UCLA EFFORT RELATED TO STARFIRE-II

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WORKSHOP ON COMMERCIAL TOKAMAK REACTOR STUDIES
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OUTLINE

- STARTUP/SHUTDOWN STUDY
  - ENGINEERING
  - PHYSICS

- OTHER UCLA PROGRAMS DIRECTLY RELEVANT TO STARFIRE-II

- THOUGHTS ON TECHNICAL FOCUS FOR STARFIRE-II

OTHER UCLA ACTIVITIES
DIRECTLY RELEVANT TO STARFIRE-II

FINESSE

TECHNICAL ISSUES IN DEVELOPMENT OF FUSION NUCLEAR COMPONENTS:

- TESTING REQUIREMENTS
- TESTING FACILITIES (INCLUDING FUSION TEST FACILITY: MINIMIZE POWER, MAXIMIZE POWER DENSITY)

PMI AND HIGH HEAT FLUX COMPONENTS

- ANALYTICAL AND EXPERIMENTAL
- PUMPING
- EROSION/REDEPOSITION
- HEAT TRANSFER
- THERMOMECHANICAL

NEUTRONICS

- FOCUS: TRITIUM BREEDING
- EXPERIMENTAL/ANALYTICAL VERIFICATION OF MODELS
- EXPERIMENTAL/ANALYTICAL DERIVATIONS OF UNCERTAINTIES AND REQUIRED DESIGN MARGIN

MATERIALS

- RADIATION EFFECTS/STRUCTURAL MODELING
- LOW ACTIVATION

UCLA STARTUP/SHUTDOWN STUDY

PRINCIPAL INVESTIGATORS: R. CONN, M. FIRESTONE, N. GHONIEM

OBJECTIVES

- IDENTIFY AND CHARACTERIZE PHYSICS AND ENGINEERING ISSUES RELATED TO:
  - A) STARTUP
  - B) SHUTDOWN
  - C) FRACTIONAL POWER OPERATION
- ATTEMPT TO DEVELOP INNOVATIVE SOLUTIONS
- PROVIDE INPUT TO REACTOR DESIGN STUDIES AND R&D PLANNING

SCOPE

FY 1983: TANDEM MIRROR REACTORS

- PHYSICS
  - DISCHARGE SCENARIOS
  - OPERATION AT FRACTIONS OF FULL POWER
  - MAGNETIC DIVERTORS
- ENGINEERING
  - PLANT STARTUP/SHUTDOWN PROCEDURE
  - LIQUID METAL BLANKET AND PRIMARY LOOP PROBLEMS
    - * THERMAL, STRUCTURAL, MATERIAL AND TRITIUM
    - * PRE-HEATING REQUIREMENTS
    - * LIFETIME PREDICTIONS

FY 1984-1985: TOKAMAKS

TOKAMAK ENGINEERING EFFORT
(FY 1984-1985)

SCOPE: STARTUP, SHUTDOWN, POWER VARIATION

1) GENERAL ISSUES FOR PLANT AND REACTOR COMPONENTS

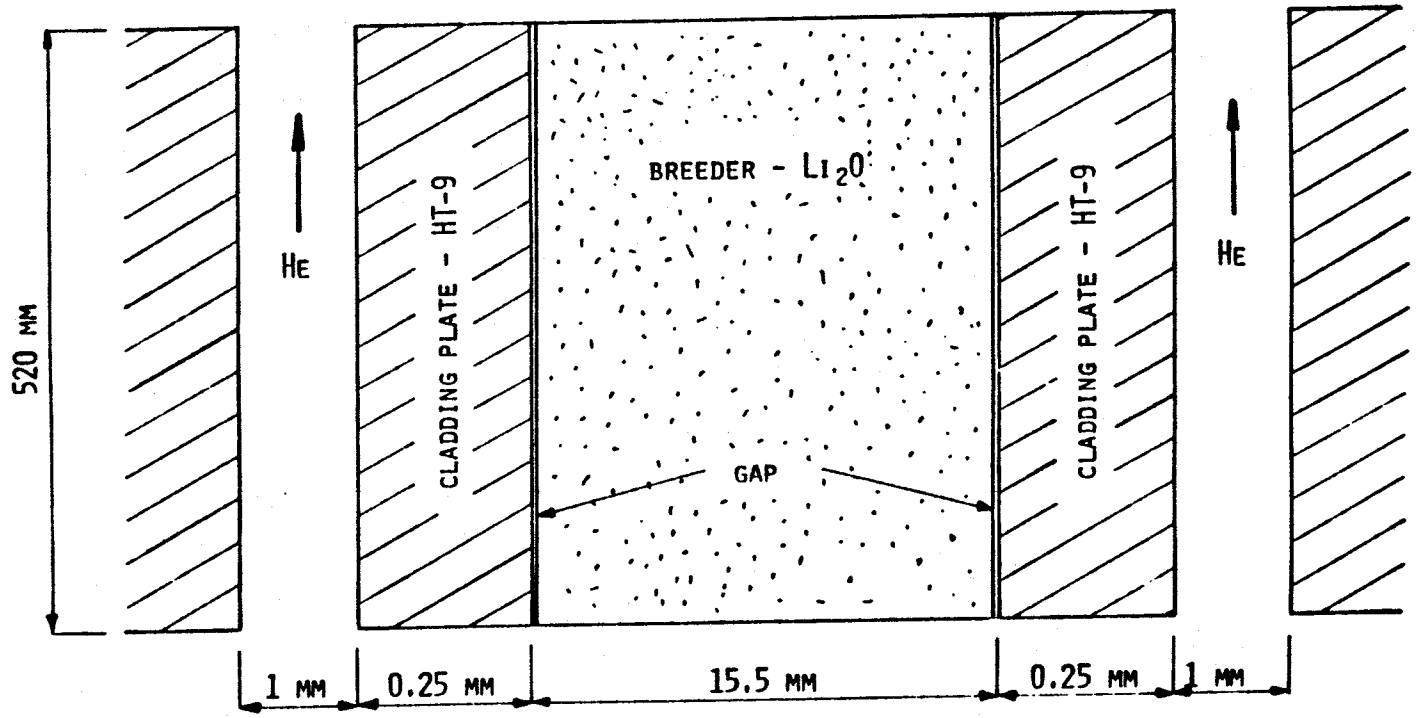
2) SPECIFIC ISSUES AND DETAILED ANALYSES FOR SOLID BREEDER BLANKETS

BLANKETS

- SOLID BREEDERS WERE SELECTED FOR STUDY BECAUSE:
  - DESIGNS ARE DIFFICULT EVEN AT NORMAL CONTINUOUS OPERATION
  - DO NOT APPEAR TO OFFER MUCH FLEXIBILITY IN ACCOMMODATING STARTUP/SHUTDOWN/POWER VARIATION REQUIREMENTS
- RESULTS ARE EXPECTED TO EITHER:
  - HOPEFULLY, NEW, INNOVATIVE DESIGNS WILL SOLVE THE MORE DIFFICULT TRANSIENT REQUIREMENTS AND, HENCE, WILL LIKELY BE ATTRACTIVE AT NORMAL CONDITIONS

    OR
  - VIABILITY OF SOLID BREEDERS?
- TECHNICAL AREAS OF EMPHASIS:
  - NEUTRONICS: TRITIUM BREEDING
  - TRITIUM RECOVERY AND THERMAL: TEMPERATURE CONSTRAINTS, TRITIUM AND MASS TRANSPORT, HE PURGE FLOW RATE, INTERFACE CONDUCTANCE, COOLANT FLOW STABILITY
  - MECHANICAL RESPONSE AND MATERIALS: THERMAL STRESS, DIFFERENTIAL SWELLING, STRESS RELAXATION, SOLID BREEDER PHYSICAL INTEGRITY

BLANKET MODEL



UCLA TOKAMAK REACTOR PHYSICS PROGRAM

OBJECTIVE:

INVESTIGATE THE TIME DEPENDENT BEHAVIOR OF SEVERAL DISCHARGE SCENARIOS - COMPARE WITH THE BASE CASE OF THE LONG PULSE HYBRID (RF CURRENT RAMP UP, OH SUSTAINS CURRENT DURING BURN).

GOAL:

TO IDENTIFY PROBLEMS AND CLARIFY ISSUES BY FINDING OPTIMAL DESIGN AND OPERATIONAL PROCEDURES FOR THE DIFFERENT DISCHARGE SCENARIOS. A MORE DETAILED COMPARISON OF THE SCENARIOS WOULD THEN BE POSSIBLE.

PHILOSOPHY:

TRY TO BE INNOVATIVE AND FLEXIBLE. NOT WEDDED TO SPECIFIC DESIGNS, CONCEPTS, AND PROCEDURES.

KEY AREAS:

I. ELECTROMAGNETICS

A. CHANGING INTERACTION BETWEEN THE PLASMA AND POLOIDAL FIELD SYSTEM IN TIME.

B. ENGINEERING CONSTRAINTS (VESSEL, BLANKET, STRUCTURES) INFLUENCE ELECTROMAGNETIC CONTROL AND PLASMA CURRENT GENERATION.

C. POLOIDAL FIELD SYSTEM REQUIREMENTS FOR:

STARTUP -	POSITION, SIZE
STAGED POWER INCREASE -	POSITION, SIZE, SHAPE
BURN CONTROL -	POSITION, SIZE, SHAPE

II. RF CURRENT DRIVE (LOWER HYBRID WAVE)

A. CURRENT DRIVE MODEL REQUIRED FOR CURRENT PROFILE EVOLUTION AND RF PULSE SHAPE AND LENGTH.

B. ELECTRON DISSIPATIVE HEATING FROM WAVE.

C. PROPER RF AND OH PROGRAMMING TO AVOID UNSTABLE CURRENT PROFILE.

INTERACTION BETWEEN RF AND OH DRIVEN CURRENTS?