Outline Prospectus and Reading List for Subgroup B, Fusion Development Path

Below we give Web Links for Documents that would be useful preparatory reading for participants in the Energy Subgroup B discussions.

	Tuesday July 13	Wednesday July 14	Thursday July 15	Friday July 16
First Half Session (starts1:30 PM)	Plenary Roadmaps, Generic Development Issues Framed 90 attendees expected	Breakouts Discuss generic development issues 4 rooms, 25 attendees per room.	Plenary Specific Device Presentations 6 presentations 90 attendees	Plenary Specific Device Presentations 5 presentations 90 attendees
Break	3:20 – 3:35 PM	3:20 – 3:35	3:20 – 3:35	3:20 – 3:35
Second Half Session (ends 5:30 PM)	Breakouts Discuss generic development issues 4 rooms, 25 attendees per room	Plenary Discuss generic devopment path issues and roadmaps 90 attendees	Breakouts Discuss above presentations 4 rooms, 25 attendees per room	Breakouts Discuss above presentations 4 rooms, 25 attendees per room

Tuesday Early Session (Half Session 1, Plenary)

Roadmaps and Plans (60 minutes)
Three distinct roadmaps will be presented in three talks without questions to set some 20 year framework for the week's discussions. Those roadmaps and presentations are:

IFE roadmap by J. Lindl
See the recent FESAC Opportunities Document for good statement of the IFE roadmap.
http://wwwofe.er.doe.gov/more_html/FESAC/FES_all.pdf
http://wwwofe.er.doe.gov/More_HTML/FESAC_Charges_Reports.html.
Another source of recent IFE material is the recent SEAB presentations.
http://lasers.llnl.gov/lasers/SEAB/
http://lasers.llnl.gov/lasers/SEAB/Campbell.pdf

Tokamak based MFE roadmap by J. Navratil
See the recent FESAC Opportunities Document for good statement of the MFE roadmap.
http://wwwofe.er.doe.gov/more_html/FESAC/FES_all.pdf
http://wwwofe.er.doe.gov/More_HTML/FESAC_Charges_Reports.html.
Another source of recent MFE material from SEAB presentations can be found at
http://www.fusionscience.org/

Spherical Torus based roadmap by R. Stambaugh
For these positions, see especially the first three papers in http://fusion.gat.com/st-fdf/

and the ST White Paper at http://nstx.pppl.gov/nstx/Research_Program/ST_WhitePaper/

Issues of Fusion Development (40 minutes)
The session convenors will present an introduction to the main issues of fusion development which are to be discussed in the subsequent breakout sessions. Those issues are framed below. We are asking attendees who come to these sessions to come prepared to discuss these issues and to educate your colleaques. Cross-cutting education can be one of our most important outcomes.

Q1) Burning Plasmas: Ignition and/or High Gain.
What is the importance of ignition/burn/high gain scientifically? What do we need to learn from a burning plasma experiment? What is the importance of achieving ignition or burn in a larger sense? Must we demonstrate ignition to move fusion forward or should be look further ahead to the challenges of high time averaged power and neutron fluence? Participants in this discussion should be prepared to address these questions and to help hone the issue list below so we can well articulate the "yearn to burn." MFE and IFE colleaques should be prepared to educate each other on the somewhat different burning plasma issues and objectives of their approaches.

MFE Burning Plasma Issues and Questions
To what extent must the issues below be answered in each separate kind of magnetic confinement device? How generic would results from a tokamak be?
Properties of DT plasmas (confinement, stability, n_e limits, L-H thresholds, etc.)
Confinement of alphas
Alpha heating
Alpha driven instabilities
Profile control in alpha heating dominated plasmas
Alpha heating effects on self-driven currents
Particle and power exhaust in alpha dominated plasmas (esp. He exhaust)
High gain burn control
http://fusion.gat.com/snowmass/BurningPlasma/'BP'_Phys_Issues_Perf_PHR_J.pdf
http://fusion.gat.com/snowmass/BurningPlasma/Perf_Measures_Applied.pdf
http://fusion.gat.com/snowmass/BurningPlasma/IPB_Chap_1.pdf
http://fusion.gat.com/snowmass/BurningPlasma/IPB_Chap_9.pdf

IFE Burning Plasma Issues and Questions
To what extent must the issues below be answered for each different driver and target type in IFE? How generic are the results from NIF?
Drive requirements (energy, pulse shape, uniformity)
Central ignition
Propagating burn
Fractional burnup
Gain, and its relation to driver efficiency and type
http://lasers.llnl.gov/lasers/SEAB/
http://lasers.llnl.gov/lasers/nif.html

Q2) The Challenge of Steady-state and High Time Average Power.
What are the non-nuclear issues connected with steady-state and high time average power? How are we going to approach them and when? Are these issues more important than burning plasma issues?

The Technology Group Website has useful material on many of these topics.
http://www.fusion.ucla.edu/snowmass/

MFE High Time Average Power Issues
Non-inductive current drive and profile control in devices with current
http://www.fusion.ucla.edu/snowmass/questions/pq1/opinionpaper.pdf
Is a pulsed magnetic system acceptable?
Stellarators
The problems of fluence, erosion and codeposition
Problems of heat exhaust (both MFE and IFE)
http://www.fusion.ucla.edu/snowmass/questions/cq1/opinionpaper.pdf
http://www.fusion.ucla.edu/snowmass/questions/cq2/opinionpaper.html
Problems of operational boundaries (e.g. disruptions)
http://fusion.gat.com/presentations/disruptions.html

IFE High Time Average Power Issues
First wall and optics protection
Chamber clearing between shots
High rep-rate drivers (KrF, DPSSL, HIB)
Low cost target production and high rep-rate target insertion
http://www.fusion.ucla.edu/snowmass/questions/prospectusPQ3.html
Problems of heat removal
http://www.fusion.ucla.edu/snowmass/questions/cq1/opinionpaper.pdf
http://www.fusion.ucla.edu/snowmass/questions/cq2/opinionpaper.html

Q3) Nuclear Technology Development

These questions are largely common to MFE and IFE and can be profitably discussed together.

The Technology Group Website has useful material on many of these topics.
http://www.fusion.ucla.edu/snowmass/

What is our plan to develop blanket technology?

What are the limits on MW/m^2 of neutrons or heat at the first wall? What underlies those limits? What do such limits imply about the minimum size (or maximum power density) of fusion systems?
http://www.fusion.ucla.edu/snowmass/questions/cq1/opinionpaper.pdf

How are we going to survive neutron damage? We will endeavor to have experts at the meeting inform us as to the reasons why typical fusion systems project the need to change the blanket components every two-four years.

Do we need both a point neutron source and a volume neutron source? Should we plan to learn by doing, e.g build and deploy blankets on a suitable source?
http://www.fusion.ucla.edu/snowmass/questions/cq4/opinionpaper.html

How important are low activation materials and how are we going to introduce them? What are the viewpoints in MFE and IFE?
http://www.fusion.ucla.edu/snowmass/questions/cq5/opinionpaper.doc

What do the MFE and IFE roadmaps envision for Tritium usage in the various stages of development? When must fusion energy make the transition from external Tritium supply to self-sufficiency?
http://www.fusion.ucla.edu/snowmass/questions/cq6/opinionpaper.html

How are we going to get an overall system TBR>1. What are the Tritium inventory centers in MFE and IFE systems? What research can we do to address the challenges?
http://www.fusion.ucla.edu/snowmass/questions/cq6/opinionpaper.html

In view of the above costly aspects of the DT fuel cycle, should we skip DT and aim for advanced fuel systems? What are the prospects for MFE and IFE?
http://aries.ucsd.edu/snowmass/SG-A/Alt._Fuels_2-pager.4-26.html

Tuesday Later Session and Wednesday Early Session (Half days 2 and 3)
Breakout discussions on the issues of fusion development.

Wednesday Later Session (Half Day 4, Plenary)

Plenary discussion period on the issues of fusion development and the roadmaps presented in the first half day session. This discussion can draw upon the preceding breakout discussions of the general development path issues. This session should enable MFE/IFE development path cross-comparisons.

Next Step Options
Thursday both half-sessions and Friday both half-sessions
(The first half session will be plenary and consist of presentations without questions. The second half session will be in breakouts to allow discussion of the presented devices.)
A number of next step fusion devices have been proposed or are under construction: tokamaks (large integration, short-pulse ignition, and steady-state advanced tokamak), spherical tokamaks, stellarators, NIF, IRE, etc. In this Energy sub-group we will examine and discuss many of these proposed next step fusion devices from the point of view of their role in the development of fusion energy. The group should discuss these proposals in regard to their matchup to the list of Issues of Fusion Development given above.

The scientific issues related to most of the devices scheduled for presentation in our Thursday, July 15, and Friday, July 16, plenary sessions will be discussed in the morning MFE and IFE session and all participants are encouraged to attend these sessions as part of the preparation for our cross-cutting discussion in this Energy sub-group.

Thursday, July 15, First Half Session (Plenary)

Device	Speaker	Time
FIRE http://fire.pppl.gov	D. Meade	20

JET Upgrades	C. Gormezano	15
ST in a Fusion Development Facility http://fusion.gat.com/st-fdf/	R. Stambaugh	20
IRE (Introduction and HIB driver) http://lasers.llnl.gov/lasers/SEAB/Bangerter.pdf	R. Bangerter	15
IRE (KrF driver) http://lasers.llnl.gov/lasers/SEAB/Bodner.pdf http://lasers.llnl.gov/lasers/SEAB/Sethian.pdf	J. Sethian	10
IRE (DPSSL driver) http://lasers.llnl.gov/lasers/SEAB/Powell.pdf	H. Powell	10
IFE Engineering Test Facility http://lasers.llnl.gov/lasers/SEAB/Campbell.pdf	W. Meier	20

Thursday, July 15, Second Half Session
Breakout discussions of the above presentations

Friday, July 16, First Half Session (Plenary)

Device	Speaker	Time
ITER-RC	R. Parker	25
Steady-state tokamak (e.g. TPX, JT60-SU, KSTAR) http://fusion.gat.com/at/	K. Thomassen	20
Stellarator	N. Ohyabu	15
NIF and LMJ and Japan's ICF Program http://lasers.llnl.gov/lasers/SEAB/Kilkenny.pdf, http://lasers.llnl.gov/lasers/nif.html	W. Hogan	15
IGNITOR	L. Sugiyama	20
Discussion		15

Friday, July 16, Second Half Session
Breakout discussions of the above presentations