

"TASK I: ISSUES AND TESTING NEEDS"

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FINESSE PROJECT MEETING  
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UCLA

# TASK I

## IDENTIFICATION OF ISSUES AND REQUIRED NUCLEAR TESTS

### SCOPE

1. IDENTIFY, CHARACTERIZE (AND PRIORITIZE):
  - CRITICAL ISSUES (FEASIBILITY, CRUCIAL FOR REASONABLE PERFORMANCE)
  - KEY ISSUES (LARGE IMPACT ON PERFORMANCE, ATTRACTIVENESS)
  - GENERAL ISSUES
2. IDENTIFY, CHARACTERIZE, CLASSIFY (AND PRIORITIZE):
  - ENGINEERING TESTS (R&D)

### IMPORTANCE OF TASK I

- THE NATIONAL FUSION PROGRAM NEEDS A CLEAR "STATEMENT OF NEEDS" IN THE FUSION NUCLEAR TECHNOLOGY AREA. FINESSE IS A LOGICAL PLACE TO DO THIS.
- TASKS II, IV, AND V NEED THE RESULTS FROM TASK I.

## "NUCLEAR" COMPONENTS INCLUDED IN TASK I

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

### ORGANIZATION

- OUR FOCUS IS NOW ON BLANKET/FIRST WALL.
- TRW (STEELE/BERWALD) IS ADDRESSING OTHER COMPONENTS AS PART OF THEIR WORK FOR LLNL.
- TRW WORK WILL BE USED AS A STARTING POINT FOR FINESSE WORK ON NON-BLANKET COMPONENTS THIS SUMMER.

Table 1Technical Disciplines for Classifying Blanket Testing Issues

1. Structural Behavior
  - Primary and Thermal Stresses
  - Transient and Cyclic Stresses
  - Lifetime Effects
2. Materials
  - Thermophysical and Mechanical Properties (Structure, Breeder, Multiplier and Others)
  - Radiation Effects
3. Fluid Mechanics
  - Pressure Drops
  - Velocity Profiles
  - MHD Effects
  - Flow Oscillation
4. Heat Transfer
  - Heat Conduction
  - Interface Heat Transfer
  - Temperature Control and Hot Spots
  - Transient Thermal Response
5. Corrosion and Materials Compatibility
  - Corrosion and Mass Transfer Rates
  - Temperature Limits
6. Neutronics
  - Tritium Breeding
  - Bulk Heating
  - Reaction Rates (dpa, He, H)
7. Tritium Transport
  - Migration
  - Permeation
  - Recovery

8. Failure Modes

- Mechanisms
- Effects
- Preventative Measures

9. Safety

- Tritium and Activation Product Release
- Afterheat
- Radiation Levels
- Toxic Chemicals
- Energy Sources and Release Mechanisms

10. Other Interfaces and Systems Integration

- Maintenance
- Fabrication
- Instrumentation and Control
- Blanket-Related Systems Interactions

## SUBGROUPS FOR TASK I: FIRST WALL/BLANKET

(EACH SUBGROUP WILL ADDRESS ALL GENERIC BLANKET TYPES.)

### SUBGROUP A: STRUCTURAL AND MATERIALS AND FAILURE MODES

- STRUCTURAL RESPONSE (OPERATIONAL AND TRANSIENT STRESSES)
- MATERIALS (ALL MATERIALS EXCEPT SOLID BREEDER MATERIALS)
- RADIATION EFFECTS
- FAILURE MODES FOR ALL OF FIRST WALL AND BLANKET
- LIFETIME

### SUBGROUP B: THERMAL AND CORROSION

- THERMAL HYDRAULICS
- HEAT CONDUCTION, HEAT TRANSFER
- COOLANT PROBLEMS (GENERAL)
- MHD FOR LIQUID METALS
- CORROSION AND MASS TRANSFER

### SUBGROUP C: SOLID BREEDERS AND TRITIUM

- SOLID BREEDER MATERIALS
  - PROPERTIES UNDER IRRADIATION (THERMOPHYSICAL, CHEMICAL AND MECHANICAL)
  - STRESSES, CRACKING, ETC.
- TRITIUM RECOVERY
  - SOLUBILITY, MIGRATION
  - RADIATION EFFECTS
  - TRITIUM RECOVERY SCHEME

#### SUBGROUP D: NEUTRONICS

- TRITIUM BREEDING
- NUCLEAR HEATING
- ACTIVATION (PREDICTION NOT IMPLICATION)

#### SUBGROUP E: SAFETY

- TRANSIENT EFFECTS
- TRITIUM PERMEATION
- ACTIVATION
- ALL OTHER SAFETY ISSUES

#### SUBGROUP F: INTERFACES AND SYSTEM INTEGRATION

- MAINTENANCE OF FIRST WALL/BLANKET
- INSTRUMENTATION AND CONTROL
- INTERACTION BETWEEN FIRST WALL/BLANKET AND OTHER REACTOR/  
PLANT SUBSYSTEMS

#### SUBGROUP G: NON-BLANKET COMPONENTS

SUBGROUP LISTINGS WHICH INCLUDE LEADERS,  
MEMBERS AND OUTSIDE CONTACTS ARE INCLUDED  
AS ATTACHMENT 17.



## SCHEDULE FOR TASK I: FIRST WALL/BLANKET

- SUBGROUP MEETINGS, TUESDAY, FEBRUARY 28
  - DISCUSS AND AGREE ON APPROACH
  - INITIAL LIST OF: A) ISSUES, B) TESTING NEEDS
  - ASSIGN RESPONSIBILITY FOR INDIVIDUAL ISSUES, TESTING NEEDS, ETC.
  
- PERIOD BETWEEN FEBRUARY 28 AND MARCH 30
  - INTERACTION AMONG GROUP MEMBERS
  - CONSULTATION WITH EXPERTS OUTSIDE FINESSE
  
- APRIL 3 (FINESSE PROJECT MEETING)
  - MORNING: SUBGROUP MEETINGS (DISCUSS RESULTS)
  - AFTERNOON: PRESENTATIONS BY SUBGROUP LEADERS (WORK PRESENTED MUST BE IN GOOD SHAPE, FOCUSED, CLEAR AND NEARLY COMPLETE)
  
- MAY 1
  - DRAFT OF SECTION BY EACH SUBGROUP TO BE MAILED BY SUBGROUP LEADER TO M. ABDOU BY MAY 1
  
- MAY 15 (FINESSE PROJECT MEETING)
  - FINAL PRESENTATIONS, FINALIZE REPORT ON TASK I: FIRST WALL/BLANKET
  - INITIATE EFFORT ON NON-BLANKET COMPONENTS

EXPECTED OUTPUT FROM  
TASK I: FIRST WALL/BLANKET

- 10-15 TYPED PAGES PER SECTION
- EACH SECTION SHOULD HAVE TWO SUBSECTIONS:
  - A) ISSUES
  - B) TESTING NEEDS
- FOR ISSUES SUBSECTION:
  - BRIEF DESCRIPTION OF EACH ISSUE
  - WHY IT IS AN ISSUE; HOW IT RELATES TO OTHER ISSUES
  - IMPORTANCE OF ISSUE (FEASIBILITY ISSUE, PERFORMANCE ISSUE, ETC.)
- FOR TESTING NEEDS SUBSECTION:
  - BRIEF DESCRIPTION OF TEST
  - WHY TEST IS NEEDED
  - REQUIREMENTS ON TEST ENVIRONMENT (ELECTROMAGNETICS, VACUUM, NEUTRONS, TRITIUM, ETC.)
  - IMPORTANCE OF NEUTRONS IN THE TEST
  - EXTENT NECESSARY FOR TEST TO BE PART OF INTEGRAL TEST

TIME PERIOD TO BE CONSIDERED  
IN IDENTIFYING ISSUES/TESTING NEEDS

- PERIOD 1985 TO DEMONSTRATION
  
- DIVIDE INTO TWO TIME FRAMES:
  - 1985-1995      SEPARATE AND MULTIPLE-EFFECT TESTS (INCLUDE FISSION REACTORS, POINT NEUTRON SOURCES)
  - 1995-2010      FUSION ENGINEERING TEST FACILITY
  
- ISSUES AND TESTS IN THE FUSION ENGINEERING TEST FACILITY MUST RECEIVE MORE SERIOUS EXAMINATION AND MORE DETAILS IN WRITING (BE BRIEF AND USE BROAD CATEGORIES, E.G., THERMOPHYSICAL PROPERTIES, RATHER THAN DETAILED  $k$ ,  $\rho$ , ETC.) FOR THE PERIOD 1985-1995