Summary
June Snowmass Planning Meeting

Dallas, TX
June 14-15, 1999

The following slides summarize the Snowmass Planning meeting of working group convenors and session leaders held in Dallas on June 14-15.

The meeting provided an opportunity to (1) review the overall objectives and deliverables of the 1999 Fusion Summer Study, (2) describe and anticipate (as much as can be expected) the overall flow of the two-week meeting, (3) discuss and share a common format for the "process" within the discussion sessions, and (4) coordinate the schedule of talks and discussions among the working groups.

We have attached in the approximate order presented, the transparencies used to guide discussions. In addition, Ms. Donna Carvalho served as our recorder. Her "flip chart" notes were taken in full color, but we were able only to attached B & W copies reconstructed from the 11×17 inch originals.

John De Looper presented a preliminary discussion of facilities, meeting rooms, and logistics. John's presentation will be sent to you in a separate email.

Some Important Decisions

Dallas also provided an opportunity to discuss and clarify issues concerning Snowmass planning, logistics, and process. These discussions were very informative, and they provided an overview of Snowmass to session leaders and convenors. Some items resulted in "group decisions" or important clarifications. These were recorded by Donna Carvalho and noted below:

1. Snowmass has a scientific and technical focus on "key issues" for fusion energy development and "opportunities. . .to optimize fusion's development path and achieve attractive economic and environmental features." General/basic plasma science and non-fusion technology facilities and programs are welcome at Snowmass–provided they are discussed in the context of addressing fusion energy research.

2. Written "chits" will be used to improve communication during plenary sessions. These chits should be examined by the working and subtopical groups, but they do not need to respond in writing to each.

3. WWW links to our Snowmass "Reference Library" will be made available to participants *prior* to the start of the meeting.

4. Every working group will have a table beside their posters for distributing handouts and information sheets.

5. During the second Monday working group status reports, each working group is required to reserve about 33% of the their allocated time for discussion.

6. A disclaimer will be included in the *Proceedings* to distinguish between the working and subtopical group reports and the contributed reports.

7. The deadline for submitting the written reports for the *Proceedings* is September 10, 1999.

8. Contributed reports need to address issues discussed during Snowmass. Therefore, contributed reports are submitted through one or more working groups.

9. Community "white papers" will not be published in the *Proceedings* although authors of these white papers can submit them as contributed reports.

10. The page limit of the Contributed reports will be decided by the Organizing Committee. The Organizing Committee will also specify editorial format of *Proceedings* articles.

11. We decided to have coffee service during working group discussions. This will probably necessitate a "food service fee" of all Snowmass participants. This fee would need to be expensed as part of allowed government *per diem*.

12. All working groups must submit final room needs to John De Looper by this week. (John will attempt to meet all needs, but meeting space is tight since the meeting is larger than anticipated.)

13. Working groups should contact as many participants as possible *now*!

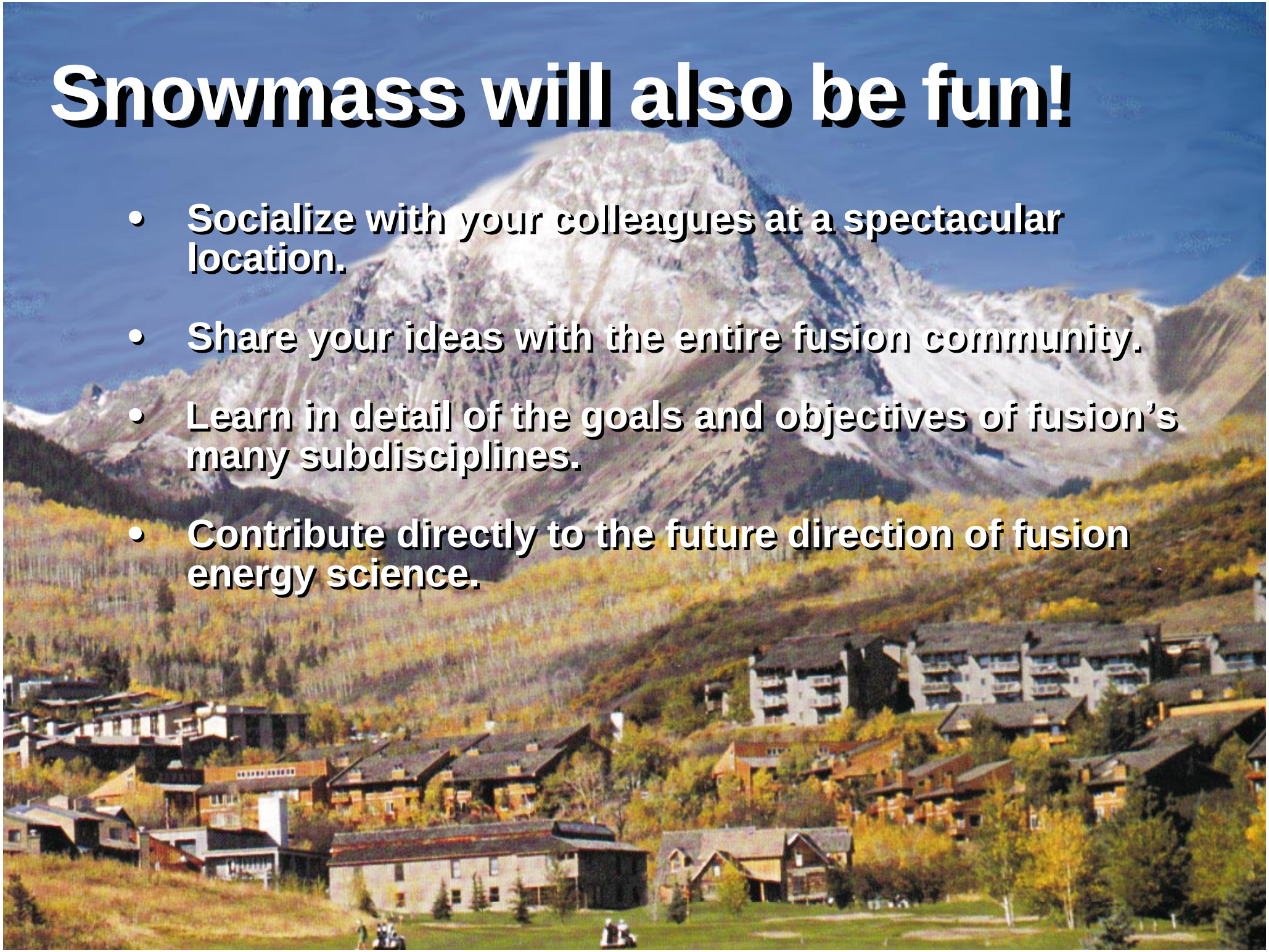
14. Try to select session recorders *before* a session starts.

15. Try to keep the organizing committee informed of your progress and issues.

We were pleased to note that the meeting proceeded according to schedule and we were able to adjourn 10 minutes early. (If only Snowmass runs so smoothly!)

Snowmass will also be fun!

- Socialize with your colleagues at a spectacular location.
- Share your ideas with the entire fusion community.
- Learn in detail of the goals and objectives of fusion's many subdisciplines.
- Contribute directly to the future direction of fusion energy science.



Welcome

Agenda and Goals for the June Snowmass Planning Meeting

Dallas, TX
June 14-15, 1999

- Review the overall objectives and deliverables of the 1999 Fusion Summer Study,
- Describe and anticipate (as much as can be expected) the overall flow of the two-week meeting,
- Discuss and share a common format for the “process” within the discussion sessions, and
- Coordinate the schedule of talks and discussions among the working groups.

Dallas Snowmass Planning Meeting Agenda

Monday Morning

8:30 AM	Mike Mauel Welcome Agenda and goals for next day and a half.
9:00 AM	Mike Mauel Review of the goals and objectives of the 1999 Fusion Summer Study.
10:00 AM	** BREAK **
10:30 AM	Rich Hawryluk The first week of Snowmass: From opening plenary to the Monday's mid-workshop report.
11:30 AM	Grant Logan The second week of Snowmass: (1) Synthesizing, summarizing, and preparing at your final reports, (2) Responding to comments from the broad community, and (3) Describing the Thursday and Friday plenary sessions.
12:30 PM	** LUNCH **

Dallas Snowmass Planning Meeting Agenda

Monday Afternoon and Evening

12:30 PM	** LUNCH **
1:30 PM	Mike Mauel Post-Snowmass follow-up: Publishing the proceedings.
2:00 PM	Donna Carvalho (with Mike Mauel) Process within the discussion groups. Setting the agenda and keeping on track. Examples and scenarios.
4:00 PM	** BREAK **
4:30 PM	Further Discussion
5:30 PM	** DINNER BREAK **
6:30 PM	John De Looper Conference Schedule, Meeting Rooms, and Logistics

Dallas Snowmass Planning Meeting Agenda

Tuesday Morning

8:30 AM	Tony Taylor Plans for MFE Concepts Working Group
8:50 AM	Dan Barnes Plans for Emerging Fusion Concepts Working Group
9:10 AM	Craig Olson Plans for IFE Concepts Working Group
9:30 AM	Mohamed Abdou Plans for Technology Issues Working Group
9:50 AM	Farrokh Najmabadi Plans for Energy Issues Working Group
10:10 PM	Arnold Kritz Plans for Plasma Science Working Group
10:30 AM	** BREAK **
11:00 AM	General Discussion of Working Group Coordination
12:30 PM	** ADJOURN **

If Snowmass were the U.N., then. . .

You would be the ambassadors.

- You are the 50 working group convenors and 20 session leaders representing every subdiscipline in fusion energy science.

- You need to call on your scientific and technical expertise during the Snowmass process.

- At the same time, you need to work for the development of the broad field of fusion energy science.

- Like ambassadors, you will need to listen to others and to work to keep everyone involved.

If Snowmass were a summer camp, then. . .

You would be the camp counselors.

- You need to understand, and be able to explain to others, “how Snowmass will work” and what we are trying to accomplish.

- You need to know the Snowmass schedule and help answer the questions of those in your working group and subtopical discussion groups.

- Like camp counselors, you need to be willing to accommodate the views of Snowmass participants while providing clear guidance and leadership.

If Snowmass were a magazine, then. . .

You would be the journalists.

- You are responsible for preparing the oral summary reports and the content of the *Proceedings*.

- You are responsible for “delivering the results” from the Fusion Summer Study.

- Like journalists, when you prepare your reports, you need to be objective and accurately reflect the views of your working group and subtopical groups.

If Snowmass were a three-ring circus, then. . .

You would be the ring masters, trapeze artists, animal trainers, . . .

- With three simultaneous independent working groups (in the morning and the afternoon) and our plenary meetings under the “big top”, Snowmass will often seem like a circus.

- You need to keep your sense of humor.

- We have time during Snowmass for informal discussions and for social activities with your colleagues.

- At two consecutive weeks, Snowmass will be our longest fusion workshop. **We need to pace ourselves.**

Last Name	First Name	Institution	e-mail	Working Group	Subgroup
Abdou	Shareef	UCLA	shareef@fusion.ucla.edu	Technology	
Abdou	Mohammad	UCLA	abdou@fusion.ucla.edu	Technology	Technology
Barnes	Dan	LANL	dbarnes@lanl.gov	EC	
Batchelor	Don	ORNL	batchelor@fed.ornl.gov	Plasma Science	Wam/Pa
Berk	Herbert L.	U Texas	berk@peaches.ph.edu	Magnetic Concepts	
Billone	Mike	ANL	billone@anl.gov		Materials
Callis	Rich	General Atomics	callis@fusion.gat.com	Technology	inert & fueling
Cary	John	U Colorado/	cary@colorado.edu	Science	
DeLooper	John	PPPL	jdelope@pppl.gov		
Hawryluk	R.J.	PPPL	rhawryluk@pppl.gov	co-chair	
Kritz	Arnold	Lehigh	kritz@fusion.physics.lehigh.edu	Science	Science
Logan	Grant	LLNL	logan1@llnl.gov	co-chair	
Mauel	Mike	Columbia Univ.	mauel@columbia.edu		
Meier	Wayne	LLNL	wmeier@llnl.gov	Energy/IFE	
Milora	Stan	ORNL	miloras1@ornl.gov	Technology	
Najmabadi	Faroth	UCSD	najmabadi@fusion.ucsd.edu		
Navratil	Gerald	Columbia Univ.	navratil@columbia.edu	Energy	Next Steps
Neilson	Hutch	PPPL	hneilson@pppl.gov		
Olson	Craig	SNL	clolson@sandia.gov	Inertial Fusion Concepts	
Peng	Martin	ORNL	mpeng@pppl.gov		
Perkins	Frances	GA/PPPL	perkins@fusion.gat.com	Magnetic Fusion/Burning	
Schultz	Joel	MIT	jhs@psfc.mit.edu	Technology	
Schultz	Ken	General Atomics	ken.schultz@gat.com	Inertial Fusion	Power Plants
Siemon	Dick	LANL	rsiemon@lanl.gov	EC	
Stambaugh	Ron	GA	stambaugh@gav.gat.com	Energy	
Strait	Ted	GA	strait@fusion.gat.com	Magnetic Fusion	
Taylor	Tony S.	GA	taylor@fusion.gat.com	MFCNG	
Ulrickson	Mike	SNL	maulric@sandia.gov	Technology	PMT
Wooley	Rupert	PPPL	woolley@pppl.gov	Technology	
Ying	Alice	UCLA	ying@fusion.ucla.edu	Technology	
Zarnstorff	Mike	PPPL	zarnstorff@pppl.gov	Magnetic Fusion Concepts	Integration

Process Issues

- Focus on the crucial issues.
- Remember to focus on the crucial issues.
- Time is *very* limited, so we need to follow our agenda.
- We will leave about 15 minutes at the end of every hour for urgent questions and discussion of crucial issues.

Opportunities and Directions in Fusion Energy Science for the Next Decade

Review of the goals and objectives of the 1999 Fusion Summer Study

- “Opportunities” indicates that the meeting is aimed to identify, to discuss, and to articulate the excitement in our field and why it is so important.
- “Directions” refers to our expectation that our work at Snowmass will not re-define fusion program strategy or micro-manage existing research programs.
- “Fusion Energy Science” means the whole program, from plasma science to fusion technologies, from MFE to IFE.
- “Next Decade” means the next 10 years.

The Three Goals and Deliverables of Snowmass

1. "Bring together individuals involved with fusion research to interact with each other and to work to develop a scientific and technical basis for consensus on (1) Key issues for plasma science, technology, and energy and environment for fusion energy development, and (2) Opportunities and potential contributions of existing and possible future facilities and programs to reduce fusion development costs and achieve attractive economic and environmental features."

2. Provide technical and scientific input to the plans being developed by FESAC, SEAB, and the NRC.

3. Publish a technical proceedings of the activities of the Fusion Summer Study in order to provide a written record of our work.

Goal 1: The “heart” of the Snowmass meeting.

Bring together individuals involved with fusion research to interact with each other and to work to develop a scientific and technical basis for consensus on:

- Key issues for plasma science, technology, and energy and environment for fusion energy development, and

- Opportunities and potential contributions of existing and possible future facilities and programs to reduce fusion development costs and achieve attractive economic and environmental features.

“Key Issues”

- Up until now, the main activity of the working groups has been defining subtopical “frameworks” and agendas to guide your discussions of the “key issues”.

- By the end of Snowmass, you must be able to articulate to the general fusion community a limited list of “key issues” and explain
  - Why your issues are “key” and “important,” and
  - How resolution of these key issues will advance fusion energy science.

- This will not be a simple task. (Remember your 10 year time frame.)

“Opportunities”

- After identifying and understanding the “key issues”, you need to assess how the “opportunities” can address the key issues.
- “Opportunities” refer to “Opportunities and potential contributions of existing and possible future facilities and programs to reduce fusion development costs and achieve attractive economic and environmental features.”
- “. . .existing and possible future facilities and programs. . .”
- In forming your assessments, you need to develop and to explain to others *in a scientific or technical way* how an “opportunity” addresses your key issues.
- If possible, provide a quantitative measure of “key issue resolution.”
- This will not be a simple list. (Remember your 10 year time frame.)

Goal 2: Technical and scientific input to the plans being developed by FESAC, SEAB, and the NRC.

- We are not doing the work of these committees.
- We are not answering questions of program balance. No budgets, no program pie-charts. (. . . although cost estimates/comparisons of the facilities and research paths needed to address key issues can be discussed.)
- We are explaining to these committees the key issues in our field and the opportunities to address them *from our points of view*.
- We need to provide a scientific and technical basis for our statements.
- We should also motivate why our "key issues" will have long-term impact and why these "opportunities" are exciting.
- We provide input (1) by our oral presentations, and (2) by direct participation of committee members in Snowmass.

Goal 3: Publish a technical proceedings of the activities of the Fusion Summer Study.

- The *Proceedings* comprise the written summaries of:
  - Working groups, authored by the working group convenors,
  - Subtopical discussion groups, authored by the contributing participants, and
  - Contributed reports, authored by individuals and groups.

    These may have a page limit (about 4 pages in length ?).

    These may include community "white papers" authored by advocates.
- Written summaries need to reflect accurately the views of your working and subtopical groups.
- The main audience for the *Proceedings* is the fusion community itself; however, the working group reports should be readable by the general scientific community

The first week of Snowmass:

From opening plenary to the Monday's mid-workshop report

Sunday	*Meeting of Organizers, Working Groups, and Session Leaders* *Registration*
Monday	Opening Plenary
Tuesday	Working Groups
Wednesday	Working Groups
Thursday	Working Groups
Friday	Working Groups
Weekend	*Prepare Mid-workshop Reports*
Monday	Plenary: Mid-workshop Reports

Opening Plenary

- Plenary speakers have been invited by Organizing Committee.

- The plenary speakers have been asked to express their personal opinions (or visions) of the "Opportunities and Directions in Fusion Energy Science for the Next Decade."

- Speakers have been asked to speak to the broad entirety of fusion research, although individual speakers will naturally emphasize particular topics and issues.

- At the end of the day, each working group *briefly* introduces subtopical discussion groups and highlights working group schedule for the first week.

Opening Plenary Session (Monday)

8:30 AM	Mike Mauel	(Welcome)
9:00 AM	H. Grunder	
9:30 AM	M. Rosenbluth	
10:00 AM	F. Wagner	
10:30 AM	*Break*	
11:00 AM	M. Kikuchi	
11:30 AM	R. Conn	
12:00 PM	D. Ryutov	
12:30 PM	*Lunch*	
2:00 PM	D. Baldwin	
2:30 PM	M. Campbell	
3:00 PM	R. Goldston	
3:30 PM	*Break*	
4:00 PM	T. Taylor	(Magnetic Fusion Concepts)
4:15 PM	C. Olson	(Inertial Fusion Concepts)
4:30 PM	D. Barnes	(Emerging Fusion Concepts)
4:45 PM	A. Kritz	(Plasma Science Issues)
5:00 PM	M. Abdou	(Technology Issues)
5:15 PM	F. Najmabadi	(Energy Issues)
5:30 PM	*Social Hour*	

Technical Discussions of the Working Groups

- Each working group defines its own schedule and focus.

- Each working group will have two posters to display agendas, topics, and progress.

- The convenors and session leaders of each working group should plan on meeting:

  – at least once during the week to evaluate the progress of their topical groups and

  – at least once during the weekend in order to prepare their presentations for the Monday mid-week report.

Working Group Organization

Fusion Concept Working Groups:

Emerging Fusion Concepts Working Group
Inertial Fusion Concepts Working Group
Magnetic Fusion Concepts Working Group

- identify the important issues for concept development during the next decade

Cross-cutting Issues Working Groups

Energy Issues Working Group
Plasma Science Working Group
Technology Working Group

- emphasizing issues in common to more than one fusion concept

General Charge to the Working Groups

The six working groups have a natural focus and will answer, …

What are the key issues and challenges to be faced during the next decade of fusion energy science research?

What are the opportunities and potential contributions of existing and possible future facilities and programs to address these issues and challenges?

Communication! Communication! Communication!

- **Significant overlap:**
  - between discussions in the concept and issues working groups.
  - between different concept and issues groups

- **Need to ensure good transfer of information**
  - issues group identify important topic ➔ concept groups identifies opportunities to address it
  - energy group identifies impact of new technology ➔ technology group identifies requirements for facilities to address it

- As a minimum, update of schedule of talks and issues being discussed should be made on the poster boards.
  - posters will be made available to each working group

- Library will be setup
  - send us your requests for information you need and what you want distributed (journals, IAEA Proceedings, concept white papers, proposals….)
  - duplication facilities will be available

- What else should we do?

Snowmass "Reference Library" & Presentation Aides

- We will have a "Snowmass Reference Library." This may include:
  - FESAC documents (*e.g.* a recent draft of the "Opportunities" document and appendix.
  - Community "white papers" by advocates.
  - Past four proceedings from the IAEA Fusion Conferences; past five years of the special APS-DPP issues of *Phys. of Plasmas.*
  - Others. . .
- We can distribute copies to every participant; we can have copies available like the document room at IAEA; and we will have our own xerox machine.
- Complete computer room. Open 24 hour/day. T1 line, 10BT hubs, Macs and PCs, a color printer, BW printers.

Mid-Workshop Reports (2nd Monday)

- The purpose of these Mid-Workshop reports is to communicate the status of your working groups. Try to generate enthusiasm and interest for your topics.
- But, do not give a technical “review” of a subdiscipline.
- Try to summarize progress identifying “key issues” and assessing “opportunities.” But, you do not need to present preliminary “conclusions” or “recommendations”.
- Mention those topics which generated discussion and debate. If contested issues arise, the mid-week reports should give both sides of the argument.
- Each working group would have approximately one hour within which to present their reports.
- Each working group is responsible for for preparing their own mid-week summary.
- A few key leaders of your working group should speak. Make references to your posters and materials where participants can get further information.
- Finally, each speaker will be held to a **VERY STRICT** time schedule. Don’t put your main points at the end of the presentation; they might not be heard.

Mid-Week Reports (2nd Monday)

8:30 AM	Magnetic Fusion Concepts Working Group
10:00 AM	*Break*
10:15 AM	Inertial Fusion Concepts Working Group
11:15 AM	*Break*
11:30 AM	Emerging Fusion Concepts Working Group
12:30 PM	*Lunch*
1:30 PM	Plasma Science Issues Working Group
2:30 PM	*Break*
2:45 PM	Technology Issues Working Group
3:45 PM	*Break*
4:00 PM	Energy Issues Working Group
5:00 PM	*Social Hour*

2nd Monday – First Opportunity to Convey Progress of each Working Group (cont.)

- **Each group responsible for presentations**
  - **strict timelimits**

- **Summary of the status of the discussions in the previous week**
  - what was discussed
  - what remains to be addressed
  - raw data at this point in time
  - not a final product but a checkpoint

- **Seeking feedback from the broader community and providing them imput for their deliberations**

2nd Monday – First Opportunity to Convey Progress of each Working Group (cont.)

- **Issues:**
  - More material than time will allow
    - Not a review of all aspects of fusion
  - Identify key issues and opportunities that the community needs to hear about
    - Additonal details in proceedings
  - Each group will have to struggle with the number of speakers and how to stay within the timelimits.
  - Questions and chits???
    - Questions provide valuable feedback from the community about their reaction to the talk.
    - Can be dominated by a few individuals and/or not focused on the key issues?
      (My preference is to have some dedicated time for discussion as well as chits.)
  - What else????

The second week of Snowmass:

Tuesday	Working Groups
Wednesday	Working Groups
Thursday	Summary Reports from the Working Groups
Friday	Final Reports from the Working Groups

- Synthesizing, summarizing, and preparing at your final reports
- Responding to comments from the broad community, and
- The closing Thursday and Friday plenary sessions.

Activities during the Second Week

- The focus of the second week will be synthesis and summary.
- During the first week, many Snowmass participants have attended just a few subtopical discussion groups. During the second week, these individuals will want to comment on the work of other working groups.
- Contributing participants of discussion groups and working group convenors will also want to revise and to explain better the work of their own working group to others.
- On Tuesday and Wednesday, the working groups should try to form a coherent framework representative of their group's activities, and they should try to respond to the comments and suggestions from individuals from other working groups.
- Subgroups need to assign writing tasks to contributing participants for their proceedings article.

The Closing Plenary Sessions

- The purpose of these final plenary sessions is to report to the community as a whole the discussions and (hopefully) the findings of each working group.

- It is very, very important that these reports accurately reflect the work and contributions of the working group participants.

  This is the reason for having both the Thursday and Friday sessions. We want to give Snowmass participants the opportunity to see, to revise, and to comment on the final summary reports before they are actually "finalized".

- The closing session is the stage where each working group can describe the high-leverage "key issues" and the exciting "opportunities" to advance fusion energy science.

Thursday's Open Discussions of the Summary Reports

- The purpose of the Thursday presentations is to provide a limited but useful opportunity for open discussion of the final working group reports.

- The working group organizer (or a designated representative) will present the working group summary report.

- Each working group has approximately one hour.

  Each speaker should prepare formal presentation for *about half the allocated time*. The remaining time is for comments and clarifying questions from the audience of Snowmass participants.

- The audience will have forms on which to submit written comments.

Open Discussions of the Summary Reports (2nd Thursday)

8:30 AM	Magnetic Fusion Concepts Working Group
10:00 AM	*Break*
10:15 AM	Inertial Fusion Concepts Working Group
11:15 AM	*Break*
11:30 AM	Emerging Fusion Concepts Working Group
12:30 PM	*Lunch*
1:30 PM	Plasma Science Issues Working Group
2:30 PM	*Break*
2:45 PM	Technology Issues Working Group
3:45 PM	*Break*
4:00 PM	Energy Issues Working Group
5:00 PM	*Farewell Reception*

The working convenors will probably need to revise their presentations for the next day.

Final Summary Reports of the Working Groups

8:30 AM	*R. Hawryluk – Opening Remarks*
8:45 AM	Magnetic Fusion Concepts Working Group
9:30 AM	Inertial Fusion Concepts Working Group
10:00 AM	Emerging Fusion Concepts Working Group
10:30 AM	*BREAK*
11:00 AM	Plasma Science Issues Working Group
11:30 AM	Technology Issues Working Group
12:00 AM	Energy Issues Working Group
12:30 PM	*G. Logan – Closing Comments*

Post-Snowmass follow-up: Publishing the Proceedings

The proceedings will consist of:

- Written summaries of the working groups (authored by the working group convenors),
- Written summaries of the subtopical discussion groups (authored by the contributing participants),
- Contributed reports (no more than 4 pages in length ?) by individuals and groups.
- Other community documents (?) like “white papers” from advocate groups, ...
- The main audience for the *Proceedings* is the fusion community itself; however, the working group reports should be readable by the general scientific community

Publishing the proceedings

- The *Proceedings* will be published on a CD-ROM, and it will consist of a collection of papers in PDF format indexed by a browser-compatible HTML file.

- The deadline for submission of the proceedings articles is September 3, 1999.

  Authors of the Proceedings articles must complete their work during August.

- Each article will be read by the co-chairs, and some authors might be asked to reformat or revise their manuscripts for editorial reasons.

- The working groups have the greatest responsibility to insure that the proceeding articles are completed in a timely manner. Each article has to be self-contained and prepared professionally on a word-processor. Any figure compatible with PDF is acceptable, but we would hope that authors would not included a large number of high-resolution jpegs.

- The written summaries of the working groups and the subtopical groups should be consistent with Snowmass discussions.

- They should contain the technical/scientific detail and references justifying and explaining your findings.

Some Guidelines for Working Groups

- The session leaders for each subtopical discussion group should be identified.

- The session leaders for each subtopical group should contact and involve your *contributing* participants. These are your co-authors.

- Involve your contributing participants in setting your agenda.

- Send out email announcements to all registered participants of your working group and subtopical groups.

Some Draft Ground Rules for Discussion Sessions

(from Donna Carvalho)

Agree upon your ground rules before you begin. For example,

- One speaker at a time.
- Listen.
- Keep your comments brief and focused.
- Be candid and *constructive*.

Add or change these rules, but agree and “own” your discussion ground rules. Your ground rules will help you get the most out of your discussions in preparation for the synthesis and summary phase.

SNOWMASS PARTICIPANTS

326 "REGISTERED NAMES" 5/27

EC	132	(34 CONTRIB.)	126%
MC	185	(72 CONTRIB.)	
IC	92	(29 CONTRIB.)	
PS	143	(51 CONTRIB.)	119%
EY	146	(42 CONTRIB.)	
TE	98	(43 CONTRIB.)	

REMEMBER:

	EC	MC	IC	PS	EY	TE
				x	x	x
"NEW CONCEPTS"	x			x	x	x
MAGNETIC	x	x		x	x	x
INERTIAL			x			
PLASMA SCI	x	x	x	x		
ENERGY	x	x	x		x	
TECHNOLOGY	x	x	x			