

Report on Cooperation between Parties on DEMO-  
relevant breeding blanket R&D  
(US presentation)

Presented by

Alice Ying  
UCLA

4th TBWG Meeting  
JAERI Headquarters  
Tokyo, Japan  
April 15, 1997

Figure 2 R&D Plan for Solid Breeder Blanket Test Module in ITER

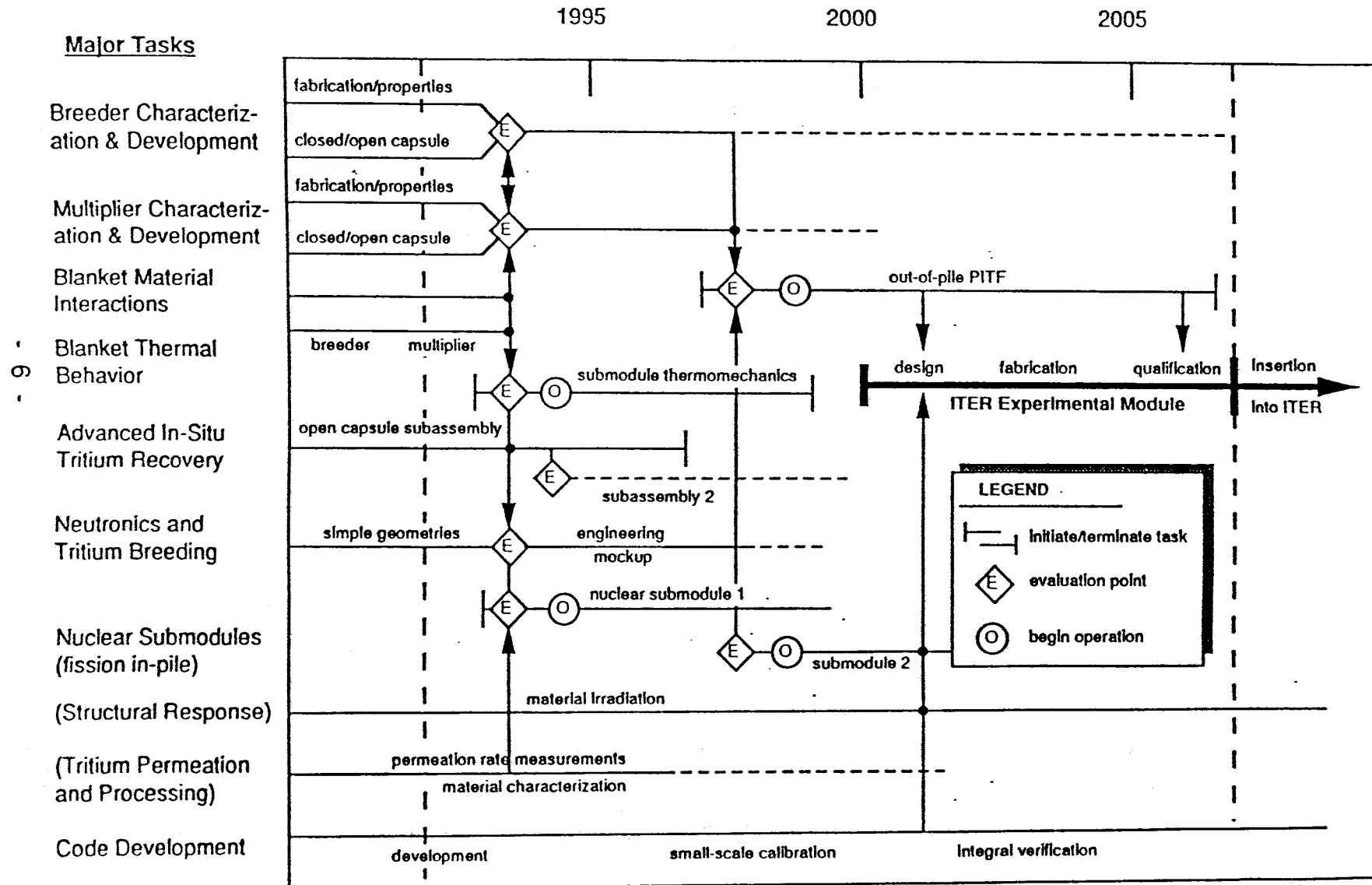


Figure 3 R&D Plan for Liquid Metal Blanket Test Module in ITER

Major Tasks

MHD Effects

Insulator Development

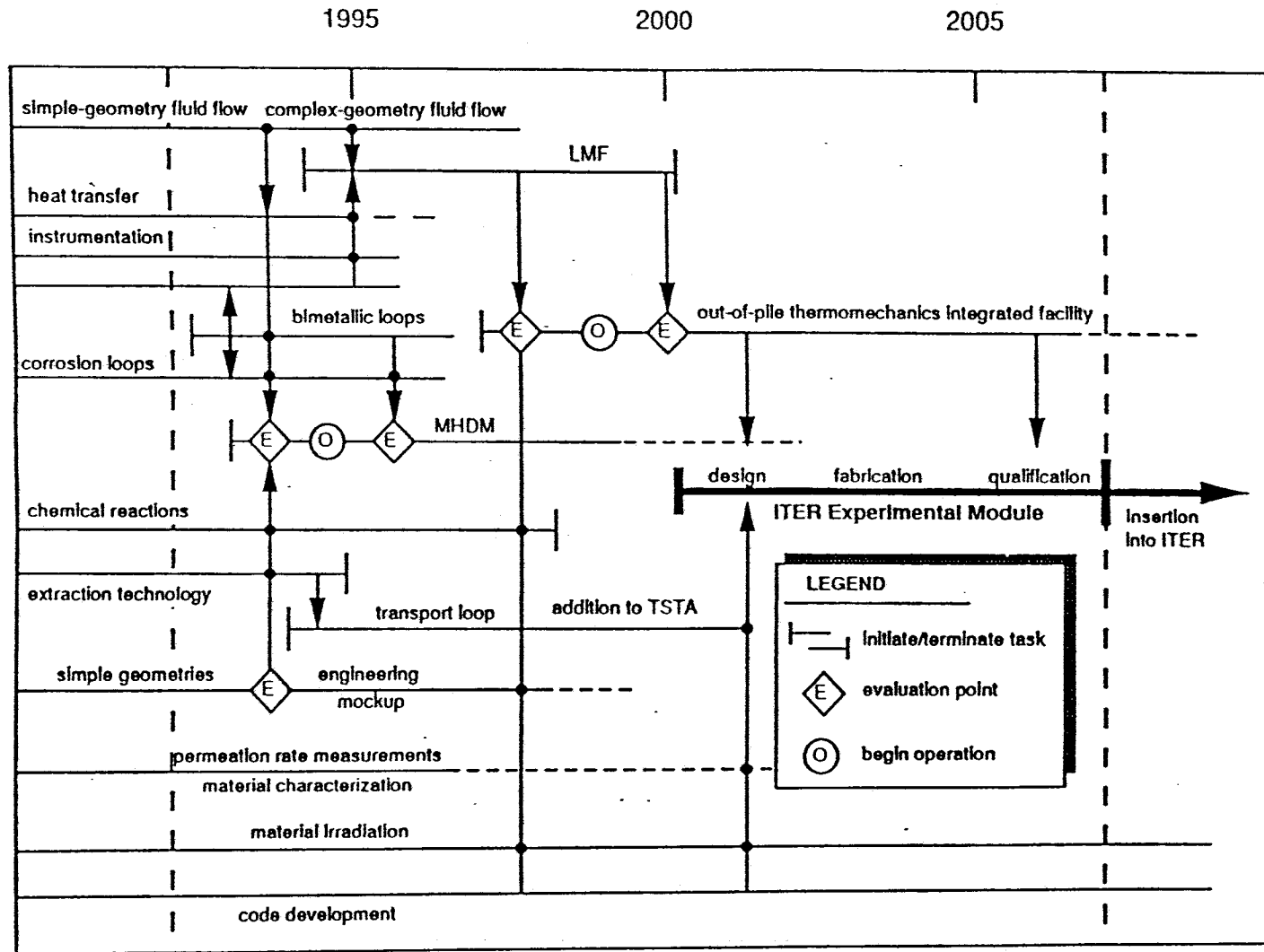
Material Compatibility

Tritium Recovery and Control

Tritium Breeding (Neutronics)

(Tritium Permeation and Processing)

(Structural Response)



# Existing Formal and Informal Collaborations Between Parties for Li/Li/V Concept Development

- US/Japan (Monbushu) Collaboration on vanadium alloy development
  - Irradiation effects on mechanical properties of vanadium alloy (ATR, HFIR, EBR reactors).
  - Irradiation creep of vanadium alloys.
  - Effects of fusion relevant helium generation rates on properties of neutron irradiated alloys by the Dynamic Helium Charging Experiment (DHCE).
  - Specimen size effects on mechanical properties of irradiated vanadium alloys.
  - Joint work on comment heat of V-4Cr-4Ti alloy.
- US/RF collaboration on vanadium alloys
  - Production of vanadium alloys including scaleup of heats and evaluation of heat-to-heat variations of compositions and properties.
  - Fabrication of plate, sheet, and tubing.
  - Collaboration on irradiation experiments in BOR-60 reactor including tensile, fracture and microstructural evaluations.
- US/European collaboration
  - Testing of US vanadium alloys in HFIR reactor.

## R&D in Li/Li/V Blanket Concept

- Present Status
  - Active work in the US is at a low level.
  - There are some activities in the RF.
  - Additional efforts in the US in FY 1998 is expected.
- Major R&D areas for the future
  - Insulating coating development
  - MHD testing
    - With insulating coatings
    - Complex geometries
    - Prototypical operating conditions
  - Tritium recovery
    - Hydrogen swamping/cold trap
    - Laboratory scale experiment
    - Large scale demonstration
- Active discussion has been in progress with RF for future collaboration.

# Existing International Collaborative Efforts on ITER Blanket Test Module for the He/SB/Fe Concept

- Bi-laterals with Japan (JAERI and Monbusho) and Multi-lateral under IEA : Development of Low Activation Ferritic/Martensitic Steels
  - Fracture-oriented studies of non-irradiated steels
    - \* micromechanics of fracture
    - \* size and crack geometry effects
    - \* low-cycle fatigue
    - \* sub-critical crack growth
    - \* composition optimization
    - \* thermal stability
    - \* mixed-mode fracture toughness and hydrogen effects
  - Irradiation effects on mechanical properties
    - \* tensile, Charpy, compact tension, and microstructure
    - \* microstructure-hardening-fracture correlations
    - \* neutron spectrum effects

# Existing International Collaborative Efforts on ITER Blanket Test Module for the He/SB/Fe Concept (Cont'd)

- Informal Lab-to-Lab work with CEA and FZK(Need to be Formalized)
  - Solid Breeder Thermomechanical Interaction Experiments
    - \* modeling and experiments on the effective thermal and mechanical properties of packed ceramic breeder bed under different purge gas, porosity and loading conditions
    - \* modeling and measurements on the interface thermal conductance between packed ceramic breeder/multiplier bed and structure under different loading conditions
    - \* material interactions multi-layer configuration of beryllium, ceramic breeder, coolant and structure experiment
  - Modeling Capability for Predicting and Characterizing Tritium Release in Solid Breeder and Beryllium

## Status Report on the US Test Blanket Module DDDs

- The US Test Blanket DDD is reasonably complete.
- Specific details of the blanket test modules, thermal and plasma interfaces, ancillary equipment and piping layout, test module attachment scheme and remote handling system may be updated depending on the final ITER design for the test ports and related systems.
- Additional Subjects to be Included in the FDR (depending on the budget availability and agreements within TBWG):
  - Diagnostics/instrumentation, specification and locations inside the test modules
  - Analysis to show that the results to be obtained from the test modules as designed can be extrapolated to DEMO and reactor conditions
  - Mechanisms concerning detections of failure mode and rate



## Status Report on the US Test Blanket Module DDDs

- The US Test Blanket DDD is reasonably complete.
- Specific details of the blanket test modules, thermal and plasma interfaces, ancillary equipment and piping layout, test module attachment scheme and remote handling system may be updated depending on the final ITER design for the test ports and related systems.
- Additional Subjects to be Included in the FDR (depending on the budget availability and agreements within TBWG):
  - Diagnostics/instrumentation, specification and locations inside the test modules
  - Analysis to show that the results to be obtained from the test modules as designed can be extrapolated to DEMO and reactor conditions
  - Mechanisms concerning detections of failure mode and rate