Overview of ITER Test Program

ITER Team

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OBJECTIVES OF ITER TEST PROGRAM

- Screening of concepts that require integrated fusion environment

- Calibration of fusion tests to results from non-fusion facilities

- Validation of blanket concepts for DEMO

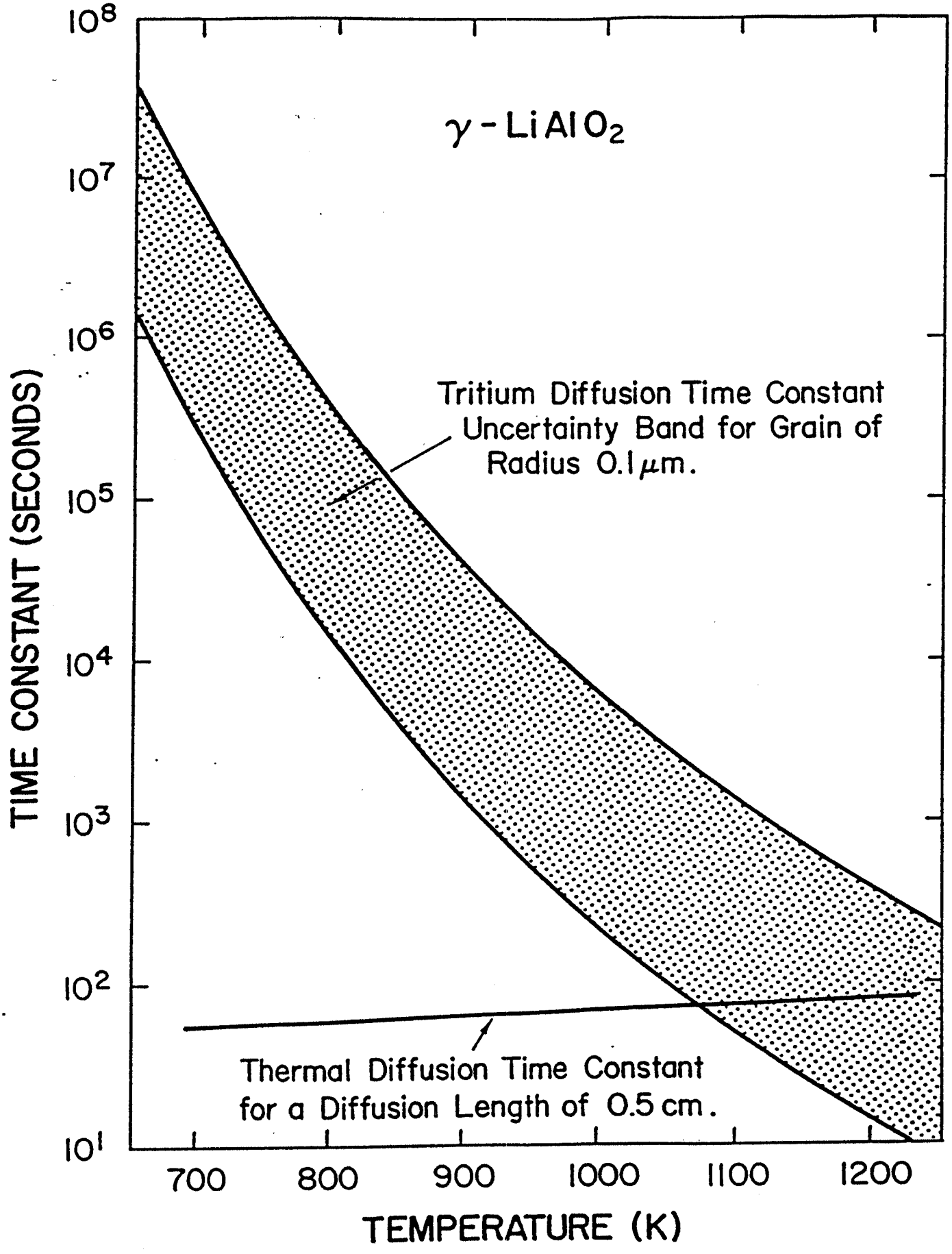
- Testing of advanced concepts e.g.:

  Low activation
  Inherent safety

Powerful, albeit limited, demonstration of fusion potential

FNT Testing Requirements

- Major Parameters of Device
  - Device Cost Drivers
  - Major Impact on Test Usefulness
- Engineering Design of Device e.g.,
  - Access to Place, Remove Test Elements
  - Provision for Ancillary Equipment
  - Accommodation of Failures in Test Elements


γ - LiAlO2
Tritium Diffusion Time Constant
Uncertainty Band for Grain of
Radius 0.1 μm.
Thermal Diffusion Time Constant
for a Diffusion Length of 0.5 cm.
TIME CONSTANT (SECONDS)
TEMPERATURE (K)
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10^1
700
800
900
1000
1100
1200

FLUENCE GOALS

Device fluence (at first wall) is a factor of 2 larger than fluence received at the test module

Device Fluence ($MW \cdot y/m^2$)

$$I_d = P_{nw} \cdot A \cdot t_d$$

Fluence at the Test Module ($MW \cdot y/m^2$)

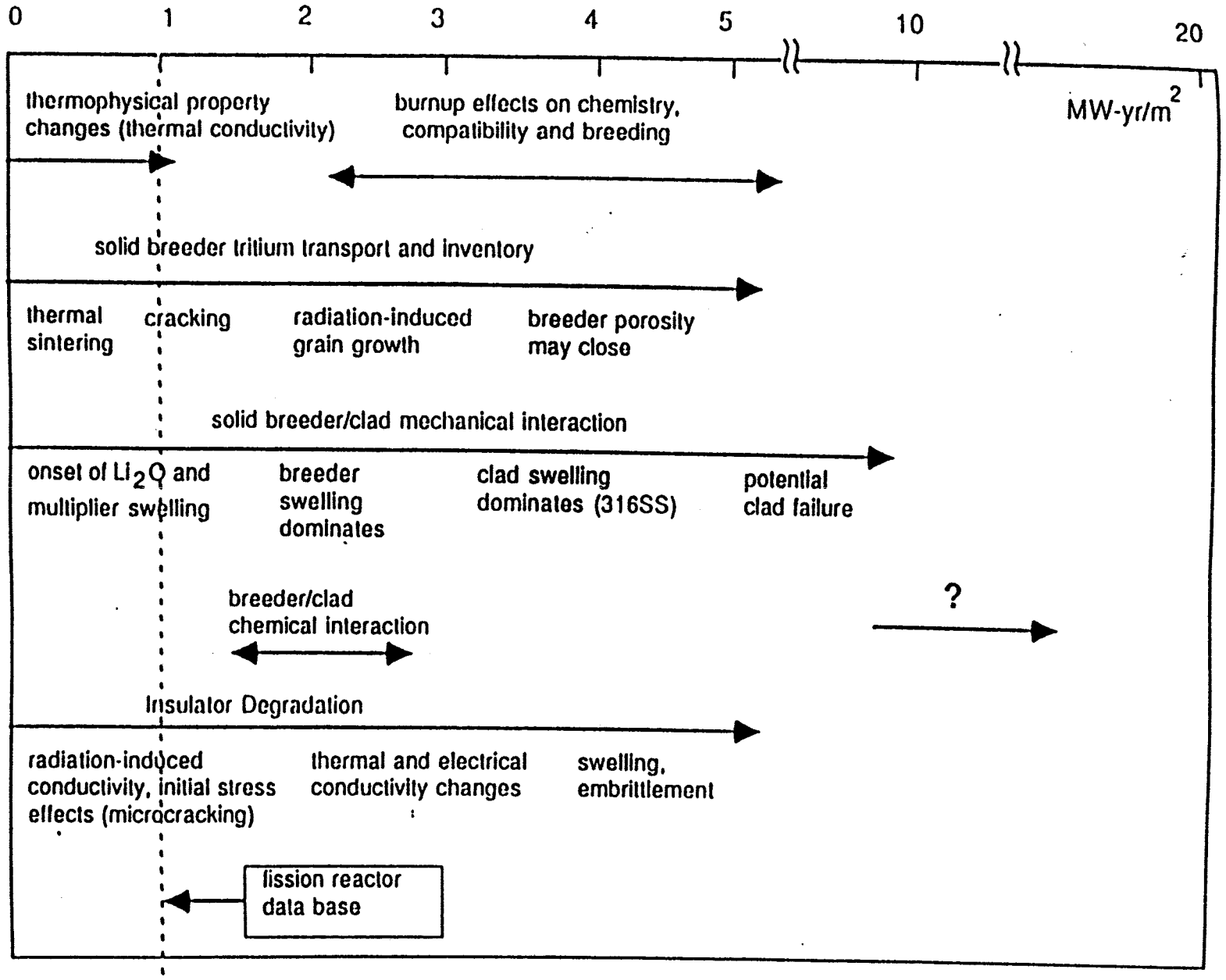
$$I_m = P_{nw} \cdot A \cdot t_m \cdot T$$

Why $I_d > I_m$ (typical: factor of 2)

- $t_d > t_m$
  - Sequential tests required for scoping → verification
  - Also, failure and replacement of test modules
- $T < 1$
  - Attenuation through PfC, first wall

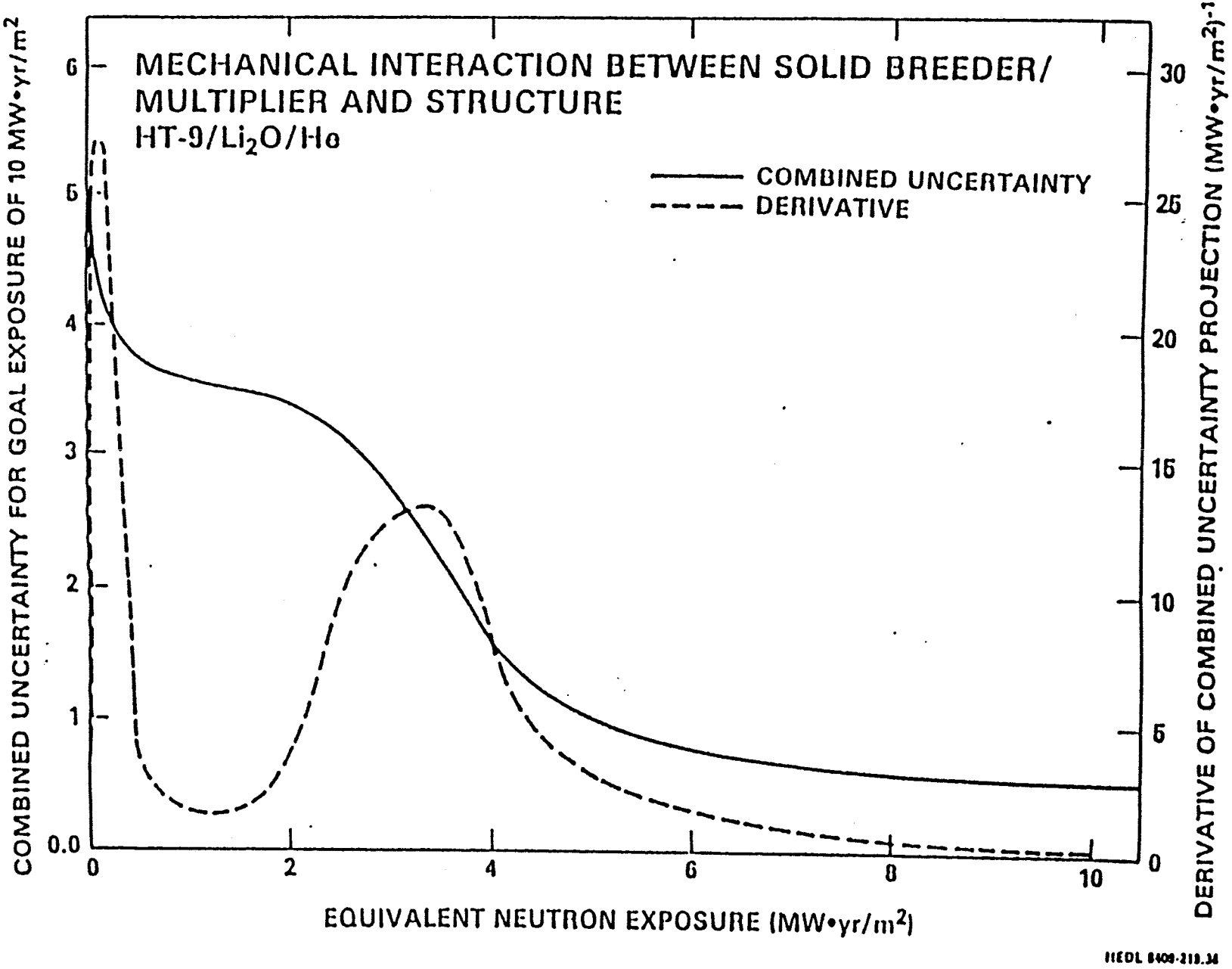
EXAMPLES OF KEY FNT ISSUES REQUIRING SUBSTANTIAL FLUENCE

- Mechanical Interactions
  e.g., Solid Breeder/Clad Interactions
- Tritium Inventory in Solid Breeders
- Burnup Effects on Chemistry, Compatibility and Breeding
- Corrosion/Redeposition
- Failure Modes, Rates



A2: Fluence-Related Effects in Solid Breeders and Insulators

EXAMPLE OF BENEFIT Vs. FLUENCE



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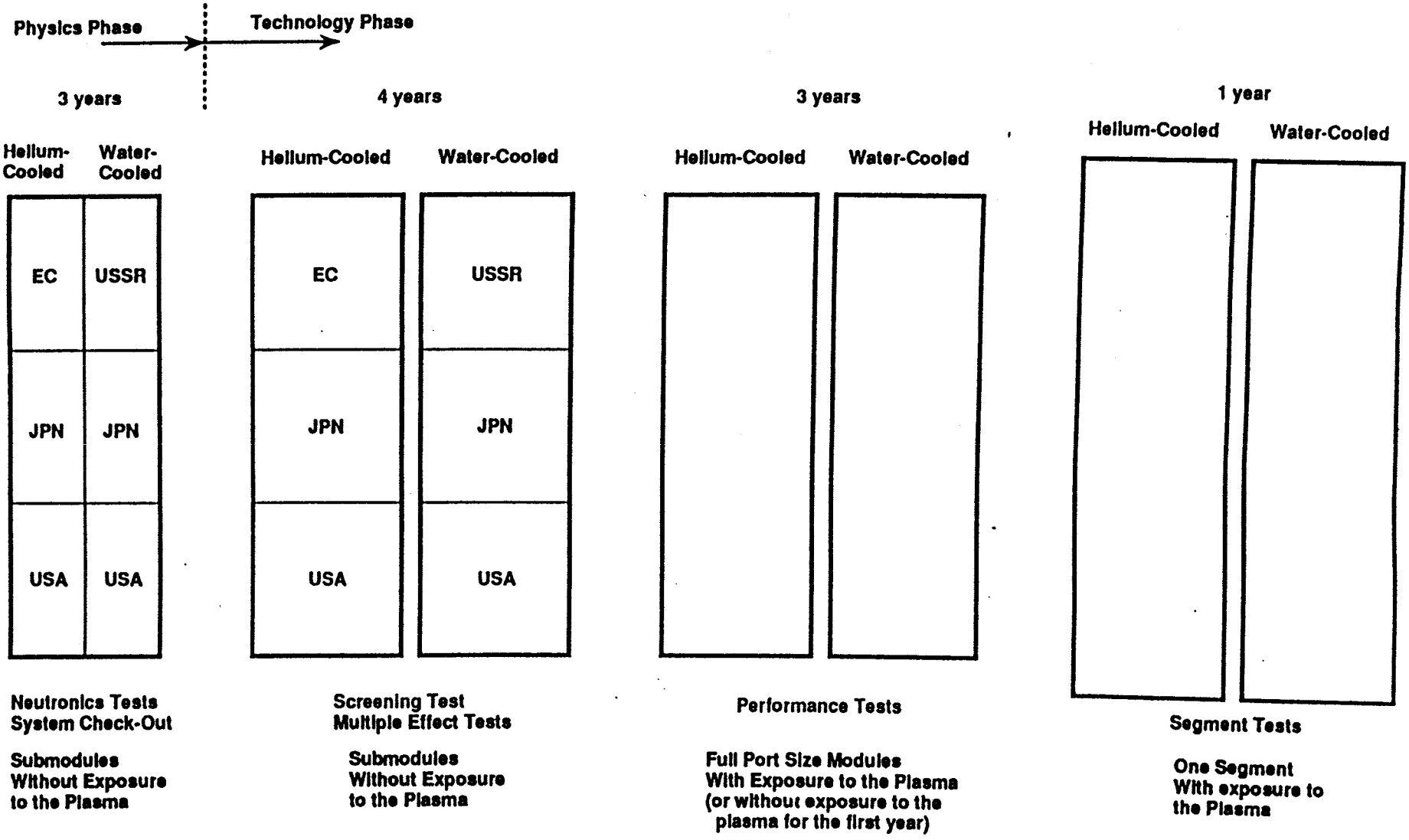

Fig. 2.6.1 Test Port Allocation to Helium- and Water-Cooled Solid Breeder Blankets

ANCILLARY EQUIPMENT FOR TEST MODULES

e.g. - Heat rejection system

- Tritium recovery systems
- Coolant and purge fluid storage
- Hot cells and PIE

- Extensive requirements on ITER configuration and maintenance