

- 1) Suggestions for an Integrated Strategy for Fusion Material Systems
- 2) Briefing on ITER Test Program

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Summary notes presented to
Dr. N. Anne Davies
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The current budget realities and current efforts to restructure the national fusion program suggest:

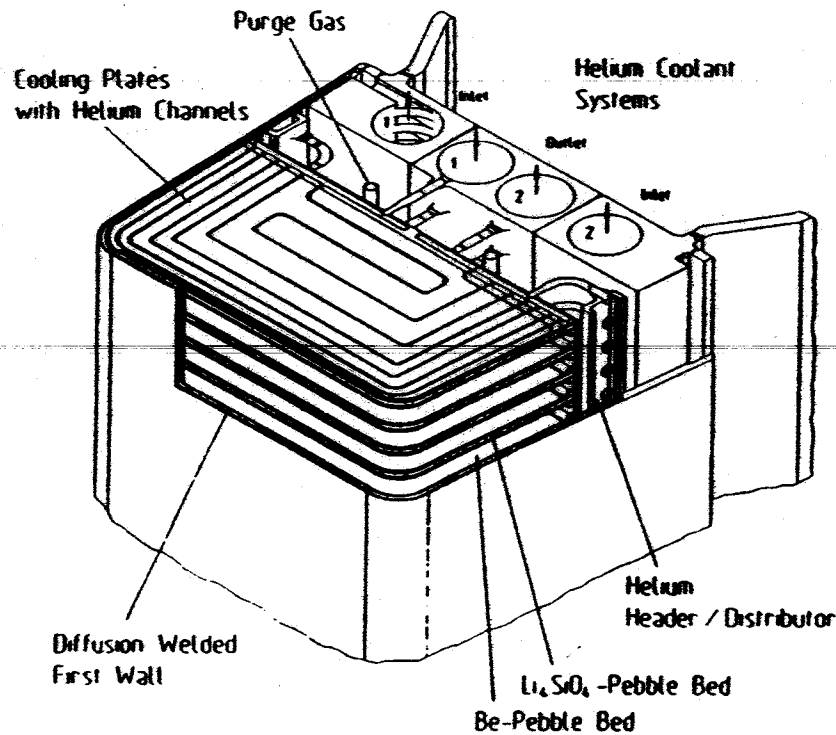
Developing a new
**INTEGRATED Strategy for R&D on
Fusion Material Systems**

- Best use of limited resources
- Enhance the Science Component of R&D
- Achieve Visible Continued Progress over time
- Effective Access to results from International Program

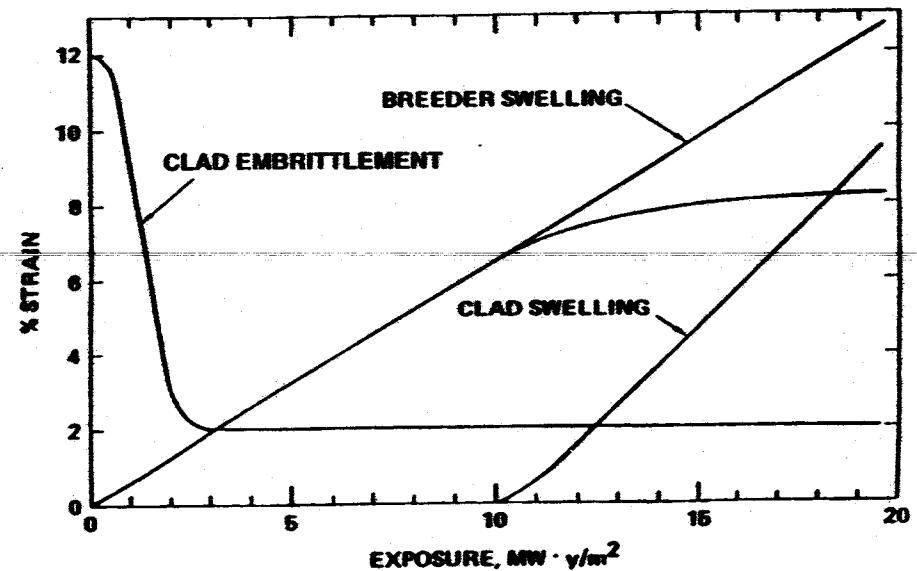
The interactions among materials are very important:

- often the most critical feasibility issues
- often the most interesting scientific issues

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**CLAD/BREEDER MECHANICAL INTERACTION
(ESTIMATES FOR Li₂O/HT-9/He)**



**EXAMPLES OF INTERACTIONS
BETWEEN PHYSICAL REGIONS**

Key Considerations in Evolving the Integrated Strategy

- 1) Our GOAL should be to develop a system of compatible materials (breeder, multiplier, coolant, structure, etc.) that can function together in the in-vessel region under the fusion environment [It is not to develop individual materials]
- 2) We need to maintain **balance** in research
 - A) among the key materials for the selected material system option
 - B) between single and multiple effects research (experiment/modeling)

Why Balance is Needed

- Feasibility issues belong to breeder, coolant, structure, insulator (not solely to one of them)
- Activation of breeder can be as serious as activation of the structure
- The most interesting science and most critical issues are often related to interactions among materials and interactions among environmental effects

Key Considerations in Evolving the Integrated Strategy

(Cont'd)

3) **Emphasize Engineering Sciences Involved in Research on the Fusion Material System**

e.g. Research on Breeding Materials involves challenging problems at the forefront of many engineering sciences

4) **Strengthen and Make Best Use of International Collaboration**

- Maintain a minimum base of skills on different materials and scientific disciplines in order to understand, follow, and interpret research results from other countries
- Focus research on a selected set of issues that are important to the world program to ensure
 - a) US stays an acceptable partner
 - b) that we gain access to results from the international program

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ITER Test Blanket Working Group (TBWG)

US Task Leader: Mohamed Abdou

- TBWG is making Progress in fulfilling its Charter:
 - a) address issues of test program
 - b) promote coordination among the parties' blanket development plans
 - US work on Test Program Definition & Interface was highly praised by the ITER Director and his Deputies.
 - Some uncertainties in the US plan need to be clarified to make further progress
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- TBWG Chairman (Eric Proust) sent a letter to the Four Program Directors advising them of Progress and Requesting Information on:
 - 1) confirmation of main-line concepts selected by each party
 - 2) intention of each party regarding international collaboration (develop a blanket alone or jointly)
 - 3) planned R&D expenditures for each blanket proposed for testing

Recent Development in Europe and Japan:

Europe

- EU has decided on only two blankets for further R&D
 - A) Helium-Cooled Solid Breeder with Ferritic Structure
 - B) Water-Cooled LiPb breeder with Ferritic Structure

EU will eliminate work on other concepts (e.g. self-cooled liquid metal)

- EU has **combined** the materials, safety, tritium processing under one program called the Blanket Program.
 - There will be a management committee for the Blanket Program (including materials) with one leader for the SB blanket, one for the LiPb blanket, and one for materials.
- The blanket budget is expected to go from \$16M/yr now to \$25M/yr by 1998
- EU R&D Program focus is on Test Modules for Testing in ITER

Recent Development in Europe and Japan (Con't)

Japan

- Japan has also selected only two blanket concepts:
 - A) Helium-Cooled Solid Breeder with ferritic structure
 - B) Water-Cooled Solid Breeder with ferritic structure
- Materials will be an integral part of the Blanket Program
- The R&D Program focus is on Test Modules for ITER
- This program will be an official STA/JAERI Project with a budget of \$120M for 10 yr. starting in 1997.

Other Information

The Cost of the R&D required to develop a Blanket Material System up to testing in ITER has been estimated independently by each party: 150 to 300 Million Dollars per Blanket Concept over 15 yr period.

Table 1. Main Line Blanket Concepts Proposed by Various Parties

	EU	Japan	USA
Helium/Solid Breeder/Ferritic Steel	X	X	X
Water/Solid Breeder/Ferritic Steel		X	
Water/Li Pb/Ferritic Steel	X		
Li/Li/Vanadium			X

*RF is not devoting resources to R&D

Current Annual Funding for Materials and Blankets R&D by Party

	Materials* (\$M)	Blanket (\$M)
Europe^a	9	16
Japan^b	2	14
USA	8	1

* What is commonly referred to as Materials is only Structural Materials

a) Material does not include IFMIF
b) 1997

US Participation in the ITER Test Program

- Continued US Participation in the ITER Test Program is now in the best interest of the US Fusion Program
 - 1) To Gain Access to R&D Results from the other parties
 - 2) Provides an Excellent Focusing Function for our Program
 - 3) There is no alternative to testing in the fusion environment
 - 4) The US has always been the strongest advocate for Technology Testing in ITER.
 - 5) Possibly the only way we can show that in 20-yr or so we can resolve some critical feasibility and attractiveness issues (e.g. Show DT cycle is feasible as basis for fusion, understand what is really important for low activation and decay heat)

- US Participation in ITER Test Program is **AFFORDABLE** within the Present Budget (if we follow Integrated Strategy Approach)

Summary

- The US can benefit now from having a new integrated strategy for research on Fusion Material Systems for the in-vessel region (blanket/first wall, divertor)
- Suggested Key Elements of the Strategy
 - 1) Focus on Fusion Systems
 - 2) BALANCE in research
 - structure, breeder, multiplier, coolant, insulator, etc.
 - 3) Nurture the science dealing with interactions among materials and fusion environmental conditions (nuclear heating, tritium, radiation, vacuum, magnetic, etc.)

- Strongly Recommend US Participation in ITER Test Program
 - Offers unique opportunity (might be the only opportunity)
 - a) to gain access to international program
 - b) to do true fusion science and address feasibility and attractiveness issues
 - Affordable within the current budget