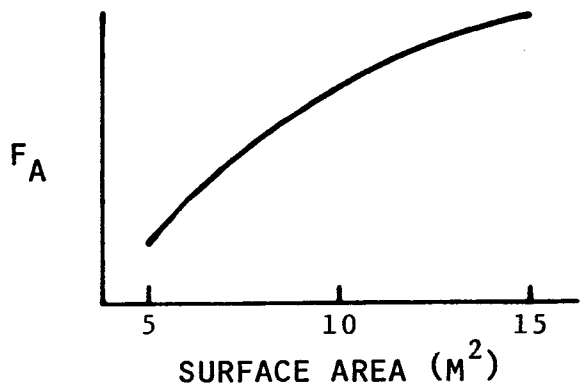
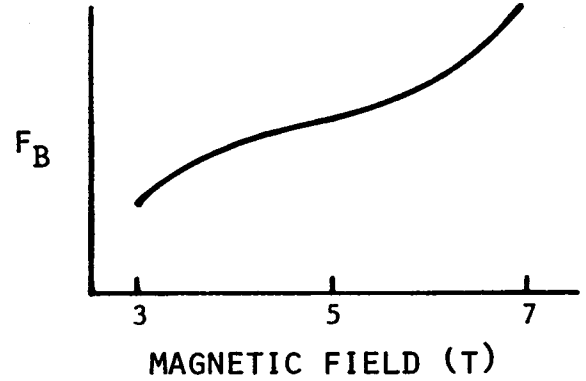
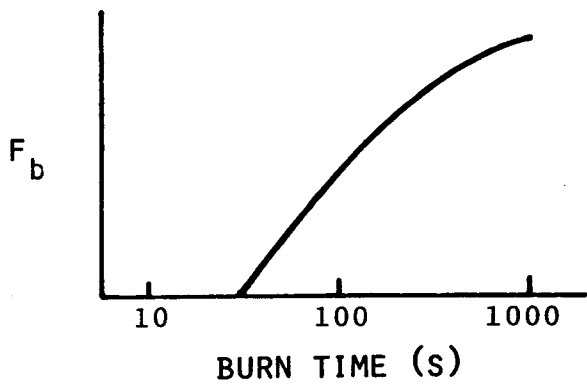
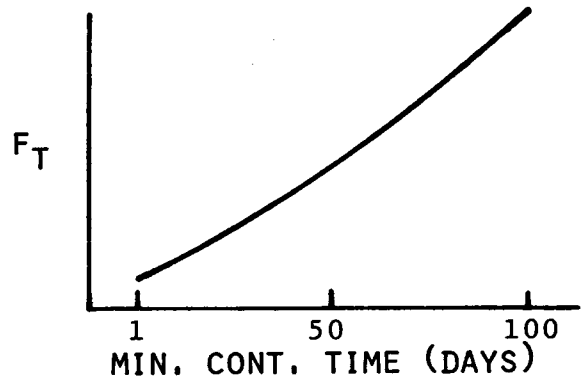
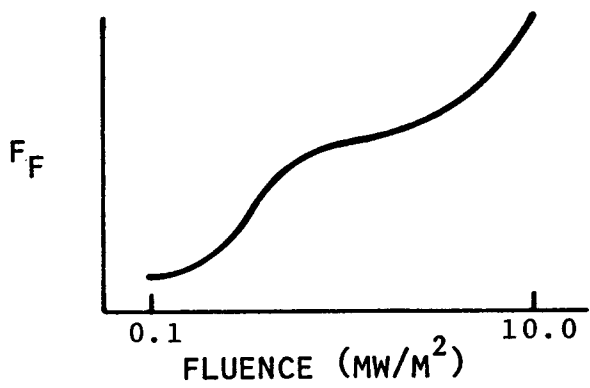
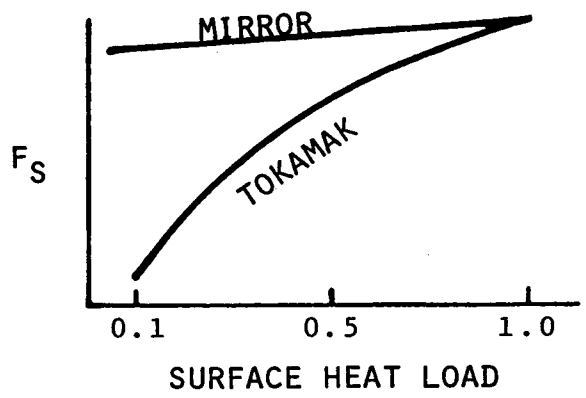
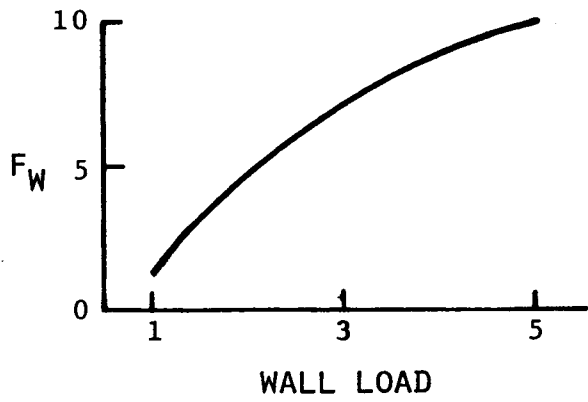
- THE BENEFIT (FIGURE-OF-MERIT) IS A COMPOSITE OF INDIVIDUAL FIGURES-OF-MERIT FOR VARIOUS ISSUES/TESTS AND COMPONENTS COMBINED WITH APPROPRIATE WEIGHTING

TASK II
QUANTIFYING TEST REQUIREMENTS
(CONT.)

SCOPE

- EVALUATE THE IMPORTANCE OF THE MAJOR DEVICE (MAD) PARAMETERS TO PERFORMING THE NUCLEAR TESTS (TESTS DEFINED IN TASK I)
- EVALUATE HOW WELL A "LOOK-ALIKE" TEST MODULE CAN PRODUCE THE DESIRED TEST INFORMATION AS A FUNCTION OF THE MAJOR DEVICE PARAMETERS (IN MANY CASES, THE "LOOK-ALIKE" TEST MODULE WILL BE USELESS)
- DEVELOP ENGINEERING SCALING RELATIONSHIPS AND DESIGN TEST ELEMENTS THAT ATTEMPT TO PRODUCE THE DESIRED TEST INFORMATION ("ACT-ALIKE") AT "SCALED CONDITIONS;" EVALUATE THE DEGREE OF SUCCESSFULNESS AS A FUNCTION OF THE MAJOR DEVICE PARAMETERS
- ANALYZE POSSIBLE "INTERACTION" EFFECTS/CONDITIONS AMONG SUBELEMENTS THAT MAY BE LOST IN "DIVIDING" AN INTEGRATED TEST INTO A NUMBER OF MULTIPLE-EFFECT TESTS
- DEVELOP TEST MATRICES (NUMBER, SIZE, ETC.) TO SATISFY REQUIREMENTS FOR VARIOUS TYPES OF TESTS, ISSUES, VARIATIONS IN TEST CONDITIONS AND STATISTICS

F ≡ FIGURE OF MERIT FOR TEST USEFULNESS



PRIMARY AREAS OF RESPONSIBILITIES FOR
SOLID BREEDER BLANKETS IN TASK II

(SIMPLISTIC TABLE; THERE ARE MANY AREAS OF OVERLAP)

	NEUTRON & SURFACE HEAT LOADS	BURN/DWELL TIMES ^A	MINIMUM CONTINUOUS TIME ^A	TEST AREA AND VOLUME ^B	FLUENCE
TRITIUM BREEDING, NEUTRONICS	UCLA	UCLA	UCLA	UCLA	UCLA
TRITIUM RECOVERY: DETAILED MODELING SIMPLE MODELING/SCALING	ANL UCLA	ANL UCLA	ANL UCLA	ANL UCLA	HEDL/ANL
THERMOMECHANICAL	UCLA/TRW	UCLA/TRW	UCLA/TRW	UCLA/TRW	HEDL
MATERIALS: STRUCTURAL MATERIALS, SOLID BREEDER MATERIALS, SPECIAL MATERIALS (E.G., TRITIUM BARRIERS), COMPATIBILITY	HEDL	HEDL	HEDL	HEDL	HEDL
FAILURE MODES, RATES ^B	UCLA/TRW	UCLA/TRW	UCLA/TRW	UCLA/TRW	HEDL

^AHEDL PROVIDES SUPPORT ON TIME REQUIRED TO TAKE ACCURATE MEASUREMENTS

^BHEDL PROVIDES SUPPORT ON NUMBER OF TESTS REQUIRED FOR VARIABLE CONDITIONS AND STATISTICS

PRIMARY AREAS OF RESPONSIBILITIES FOR
LIQUID METAL BLANKETS IN TASK II

	NEUTRON & SURFACE HEAT LOADS	BURN/DWELL TIMES ^A	MINIMUM CONTINUOUS TIME ^A	TEST AREA AND VOLUME ^B	FLUENCE
TRITIUM BREEDING, NEUTRONICS	UCLA	UCLA	UCLA	UCLA	UCLA
THERMOMECHANICAL	TRW/UCLA	TRW/UCLA	TRW/UCLA	TRW/UCLA	HEDL/TRW
FLUID FLOW, MHD EFFECTS	UCLA	UCLA	UCLA	UCLA	HEDL/UCLA
TRITIUM RECOVERY	ANL	ANL	ANL	ANL	ANL
COMPATIBILITY (AND CORROSION PRODUCT TRANSPORT)	TRW/UCLA	TRW/UCLA	TRW/UCLA	TRW/UCLA	HEDL/TRW
MATERIALS	HEDL	HEDL	HEDL	HEDL	HEDL
FAILURE MODES, RATES ^B	TRW	TRW	TRW	TRW	HEDL/TRW

^AHEDL PROVIDES SUPPORT ON TIME REQUIRED TO TAKE ACCURATE MEASUREMENTS

^BHEDL PROVIDES SUPPORT ON NUMBER OF TESTS REQUIRED FOR VARIABLE TEST CONDITIONS AND STATISTICS

TASK III
EXPERIENCE FROM OTHER TECHNOLOGIES

● OBJECTIVE:

TO LEARN FROM EXPERIENCE IN DEVELOPING OTHER TECHNOLOGIES

● TECHNOLOGIES TO BE EXAMINED:

FISSION, AEROSPACE

● FISSION EXPERIENCE:

FAST REACTORS: ANL (GOLDMAN, ET AL)

OTHER REACTORS: UCLA (OKRENT, SZABO)

● AEROSPACE EXPERIENCE:

MDAC: DAVIS, MORGAN, ET AL

● SCHEDULE:

FISSION: COMPLETE BULK OF WORK AND DRAFT REPORT BY
APRIL 1984

AEROSPACE: COMPLETE BULK OF WORK AND DRAFT REPORT BY
JUNE 1984

FOR BOTH: CONTINUE REFINEMENT, ISSUE DOCUMENT FOR FINAL
INTERIM REPORT BY SEPTEMBER 1984

TASK IV

SURVEY & EVALUATION OF NEUTRON-PRODUCING TEST FACILITIES

A. NON-FUSION DEVICES

1. ACCELERATOR-BASED SOURCES
2. FISSION REACTORS

B. FUSION DEVICES

TASK IV (CONT.)

A.1. ACCELERATOR-BASED "POINT" NEUTRON SOURCES

● CONCLUSIONS:

- VERY USEFUL FOR A) SMALL-SIZE (SAMPLE, COUPON) TYPES OF TESTS FOR EVALUATING RADIATION EFFECTS ON MATERIALS, B) SPECIAL TYPES OF INTEGRAL EXPERIMENTS (NEUTRONICS AND SHIELDING)
- NOT SUITABLE FOR COMPONENT TESTING

● EFFORT:

- NO LARGE EFFORT PLANNED
- HEDL WILL DOCUMENT A) CHARACTERISTICS OF FMIT, RTNS-II, AND OTHER "POINT" NEUTRON SOURCES, B) USES FOR MATERIAL IRRADIATION
- UCLA WILL DOCUMENT CHARACTERISTICS OF OTHER "POINT" NEUTRON SOURCES AND USES FOR NEUTRONICS AND SHIELDING

TASK IV (CONT.)

A.2. FISSION REACTORS

OBJECTIVES

- EVALUATE USEFULNESS OF FISSION REACTORS FOR TESTING FUSION NUCLEAR COMPONENTS
- CAN THE USE OF FISSION REACTORS ELIMINATE THE NEED FOR A FUSION NUCLEAR TESTING DEVICE?

SCHEDULE

- COMPLETE IN FY 1984

SCOPE/APPROACH/ORGANIZATION

- EG&G (G. DEIS) WILL COORDINATE THIS TASK
- EG&G WILL SURVEY EXISTING THERMAL AND FAST FISSION REACTORS AND CHARACTERIZE THEIR CAPABILITIES (E.G., FLUXES, SPECTRA, AVAILABLE TEST VOLUME, COST OF TESTING, MAJOR MODIFICATIONS REQUIRED, AVAILABILITY TO THE FUSION PROGRAM)
- TECHNICAL EVALUATION OF USEFULNESS:
 - EG&G: THERMAL REACTORS (AND COORDINATION)
 - ANL: FAST REACTORS
 - HEDL: SUPPORT AS NEEDED BY ANL, EG&G
 - UCLA: SUPPORT (DETAILED CALCULATIONS) AS NEEDED BY ANL, EG&G
- THE EVALUATION OF USEFULNESS OF FISSION REACTORS MUST BE BASED ON TECHNICAL ANALYSIS AND SHOULD ANSWER THE KEY ISSUES, E.G.:
 - EFFECTS OF FISSION/FUSION SPECTRAL DIFFERENCES
 - DIFFERENCES IN POWER DENSITY
 - BURNUP RATE
 - LIMITATIONS ON TEST VOLUME
 - LIMITATIONS ON FLUENCE
 - DIFFICULTIES IN SUPERIMPOSING NON-NUCLEAR CONDITIONS (E.G., ELECTROMAGNETICS)

TASK IV (CONT.)

B. FUSION DEVICES

OBJECTIVE

COMPARISON OF OPTIONS, EVALUATION, SELECTION, AND PRELIMINARY DESIGN OF A NEW FUSION DEVICE DEDICATED TO NUCLEAR TESTING

ORGANIZATIONS

- MIRRORS (TASK LEADER: D. BERWALD)
 - PRIMARY: TRW
 - SUPPORT: LLNL
- TOKAMAKS (TASK LEADER: D. JASSBY)
 - PRIMARY: PPPL, ANL
 - SUPPORT: UCLA, TRW

SCOPE/SCHEDULE

- FY 1984
 - SURVEY AND COMPARE DEVICES FROM PREVIOUS STUDIES (E.G., TDF, TASKA, TETR, FED-R, ETC.)
 - PARAMETRIC STUDIES TO PROVIDE RELATIONSHIP BETWEEN COST (CAPITAL AND OPERATING) AND DEVICE CAPABILITIES (SEE LIST OF MAJOR PARAMETERS RANGE)
 - PRELIMINARY IDENTIFICATION OF ISSUES RELATED TO PHYSICS, ENGINEERING, DESIGN AND COST DRIVERS OF THE FUSION TEST FACILITIES
- FY 1985
 - SCOPE AND ORGANIZATION WILL BE DETAILED LATER
 - IN GENERAL, THE EFFORT WILL BE FOCUSED ON A) DETAILED INVESTIGATION AND COMPARISON OF THE MOST PROMISING CANDIDATES DEFINED IN FY 1984, B) PRELIMINARY DESIGN OF RECOMMENDED FUSION TEST FACILITY

GENERAL QUESTIONS CONCERNING A FUSION NUCLEAR TESTING DEVICE

- SHOULD THE DEVICE BE DRIVEN BY ONLY THE NUCLEAR TESTING REQUIREMENTS? (E.G., ARE NORMAL COPPER COILS ACCEPTABLE?)
- DOES THE DEVICE NEED TO PRODUCE ITS OWN TRITIUM?
 - A DEVICE WITH LOW POWER (< 50 MW) DOES NOT NEED A TRITIUM-PRODUCING BLANKET
 - A DEVICE WITH LARGE POWER (> 200 MW) NEEDS A TRITIUM-PRODUCING BLANKET
 - A DEVICE WITH MEDIUM POWER (50-200 MW) ?
- THE DEVICE WILL PROVIDE FOR TESTING A NUMBER OF COMPONENTS; TO WHAT EXTENT SHOULD WE EMPHASIZE INTERACTION AMONG COMPONENTS?
- HOW MUCH EXTRAPOLATION IN PHYSICS AND TECHNOLOGY SHOULD BE ASSUMED FOR THE FUSION NUCLEAR TESTING DEVICE? (E.G., WILL INORGANIC INSULATORS FOR MAGNETS BE AVAILABLE?)
- SHOULD THE REQUIREMENTS ON THE TEST DEVICE BE DRIVEN BY COMMERCIAL OR DEMO REQUIREMENTS? (E.G., WALL LOAD: ~ 2 MW/M² DEMO, ~ 5 MW/M² COMMERCIAL)

TASK V

COMPARATIVE EVALUATION OF NON-FUSION AND FUSION DEVICES

- INVESTIGATE, BASED ON RESULTS FROM THE OTHER TASKS, WHETHER A FUSION NUCLEAR TESTING DEVICE IS NEEDED (CAN A COMBINATION OF FISSION REACTORS AND NON-NUCLEAR FACILITIES ELIMINATE THE NEED FOR A FUSION NUCLEAR TESTING DEVICE?)

- COMPARE THE MOST PROMISING OPTIONS FOR A FUSION NUCLEAR TESTING DEVICE ON THE BASIS OF:
 - TECHNICAL CAPABILITIES

 - COST

 - TIME

 - "COST/BENEFIT/RISK"

TASK VI

RECOMMENDATIONS ON FUSION NUCLEAR TECHNOLOGY DEVELOPMENT

THE RESULTS OF THE STUDY WILL BE FORMULATED
INTO RECOMMENDATIONS ON THE STRATEGY FOR
DEVELOPING THE FUSION NUCLEAR COMPONENTS

FINESSE SCHEDULE

TASK I

- BLANKET/FIRST WALL:
 - STARTED EARLY
 - PRESENT COMPLETE LIST BY FEBRUARY 28, 1984
 - FINISH AND DOCUMENT BY APRIL 3, 1984
 - UPDATE PERIODICALLY
- OTHER COMPONENTS:
 - START JUNE, 1984
 - FINISH AUGUST, 1984

TASK II

- BLANKET/FIRST WALL:
 - START NOW
 - MAJOR EFFORT DURING FY 1984
 - COMPLETE FIRST PHASE BY AUGUST, 1984
 - CONTINUE INTO FY 1985 AT A REDUCED LEVEL
- OTHER COMPONENTS:
 - START NOVEMBER, 1984
 - FINISH FIRST PHASE BY JANUARY, 1985
 - CONTINUE AT A REDUCED LEVEL

TASK III

- START JANUARY, 1984
- COMPLETE ESSENTIAL WORK FOR FISSION BY APRIL, 1984
- COMPLETE ESSENTIAL WORK FOR AEROSPACE BY JUNE, 1984
- CONTINUE REFINEMENT, ISSUE DOCUMENT FOR FINAL REPORT BY SEPTEMBER, 1984

TASK IV

- FACILITIES SURVEY AND PARAMETRIC STUDIES: START NOW, COMPLETE BY SEPTEMBER, 1984
- DETAILED INVESTIGATIONS, DESIGN AND COST OF PROMISING OPTIONS: START NOVEMBER, 1984, COMPLETE BY JUNE, 1985

FINESSE SCHEDULE (CONT.)

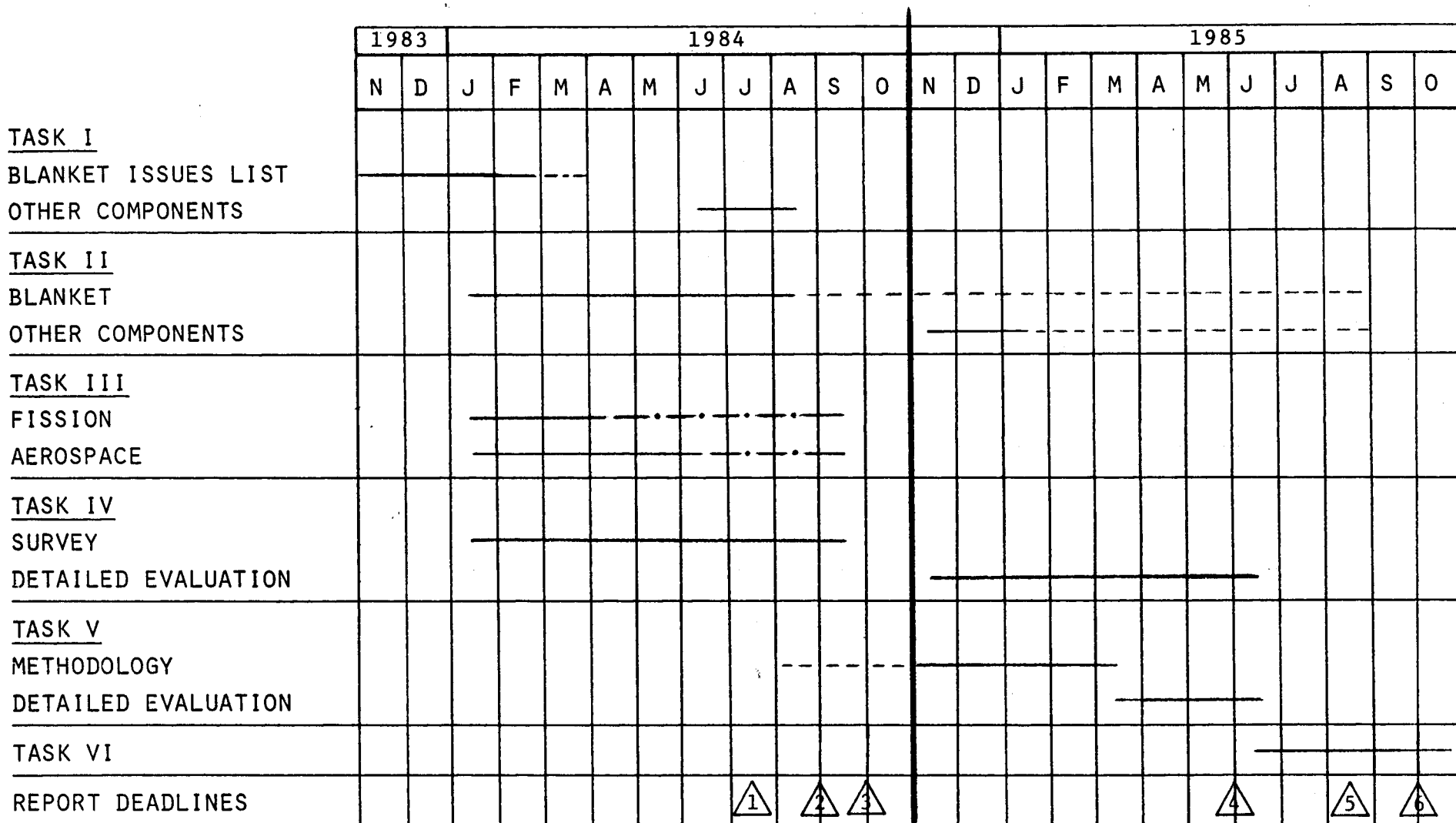
TASK V

- FRAMEWORK FOR METHODOLOGY DEVELOPED DURING LATER PART OF FY 1984, EARLY PART OF FY 1985
- DETAILED COMPARATIVE EVALUATION CONDUCTED MARCH, 1985 THROUGH JUNE, 1985

TASK VI

- JUNE, 1985 THROUGH OCTOBER, 1985

FINESSE SCHEDULE



LEGEND

- ESSENTIAL WORK
- · - · - REFINE AND DOCUMENT
- CONTINUE AT REDUCED LEVEL

- △₁ INTERIM REPORT OUTLINE
- △₂ INTERIM REPORT FIRST DRAFT
- △₃ ISSUE FINAL INTERIM REPORT
- △₄ FINAL REPORT OUTLINE
- △₅ FINAL REPORT FIRST DRAFT
- △₆ ISSUE FINAL REPORT

UCLA FINESSE GROUP

MOHAMED ABDOU: ENGINEERING SCALING, DEVICE AND TEST ELEMENT
DESIGN, NEUTRONICS

ROBERT CONN: PHYSICS, DEVICE DESIGN

RON DIMELFI: MATERIALS, RADIATION EFFECTS

CHIP GARNER (TRW): THERMOMECHANICAL, HEAT TRANSFER

PAUL GIERSZEWSKI: COORDINATION OF SOLID BREEDERS, TRITIUM RECOVERY,
RELIABILITY

STEVE GROTZ: FAILURE MODES, RATES

KAZUO SHIN: NEUTRONICS

JACOB SZABO: FISSION REACTOR EXPERIENCE

KAVEH TAGHAVI: THERMAL HYDRAULICS, CORROSION

MARK TILLACK: COORDINATION OF LIQUID METALS, FLUID FLOW,
MHD EFFECTS

MAHMOUD YOUSSEF: NEUTRONICS

STUDENTS

JAKE BLANCHARD: STRESS ANALYSIS, MATERIALS

CHEN-YU GUNG: NEUTRONICS

TIM NAUGHTON: SOLID BREEDERS

GEORGE ORIENT: STRESS ANALYSIS