Initial Report of ISCUS Subgroup on Nuclear Testing in ITER

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ISCUS Subgroup on Nuclear Testing In ITER

Scope

Evaluate the nuclear testing capability of ITER and the Base Program in the US that will be required to utilize that capability

Charge

Develop for ISCUS findings and recommendations from the following evaluations:

1. Evaluate the nuclear testing capability of the present ITER design/operating scenario within the context of the nuclear testing that will be required to develop the data base for the design of the DEMO in the US Program Plan. Identify any features of the design/operating scenario that could plausibly be changed to enhance the nuclear testing capability of ITER.

2. Evaluate the tritium availability to support nuclear testing in ITER. This would include an evaluation of external tritium supplies and of the feasibility of various options/scenarios for producing tritium in ITER.

3. Evaluate the Base Program in the US that will be required to utilize the nuclear testing capability of ITER vis-a-vis the existing US Base Program.

Schedule

- Introductory/Background Presentations on 11/17/94
- ???

Subgroup Members

M.A. Abdou
J. Anderson
D.M. Meade
D.L. Smith
D. Steiner
K.I. Thomassen

Presentations 11/17/94

1. Summary of Nuclear Testing Issues
   M. Abdou

2. Tritium Supply Assessment
   J. Anderson

3. Status of Base Blanket Program Capabilities
   D.L. Smith

Output of Discussion Today

Provide subgroup members with guidance on whether they need to do more, and specifically on what topics and with what constraints.

Status of ITER Capabilities Relevant to Nuclear Testing

- Director Design Assessment Meeting led to decisions on certain areas and left open some areas

Clear

- Tests will start from Day 1 of DT operation in BPP
- BPP will have a fluence of 0.3 MW•y/m^2 over 12 years
- No breeding blanket in BPP
- Must evolve and enforce Development criteria for extent of R&D required to qualify a concept to be tested as test modules in ITER
- Must evolve and enforce Safety criteria for design and acceptance of test modules

Open Issues

- Fluence during EPP
  - Previously: 1 MW•y/m^2
  - Director believes EPP costs too much (0.5B per year) and get too little fluence.
    He prefers to focus now only on BPP

- Is there a "base" breeding blanket in EPP?
  - Subject was not an item for discussion
  - Shimomura prefers having hot reactor relevant blanket in EPP with ITER serving as "Pre-Demonstration"

- Burn/dwell times
  - Now 1000 s burn, 1200 s dwell
  - No new information from JCT

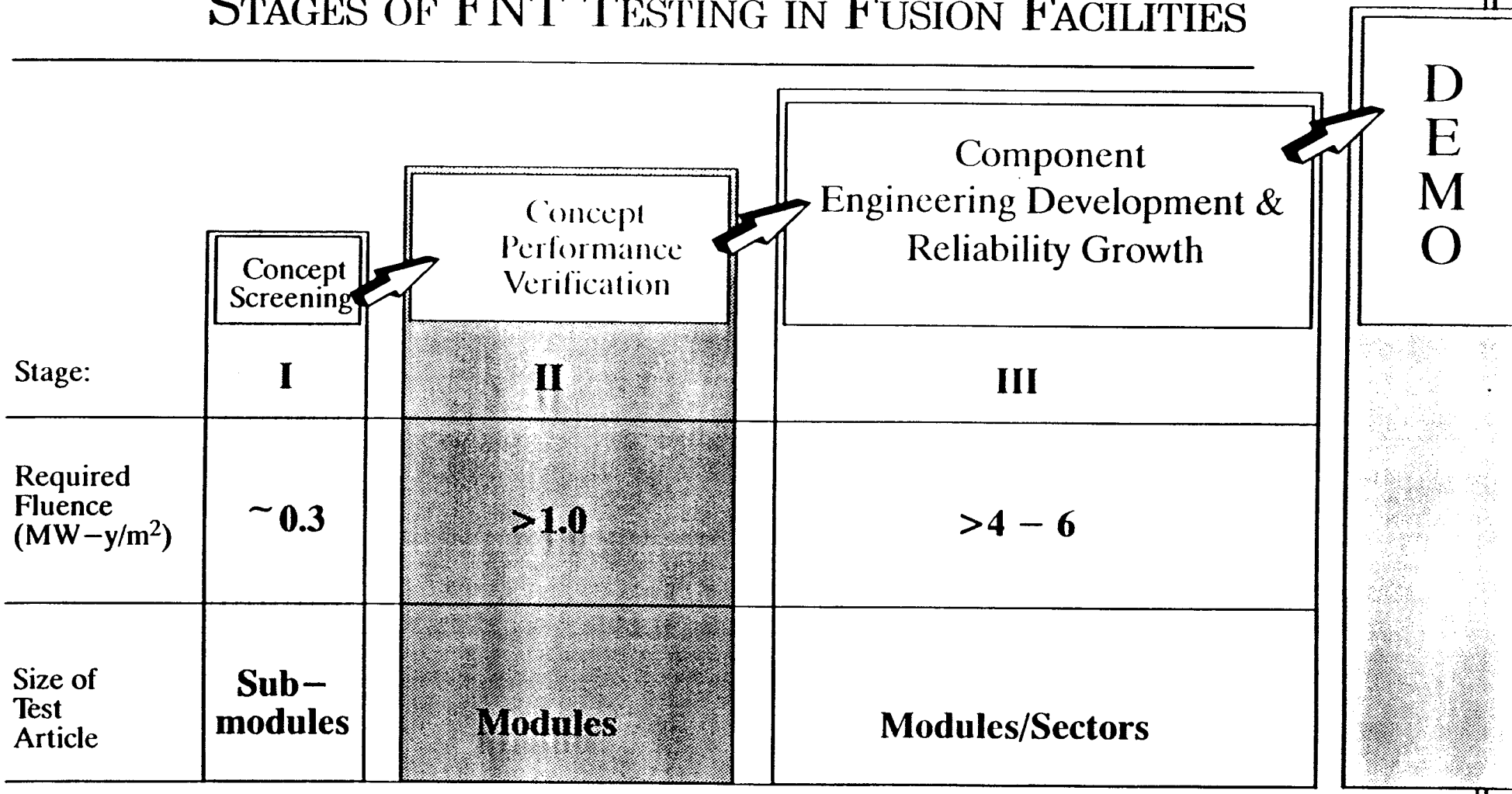
- Will plasma exposure of the test module first wall be allowed?

Fusion Testing Needs
[How Much Fusion Testing is Needed to Construct DEMO Blanket]

Parameter	Value
Neutron Wall Load, MW/m^2	1-2
Plasma Mode of Operation	Steady State*
Neutron Fluence at Test Module	
Stage I $MW.a/m^2$	0.3
Stage II $MW.a/m^2$	>1
Stage III $MW.a/m^2$	4-6
Total Neutron Fluence for Test Device, MW.a/m2	6
Total Test Area, m2	>10
Minimum Continuous Operating Time, Weeks	1-2

* or long burn with plasma duty cycle > 80%

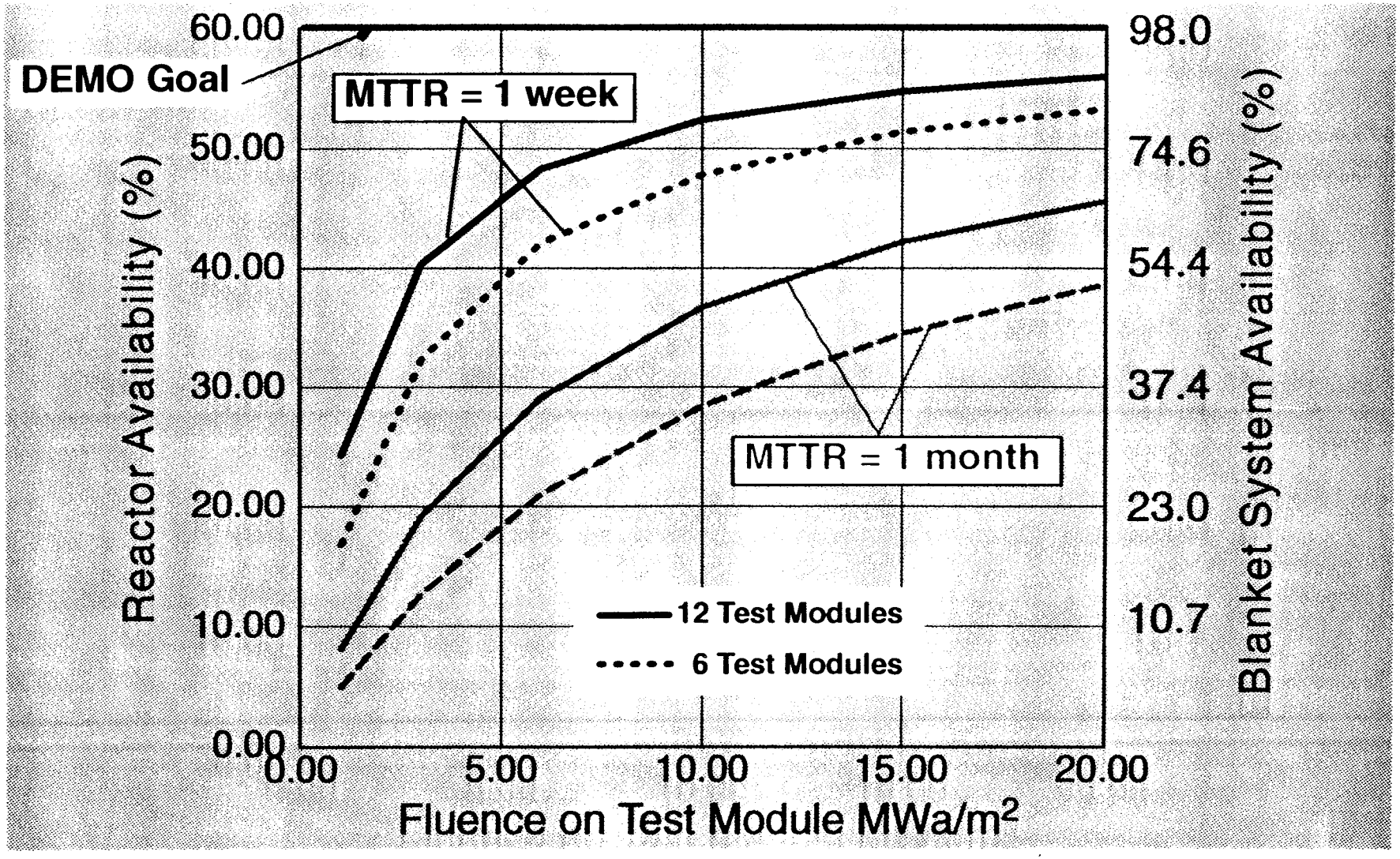
STAGES OF FNT TESTING IN FUSION FACILITIES



- **ENGINEERING DEVELOPMENT & RELIABILITY TESTING IS MOST DEMANDING:**
  - Requires fusion operating environment (n,γ,B,T,V)
  - Requires an aggressive design/test/fix iterative program
  - Requires many test modules and high fluence

ACHIEVABLE DEMO AND BLANKET AVAILABILITIES DEPEND ON:

- TESTING FLUENCE AT THE BLANKET TEST MODULE
- ACHIEVABLE MEAN TIME TO REPLACE (MTTR) FOR BLANKETS



- Required Fluence > 6MW/m^2
- Required MTTR < 1 week

Can ITER Alone Provide Sufficient Data Base for DEMO ?

NO ! Because:

- **Pulsing Characterisitcs Not Suited to FNT Testing**
- **Fluence and Device Availability are Too Low**
- **Not Designed to Provide MTTR Data**
- **Conflict Between Physics Mission and FNT Testing Needs**

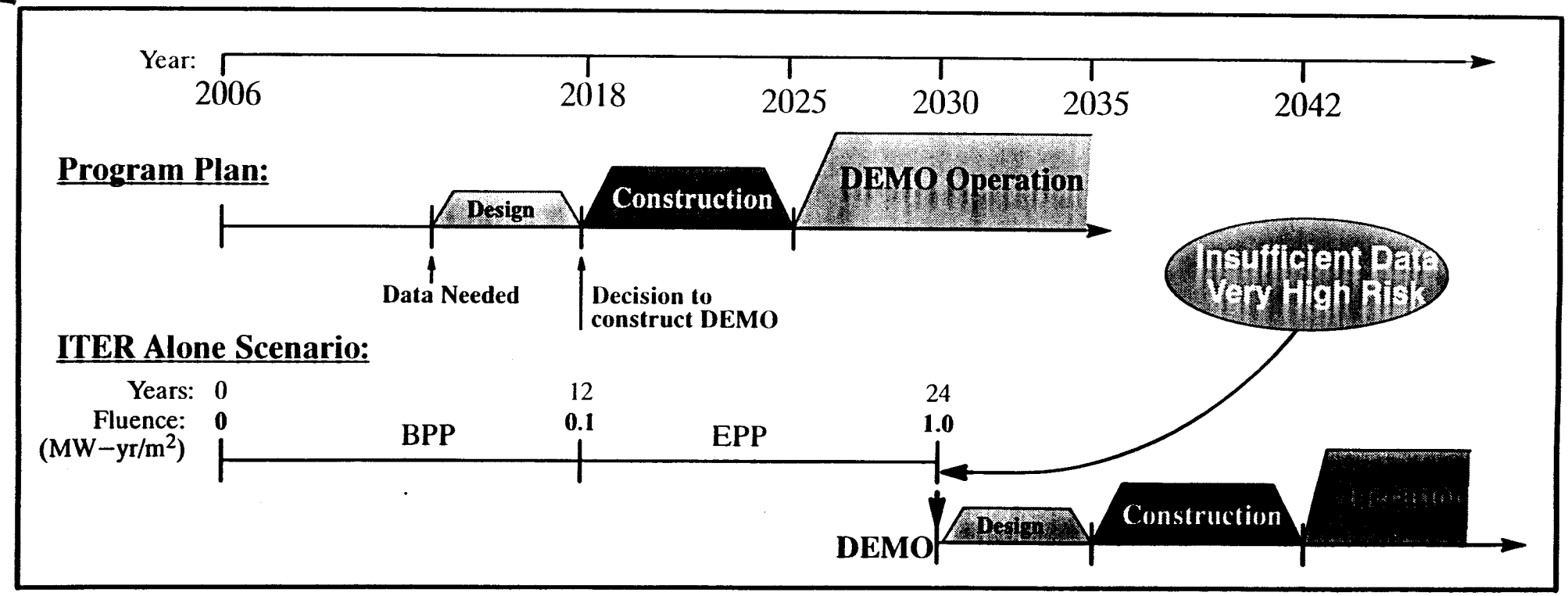


Table 28. Comparison of Physics and Nuclear Technology Requirements for Testing and Impact on Required Tritium Supply

Scenario	Fusion Power	Integrated Burn Time	Tritium Consumption
A. Separate Facility for Plasma Ignition	1500 MW	15 days	3.5 kg
B. Separate Facility for Fusion Nuclear Technology	20 MW	5 years	5.6 kg
Combined * (A + B) in one facility	1500 MW	5 years	420 kg

Physics and FNT requirements are very dissimilar

* Combining large power and high fluence leads to large tritium consumption requirements

Open Issues

* How, Where, and When can we do adequate Nuclear Testing prior to DEMO ?

Needed

1-2 MW/m^2	steady state
6 $MW \cdot y/m^2$	> 10 m^2

Option 1

Change ITER parameters to satisfy nuclear testing requirements

Problem: High Cost
High Risk
Tritium Supply Issue
Breeding Blanket Issue

Option 2

- Let ITER focus on physics, system integration (without blanket), and plasma support technology (Reduced cost and risk to ITER)

- Find lower cost option to do the more risky FNT testing