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
\( \gamma - \text{LiAlO}_2 \)

Tritium Diffusion Time Constant Uncertainty Band for Grain of Radius 0.1 \( \mu \text{m} \).

Thermal Diffusion Time Constant for a Diffusion Length of 0.5 cm.
**Fluence Goals**

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

**Device Fluence** (MW·y/m²)

\[ I_d = P_{nw} \cdot A \cdot t_d \]

**Fluence at the Test Module** (MW·y/m²)

\[ I_m = P_{nw} \cdot A \cdot t_m \cdot T \]

**Why \( I_d > I_m \)** (typical: factor of 2)

- \( t_d > t_m \)
  - Sequential tests required for scoping \( \rightarrow \) 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

MECHANICAL INTERACTION BETWEEN SOLID BREEDER/MULTIPLIER AND STRUCTURE
HT-9/Li_2O/Ho

- - - - COMBINED UNCERTAINTY
- - - - DERIVATIVE

COMBINED UNCERTAINTY FOR GOAL EXPOSURE OF 10 MW·yr/m^2

DERIVATIVE OF COMBINED UNCERTAINTY PROJECTION (MW·yr/m^2)^{-1}

EQUIVALENT NEUTRON EXPOSURE (MW·yr/m^2)
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