

APEX
Meeting Objective, Study Issues and
FY 2000 Plans

Mohamed Abdou

APEX Meeting, November 8-11, 1999
At the Doubletree Hotel, Westwood

Outline

- Meeting Objectives
- Status
- Highlights of Proposed Plan for FY 2000
 - Logic and Goals
 - Tasks
 - Task Leaders
- Steering Committee and Advisory Committee
- Future Meetings and Conference Calls
- Comments and Agenda

Introductory Remarks and Meeting Objectives

- This meeting is a particularly important point for APEX

It marks the “Transition” from one phase to the next

- During the past two years (Phase 1):

The APEX team explored a broad range of innovative ideas for the Chamber Technology

- During the next phase, starting with this meeting:

The APEX team will focus on a more serious exploration of two innovative ideas:

- Liquid Walls (with its many variations)
- High-Temperature Refractory Solid Walls with 2-phase lithium flow

Introductory Remarks (cont'd)

- Therefore, the Objectives of this Meeting are:
 - 1) Summarize the STATUS
 - Understand where we are
 - 2) Discuss and Understand PRIORITY TECHNICAL ISSUES
 - 3) Discuss and Finalize Study Plan for FY2000:
 - Study Approach
 - Technical Tasks
 - Task and Group Leaders and Performers

- Please note that there have been intensive discussions among the team members, particularly the group leaders prior to this meeting (via email, conference calls, individual calls).

Introductory Remarks (cont'd)

- A proposed FY 2000 plan with goals, tasks, subtasks, task leaders, and budget allocation was e-mailed to Group Leaders and Institutional Representatives last week.
 - This proposed plan was the result of the hard work of many people
 - It provides an excellent starting point for this meeting

Suggestion (A Wish)

Because meeting time is limited, I suggest that we ensure adequate discussion on the priority technical issues and technical approach. Lower priority or narrow specific issues that can be discussed more effectively by small group of people should be referred to that group.

APEX Status (11/8/99)

- An Interim Report documenting most of the last 2 year efforts is almost complete.
 - It is an extensive document (~ 500 pages) with important technical details
 - It was posted on the web about 3 months ago
 - A Review Panel (Youssef, Sawan, Wong) provided comments to lead authors. Revisions were made.
 - We plan to issue a hard copy for distribution in 3 weeks
 - Youssef will summarize precise status later this morning
- We made a lot of technical progress over the past two years.
 - A broad range of concepts were explored
 - New phenomena were identified
 - Better understanding of the underlying engineering sciences

APEX Status (cont'd)

- We began the challenging job of quantitative characterization of phenomena through serious modelling and simulation, e.g. for free surface liquid flow and hydrodynamics, plasma-edge modelling, etc.
- For APEX to succeed, some scientists must do the hard work of writing equations, performing complex 3-D modelling and computer simulations, doing experiments, etc.

APEX is fortunate to have some scientists who are doing this challenging research.

APEX Status (cont'd)

- There is a lot of new information, serious analysis, and important conclusions in the Interim Report, particularly for relatively new areas of research such as liquid walls
 - Understanding what was done is a prerequisite to defining an effective direction for future work
 - This is why we asked the Group Leaders to summarize key technical areas and conclusions during this meeting.
- There are also some important new results obtained the past 2 months that were not included in the Interim Reports. Summaries of the new results will be given by individual researchers.

APEX Status (cont'd)

- Understanding the Summary Presentations and Discussions Monday and Tuesday (and the first two hours on Wednesday) is **CRITICAL** to having informed and effective discussions on FY 2000 plans on Wednesday.
- Specific Notes on Liquid Walls:
 - Liquid Walls have many challenging scientific issues that we do not fully understand yet. It is premature to embark on serious engineering designs. We must first do the research to understand the underlying science.
 - Only CLIFF-Flibe (2-cm flibe) is understood well enough to begin addressing practical engineering issues (nozzles, exhaust, penetrations,etc.)
 - The potential improvements in physics performance with flowing LM discussed at Snowmass are very important to address. We need to:

APEX Status (cont'd)

- a) do plasma physics modelling and computations to understand the conditions under which such benefits may be realized
 - b) defined requirements on the design
 - c) investigate whether we can meet these design requirements
-
- We are fortunate that Mike Kotschenreuther (Univ. of Texas) and Bob Kaita (PPPL) will join the APEX team and address the physics issues (Kaita will also be the institutional representative for PPPL).

Highlights of Proposed FY 2000 Plan

- The proposed plan was generated based on input from Sam Berk, Advice from Charles Baker, and deliberations via email and conference calls among task leaders and institutional representatives.
 - It was emailed to the 17 task leaders and institutional representatives plus Berk and Baker on 11/4
 - Handouts are available
- Top-Level Logic of the Plan
 1. Define 5-year goals that are in harmony with the essence of Snowmass and FESAC recommendations
 2. Based on our current understanding of APEX technical results, identify major priority tasks for FY 2000 that are most important to achieving the 5 year goals
 3. Define a technical approach and subtasks for each major task. Focus on critical areas. Can not address everything this year (resources are limited).
 4. Estimate a reasonable level of effort for each subtask consistent with the total funding provided by DOE.
 5. Match skills with subtasks to identify performers and attempt to come as close as possible to DOE guidelines of budget distribution to institutions.

5-Year Goals

Liquid Walls

1. Fundamental understanding of free surface fluid flow phenomena and plasma-liquid interactions verified by theory and experiments.
2. Operate flowing liquid walls in a major experimental physics device (e.g. NSTX).
3. Begin construction of an integrated Thermofluid Research Facility to simulate flowing liquid walls for both IFE and MFE.
4. Understand and document advantages and implications of using liquid walls in fusion energy systems.

Solid Walls

Understanding of novel concepts that can extend the capabilities and attractiveness of solid walls.

Comments on the 5-Year Goals

The 5-yr goals emphasize emerging themes in the fusion community as articulated by Snowmass, FESAC, and other community forums:

- Emphasis on Partnership between Plasma Physics and Technology
- Emphasis on Partnership between IFE and MFE
- Emphasis on Science and understanding
- Emphasis on innovative ideas that can potentially enhance the attractiveness of fusion and lower the cost and time of R&D

APEX: FY 2000 Tasks

Task I: Explore options and issues for implementing a flowing liquid wall in NSTX. Characterize the technical issues and develop an R&D plan.

Task II: Explore high pay-off liquid wall options. Include: a) tokamaks and other confinement schemes, b) flibe and liquid metals (Li and Sn Li), c) concepts with physics advantages, and d) concepts with engineering advantages.

Task III: Investigate practical engineering issues associated with the design of a liquid wall in a high-power density fusion energy system (start with CLIFF-flibe because it is better understood and has more data available).

Task IV: Investigate key issues and develop a practical design for high-temperature refractory solid wall with primary focus on EVOLVE.

Cross-Cutting Tasks

Task A: Plasma-Liquid Surface Interactions
and Plasma Edge Modelling

Task B: Liquid Wall-Bulk Plasma
Interactions

Task C: Materials

Task D: Safety and Environment

Task Leaders and Budget Distribution

Task I: Liquid Walls in NSTX

Leader: Alice Ying

Effort: \$450K

Task II: Exploration of Liquid Walls (including plasma-liquid interactions)

Leader: Neil Morley

Effort: \$772K

Task III: Engineering Issues for Liquid Walls

Leader: Sze & Nelson

Effort: \$585K

Task IV: High-Temperature Refractory Solid Wall (focus on EVOLVE)

Leader: Clement Wong

Effort: \$470K

C.C. Task A: Plasma-Liquid Surface Interactions

Leader: Tom Rognlien

Effort: (\$100K from ALPS)

C.C. Task B: Liquid Wall-Bulk Plasma Interactions

Leader: Robert Kaita

Effort: (\$272K in Tasks I-IV)

C.C. Task C: Materials

Leader Steve Zinkle

Effort: (\$130K in Tasks I-IV)

C.C. Task D: Safety and Environmental Analysis

Leader: Kathy McCarthy

Effort: (\$100K in Tasks I-IV)

APEX Steering Committee Proposal

- Functions:
 - Responsible for efficient and effective execution of technical tasks
 - Coordination among tasks, performers and institutions
 - Monitoring and evaluating progress and actions to resolve problem areas

- Membership:
 - ◆ Leaders of Tasks I-IV
 - ◆ Leaders of C.C. Tasks A-D
 - ◆ A representative from any of the three institutions with the largest APEX funding if no one from that institution is a task leader

- S.C. Chair: Study Leader

- Communication:
 - Email
 - Conference call: once a month or more often as needed

Proposed Steering Committee Members (Based on Task Assignments)

1. Alice Ying (Task I)
2. Neil Morley (Task II)
3. Dai-Kai Sze (Task III)
4. Brad Nelson (Task III)
5. Clement Wong (Task IV)
6. Tom Rognlien (Task A)
7. Robert Kaita (Task B)
8. Steve Zinkle (Task C)
9. Kathy McCarthy (Task D)
10. Richard Nygren (SNL, Div. Integ.)

Chair: Mohamed Abdou

Advisory Committee (AC)

- Senior Community Leaders from outside APEX to advise the APEX team on broad technical and programmatic issues
- We have been attempting to form the AC for sometimes now. It is not complete yet.
- Status:
 - 1) Chair: Rob Goldston
Final acceptance is conditioned on time schedule (one meeting a year)
 - 2) Grant Logan: Yes (attending)
 - 3) Farrokh Najmabadi: Yes (attending)
 - 4) Don Steiner: Yes, but could not come to this meeting
 - 5) Stan Milora: Yes, but could not come to this meeting.
- We will finalize AC formation soon.
We will agree on one-day AC meeting. Briefings will be given by 3 or 4 APEX people.
- During this meeting: The AC members in attendance will give us their advice and recommendations.

Future Meetings and Conference Calls

- Travel Restrictions in effect for FY 2000
- Solution:
 - Reduce number of study-wide meetings
 - Encourage smaller group meetings
 - Enhance utilization of electronic meetings
 - Increase conference calls

Proposed Meetings for FY 2000

- The meeting in Japan (for APEX/HPD) scheduled for February 21, 2000 will be limited to 5 or 6 people from APEX who will make summary technical presentations.
- Only two “physical” APEX-wide meetings

First Meeting

- Date: Late March?
- Location: ?

Second Meeting

- Date: Late July?

- Three “Electronic” APEX-wide meetings
 - Each meeting is about three hours
 - Use Showstation/Internet
 - Send Vugraphs one week ahead of the meeting
 - Limit to highlights and important new findings

First Meeting: Mid February?

Second Meeting: Late May?

Third Meeting: Mid September?

- Steering Committee should discuss and decide on schedule

Conference Calls

- Recommend that each week be a 2-hr conference call on one of the Tasks (I – IV).
 - So, each task will have a conference call once a month
 - Set fixed time and day for the call (e.g. each Tuesday at noon Pacific Time).

Example

Task I: Tuesday, November 23 (noon PST)

Task II: Tuesday, November 30

Task III: Tuesday, December 7

Task IV: Tuesday, December 14

Task V: Tuesday, December 21

Task I: Tuesday, January 5

Task II: Tuesday, January 12

Task III: Tuesday, January 19

Task IV: Tuesday, January 26

Etc.

- Steering Committee should discuss and decide

