International Workshop on Ceramic Breeder Blanket Interactions

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- Welcome to UCLA

- Issues Facing Blanket Community

- Specific Issues for Solid Breeder Blanket Community
Issues Facing Blanket Community

1. Resources

- Funding for Blankets remains too small to carry out serious and timely Blanket R&D Program

- Trends of Decline in Blanket Funding is alarming

- To be ready for testing blanket in fusion facilities (ITER and VNS) in the year 2006 requires World Blanket Program~$100M/yr (Now it is only ~ $30M/yr)

2. Near Term R&D Tasks

- Non-Fusion Facilities (existing and new)

- Experiments, Modeling and Analysis
3. Fusion Testing Facilities

Need to ensure that there is a fusion facility adequate for blanket testing by the year 2005

ITER

- Need to improve parameters and design to be more suited for blanket testing (pulsing/steady state, fluence, etc.)

VNS

- VNS is a dedicated facility to test, develop and qualify fusion nuclear components, particularly ITER, for DEMO

- VNS will provide
  - Driver for FNT R&D now
  - Timely Data for lower risk DEMO
Specific Issues for Solid Breeder Blankets

1. Overcome "Unfair and Uninformed" negative perception developed in discussions of ITER Driver Breeding Blanket

2. Continue Improvements in Design
   - Design activity to incorporate new data is needed
   - Need to show attractive design(s)

3. Focus on Selected Blanket Options
   - Select 2 solid breeder materials
   - Select no more than 2 or 3 configurations
   - Coolant? Helium alone? Pressurized Water?
   - Structural material?
4. Near Term R&D Tasks

- Complete Material Property Data Base

- Begin construction and operation of experiments for more integrated tests (interactions among elements)

- Submodule experiments in fission reactors

5. Develop Plan for Construction and Testing of Modules in Fusion Facilities

- Also, ensure that fusion facilities to be operated in the early 2000's are suitable for testing solid breeder blankets
Blanket Options for DEMO

<table>
<thead>
<tr>
<th>Breeder</th>
<th>Coolant</th>
<th>Structural Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Solid Breeders</td>
<td>He or H₂O</td>
<td>FS, V alloy, SiC</td>
</tr>
<tr>
<td>Li₂O, Li₄SiO₄, Li₂ZrO₃, etc.</td>
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<tr>
<td>B. Self Cooled Liquid Metals</td>
<td>Li, LiPb</td>
<td>FS, V alloy with Electric Insulator (SiC with LiPb only)</td>
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<tr>
<td>Li, LiPb</td>
<td>Li, LiPb</td>
<td></td>
</tr>
<tr>
<td>C. Separately Cooled Liquid Metals</td>
<td>Li</td>
<td>FS, V alloy</td>
</tr>
<tr>
<td>Li</td>
<td>He</td>
<td></td>
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</tbody>
</table>

- All options have feasibility and performance issues.
- Resolving many of these issues requires testing of material combinations in subcomponents in the fusion environment (n, γ, B, T, V, etc.).
- R&D needs: basic properties, material interactions, synergistic effects; technology for alloy production, fabrication, etc.
Why Fusion Nuclear Technology is Crucial to Fusion

Blanket/FW

- Many feasibility issues
  [We are not sure there is a blanket that will work.]
- Many of fusion attractiveness issues are blanket issues

Renewable Energy Source

Must demonstrate tritium self sufficiency (blanket issue)

Environment/Safety

- FW/blanket exposed to the most intense 14 MeV neutrons
- High heating rate, high temperature
- High stresses
- Tritium production, transport, permeation, inventory
- Decay heat
- Radioactivity
- Highest failure rates, potential accidents

Developing and demonstrating blanket component that can simultaneously produce tritium, extract high grade heat, without severe accidents and without large radwaste must be a dominant focus of fusion R&D (next to plasma physics)

Reliability/Availability (Practicality of Fusion Systems)

- DEMO availability > 50% requires blanket availability > 95%
  i.e. MTBF > 3 yr
  (Estimate of presently achievable MTBF is hours)

Need engineering component development which will take long time
[estimates from experience in other technologies]

- Testing in non fusion facilities now
- Testing in fusion environment (ITER and VNS)