Summary of FIRE Physics and FIRE Physics Design Report

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FIRE Engineering Meeting

May 31 - June 1, 2000

Princeton Plasma Physics Laboratory

FIRE Physics Workshop Highlights

- Confinement

  - broad range of projections ranging from Q ~ 3 to ignited for the baseline

  - baseline projects to Q ≈ 10 with physics (HH and β_N) that projects to Q≈1 in JT-60 SC and JET Upgrade

  - strong interest in 12 T / 7.7 MA capability as an upgrade.

  - recent H-mode power threshold experiments may allow lower fusion power.

  - the PAC will make recommendations on the FIRE Mission, esp., positioning FIRE to address burning plasma and advanced tokamak issues while maintaining low cost.

FIRE Physics Workshop Highlights (2)

- Stability

    - concerns about m = 1 (sawteeth, neoclassical tearing modes)

    - self consistent advanced modes needed, wall stabilization requirements

Power Handling and Disruptions

- issues are understood, Ulrickson and Wesley efforts making good progress
- disruption simulations and double null disruption data needed

Plasma Control, Diagnostics and Operations

- will need more emphasis in the future

Plans for Follow Up to FIRE Physics Workshop

1. Complete Record of meeting - all talks on web, respond and follow up on chits.

2. Develop a Physics R&D Plan for FIRE

   pull together items identified in this workshop, circulate and iterate with workshop participants

   draft for FIRE PAC meeting in mid July

3. Form Tokamak Physics Working Groups

   to help resolve issues identified above

4. Draft FIRE Physics Report by ~ mid June

   iterate with PAC, community

   followup meeting in the fall - APS??

5. FIRE papers at EPS, SOFT, ANS, IAEA, APS

6. Prepare plan for FY 2001

NSO/FIRE Program Advisory Committee

- PAC Charter established. Tony Taylor will be chair with Jerry Navratil as Vice Chair. Twelve members are being notified. There will be European and Japanese members.
- First meeting July 20 - 21 at GA right after FESAC meeting.
- Charge and agenda for the first meeting are being developed.

FESAC NSO/FIRE Review

- will be later this summer, responsibility of “new” FESAC

News on International Multi-Machine Strategy

- JT-60 SC proposal is being discussed in Japan as a replacement for JT-60U.

  - $R = 2.8$ m, $\kappa = 1.7$, $A = 3.3$, $B = 3.8$ T, $I_p = 4$ MA (equiv $Q_{DT} \approx 2$)

  - JT-60 U would stop in 2001, JT-60 SC would start in 2004, cost ~$400M

  - needed to support ITER-FEAT (Japan Atomic Industrial Forum Newsletter)

- JET Upgrade reviewed by Weynant's Committee

  - first stage increasing auxiliary heating power to ~ 40 MW is recommended.

  - second stage increasing current to 6 MA ($Q_{DT} \approx 2$) is deferred pending ITER

- Other studies being carried out in Europe include burning plasma tokamaks with

  $R \approx 5$m, 5.3T, 9.4 MA, 500 s pulse length, $Q_{DT} \geq 5$ and 210 MW fusion power.

Note: compare performance projections with FIRE.

Upcoming Technical Meetings

European Physical Society Conference on Controlled Fusion and Plasma Physics (June 12 - 16, Budapest, Hungary)

Physics Basis for the Fusion Ignition Research Experiment (FIRE) - paper/poster
visits and talks at IPP Garching, Tore Supra Cadarache, and JET-EFDA

Fusion Power Associates Annual Meeting Science and Technology for Fusion Power (July 17, UCSD)

SOFT (September 11 - 15, Madrid, Spain)

Physics Basis for the Fusion Ignition Research Experiment (FIRE) Plasma Facing Components - Ulrickson et al

Engineering Features of the Fusion Ignition Research Experiment (Fire) Thome et al

IAEA (October 4 - 10, Sorrento, Italy)

Mission and Design of the Fusion Ignition Research Experiment (FIRE) - paper/poster

ANS (October 15 - 19, Park City, Utah) - abstracts due June 1

APS-DPP (October 23 - 27, Quebec City, Canada) - abstracts due July 12

NSO FIRE Physics Design Report
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Section	Guidance Based ITER Outline Report	Section Organizer
1.0 Background & Introduction	2 pages total	Meade
1.1 Plasma Performance Objectives	0.4 p	
1.2 Engineering Performance & Testing Objectives	0.4	
1.3 Design Requirements	0.6 p	
1.4 Operational Requirements	0.6 p	
2.0 Approach to an Outline Design	1 p total	Meade
2.1 System Studies	0.5 p	
2.2 Study of Representative Options	0.5 p	
3.0 FIRE Parameters & Design Overview	1 p + 3 figs	Meade
4.0 Physics Basis & Plasma Performance Projections	14 p total	Meade
4.1 Overview	1.5 p	
4.2 Physics Basis & Selection of Plasma Parameters	4 p with 1 fig	
4.3 Domains of Inductive Operation	2.5 p with 1 table + 1 fig	
4.4 Operating Flexibility	0.3 p	
4.5 Steady State & Hybrid Operation	1.5 p with 1 fig	
4.6 Probabilistic Performance Analysis	2 p with 1 fig	
4.7 Deterministic Assessment of Performance	1.8 p with 1 fig	
5.0 Engineering Design Features	12 p total	Thome & Heitzenroeder
6.0 Evaluation of the Design		