Summary Remarks and Main Action Items in Response to the First APEX Project Meeting

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Friday, October 17, 1997

Agenda for Friday Morning
APEX Study Meeting
UCLA, Engineering IV, Room 37-124
October 17, 1997

8:30 a.m.
- Date, location for next meeting
- Matrix Groups/Tasks
- Response to Questions Raised

9:00 a.m. Group/Design Conceptualization & Analysis
- What is needed by next meeting
- Concepts to be pursued
  - Lead Organization/individuals
  - Supporting Organizations/individuals
- Interests of (and role of) organizations and individuals

10:00 a.m. Coffee Break

10:15 a.m.
Group 2: Mechanical design and availability
(Group 3: Materials already covered Thursday)
Group 4: Power conversion system
Group 5: Physics Interface
Group 6: Safety & Environment
Group 7: Alternate Confinement Concepts
Group 8: Judgement & Selection (only ideas for now)

11:30 a.m. Other issues/business

Date for Next Meeting

Suggested January 12 - 14

From 1:00 p.m. Monday, January 12

To Wednesday Noon, January 14

Location: UCLA

Actions Items related to summary of this meeting

1) The minutes will be delayed by about two weeks (special case this time; APEX secretary will be hospitalized for at least one week)

2) Session Chairs, Please send a summary (to M. Abdou with cc to APEX Team) by October 24.

   Summary should have:
   1. key points presented
   2. key questions raised and responses
   3. any additional comments by the session chair (clearly indicated as such)

APEX: Relationships between Tasks and Groups

	Task 1 Functional Requirements, Scientific feasibility, Evaluation Approach	Task 2 Key Limiting Factors in current concepts	Task 3 EXPLORE concepts with High Power Density Capabilities	Task 4 Preliminary Conceptual Designs for new concepts	Task 5 Comparative Evaluation and Selection of most promising concepts	Task 6 Detailed Analysis & Evaluation of most promising concepts
Group 1: Design Conceptualization & Analysis		(essentially complete, no further work required)	***	***	X X	X X X
Group 2: Mechanical Design and Availability	X		X X X	X X X	X X	X X
Group 3: Materials	X		Material properties and limits	Material properties and limits	X X	X X
Group 4: Power Conversion System			provide outlet coolant temp. requirements and $\eta(T_{in},T_{out})$ →	→	→	→
Group 5: Physics Interface	X		Physics boundary conditions →	→	→	→
Group 6: Safety Environment	X X					
Group 7: Alternate Confinement Concepts	X		Requirements for alternate concepts →	→	→	→
Group 8: Judgement and Selection Panel	***					

Response to Special Questions Raised

A. *Failure modes/rates and maintainability considerations should be incorporated early*

Response

1) Add availability (reliability and maintainability) as an additional important role for the mechanical design group
   - come up with general guidelines/suggestions to designers to reduce failure rates and to enhance maintainability (and fault-tolerant designs).
   - re-think the mechanical configuration from the edge of the plasma to the interior of the magnet (including vacuum boundary). "Invent" new configuration(s) for enhancing maintainability.

2) Encourage designers to account for failure rate & maintainability (but they must satisfy high power density requirements). Interact and listen to mechanical design/availability group.

Response to Special Questions Raised (cont'd)

B. *Stronger coupling with Physicists and Greater Accounting for plasma interface*

Response

1) Strengthen Group 5 Physics Interface
   - Invite PPPL and key individuals (e.g. Dale Meade) to take the lead
   - design concepts that are more tolerant of a wider range of plasma operating conditions (e.g. accommodating a number of disruptions) should get credit in evaluation

2) Utilize the ALPS physics boundary conditions. (Rich Mattas will ensure data base from ALPS is accessible to APEX).

3) Remember: It is still very useful to find out what the technology limits are. These provide boundary conditions for physics research (It is a two-way street)

Response to Special Questions Raised (cont'd)

C. *Alternate confinement concepts may have different requirements on FPT concept*

Response

1) Form a new group (Group 7: Alternate confinement concepts) to summarize the main configuration features and general range of parameters (wall load, surface heat flux, etc.) for alternate confinement concepts and to contrast them to tokamaks
   - Chair: Ralph Moir
   - Invite Dale Meade (PPPL) to co-chair/help/advise

2) Plan a workshop concerning alternate confinement concepts to promote understanding of the their main features and agree on general requirements for FPT designs (Group 7 will have the responsibility for organizing the workshop) Time Frame: about late February 1998

Response to Special Questions Raised (cont'd)

D. *Thickness of first wall: people have different viewpoints regarding minimum thickness*

Comment

Avoid the temptation to solve the problem by simply hypothesizing a very thin wall. This is not consistent with the APEX spirit of providing large design margin. If the feasibility of a concept depends on whether the thickness is 2mm instead of 3mm, this concept has to be questioned.

Response

1) The Mechanical Design/Availability Group is requested to examine the issue of minimum thickness consideration. Report findings ASAP and prevent them during the next meeting.

2) Designers (concepts advocates) have the burden of making and reporting sufficiently detailed analysis to justify their choice of first wall thickness
   - concepts that use thinner walls, and where feasibility is crucially dependent on the thinness of the first wall, are required to have more detailed stress, failure rate, etc. analysis.

Design Concepts

- Which concepts are to be pursued?
- Which organization/individual want to take the lead?
- Other organizations/individuals who want to support the concept

Group 1

Design Conceptualization
This is the Core effort of APEX

What is needed by next meeting (January 12)

1. For concepts proposed in the kick-off meeting that organizations/individuals will pursue:
    a) description of the basic features of the concepts (materials, novel features)
    b) basic layout/configuration of the concept
    c) self-consistent performance parameters based on Actual ANALYSIS (not all guesses)
        - neutronics (simple 1-D ok)
        - thermal-hydraulics analysis (temperature distribution)
        - fluid mechanics analysis
        - electromagnetic analysis where essential
        - other key parameters
    d) A set of issues related to difficulties in modeling, unknown phenomena, lack of database
    Note: Design Groups can call on Mechanical Design Group for support

2. We still encourage exploring new concepts
    - concepts that are truly new do not have to present items required in 1

UCLA
(Technical Coordinator: Alice Ying)

- support Materials Groups: Ghoniem, El-Azab, ZiLu
- support Mechanical Design Group: Mo Dagher
- support Safety Group: M. Youssef

Concepts to be pursued (UCLA Lead Role)

1) Thin Film internally driven (through porous wall)
   Leader: Neil Morley
   Others: A. Ying, A. Gaizer, M. Youssef, A. El-Azab, Zi Lu
   Metallic Foam: Nasr Ghoniem
   Interest of Other Organizations? Steve Zinkle

2) Thin Film with Externally-Driven Fluid Flow
   Leader: Neil Morley
   Others: A. Ying, A. Gaizer, Ghoniem's group, El-Azab, Askar K.,
   Interest of other organizations? ANL/ALPS/Mattas

UCLA (cont'd)

Concepts to be pursued depending on support from other organizations

3) Heat Pipe, Possible UCLA/Sandia Partnership?
   Leader: Alice Ying for UCLA
   Others: R. Nygren for Sandia
   Other Organizations? Invite Mike Hoffmann

Concepts to be deferred

4) Heat Mist Flow
   We will consider if Japanese team can support our effort

   Any other organization interested?

GA

He / V / Liquid Metal

Clement Wong will lead

Others? ANL (Sze)

ANL

* Interface with ALPS: Rich Mattas
* Support Material Group: Rich Mattas, Mike Billone, Saurin Majumdar
* Lead Power Conversion Group: D. Sze
* Tritium Issue of Liquid Breeder: D. Sze

Concepts

1) LiO_2 Particulate Flow
   Leader: Dai-kai Sze
   Others from ANL?
   Other organizations/individuals: ?

2) Support Neil with LM wall

ORNL

* Lead Mechanical Design Group
  Leader: Brad Nelson
  Others from ORNL: ?
  Others: ?

* Lead Material Group
  Leader: Steve Zinkle
  Others from ORNL
  Others: R. Mattas, M. Billone, S. Majumdar, N. Ghoniem, A. El-Azab, Zi Lu, R. Johnson (GA)

* Support Planning & Evaluation
  John Haines, Lee Berry

* Support Physics Interface, Alternate Concepts
  Lee Berry

PPPL

* Lead Physics Interface?
* Co-lead Alternate Confinement Group?
* Power conversion

Concepts

1) Thick Lithium Wall/Blanket

Leader: Robert Woolley

Others from PPPL: ?

Other organizations/individuals:

Ralph Moir

UCLA (Neil Morley)

Sandia (Thermal Hydraulics - R. Nygren)

2) LM MHD Power conversion in the blanket

Leader: R. Woolley

Support: D. Sze

Sandia

* Support Materials Group
  Ulrickson / Nygren

* Support Plasma Interface Group
  Ulrickson

* Support Mechanical Design/Availability Group on Fabrication

* Other Roles
  thermal analysis?

Concepts

1) Heat Pipe? (joint effort with UCLA?)

2) ??

LLNL

* Lead Alternate Confinement (DT Magnetic) Concept Group
  Leader: Ralph Moir

* Other roles: ?

FPT Design Concepts (for First Wall/Blanket)

1) Massively Wet Wall (Flibe)
   Leader: Ralph Moir
   Others from LLNL: ?
   Other organizations/individuals: ?

Rocketdyne

* Support mechanical design group? Yes
* Experience from rocket engine
* Experience on liquid metal

Concepts

1) New concepts based on experience from rocket engine design

Leader: Don Clemens
Support: UCLA

INEL

* Lead Safety Group (substantial effort)

* Support concept evaluation and selection
  Leader: Kathy McCarthy
  Others from INEL: ?
  Others: M. Youssef (UCLA)

UCSD

* Support Power Conversion
  Mark Tillack

* Support "reference tokamak parameters"

* Other areas?

* Link with PISCES Group
  ?? (Stan ?)