



**FUSION ENERGY SCIENCES ADVISORY COMMITTEE
OFFICE OF SCIENCE**

MINUTES

**Hilton Hotel
620 Perry Parkway
Gaithersburg, Maryland
Thursday, July 28, 2011**

Agenda Thursday, July 28, 2011

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9:00	Welcome/Meeting Agenda/Logistics	2	Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology
9:05	DOE Perspectives	4	Dr. W.F. Brinkman, Director, Office of Science
9:20	FES Perspectives	5	Dr. Ed Synakowski, Associate Director for Fusion Energy Sciences
10:20	Break		
10:35	Briefing on the report Policies and Practices Influencing the Dissemination of Research Results	11	Dr. Bruce I. Cohen, FESAC Subcommittee Chair, Lawrence Livermore National Laboratory
	Discussion of the report by the full committee	13	Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology
11:30	Briefing on the Fusion Nuclear Sciences Pathway Assessment activity	16	Dr. Charles Kessel, FNSPA Leader
12:15	Lunch		
1:15	Briefing on the report International Collaboration Opportunities for the US FES Program	19	Dr. Michael Zarnstorff, Deputy Director for Research, Princeton Plasma Physics Laboratory

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2:00	Discussion of a new charge	24	Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology
3:30	Break		
3:45	Update on ITER Project Status	30	Tom Vanek, Senior Policy Advisor, Fusion Energy Sciences
4:15	Public Comment	33	Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology
4:45	FESAC discussions and preparation of the letter to DOE completing the research results charge	34	Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology
5:30	Adjourn	35	

THURSDAY, JULY 28, 2011

Dr. Martin J. Greenwald, Chairman, was presiding.

[Welcome/Meeting Agenda/Logistics Dr. Martin Greenwald, FESAC Chair
Massachusetts Institute of Technology](#)

Dr. Greenwald welcomed committee members and noted they would try to monitor the time considering the full agenda. He stated that if anyone present wanted to make public comments they ought Mr. Albert Opdenaker know as soon as possible. He advised that the meeting was streaming on the internet. He welcomed Dr. Brinkman who was to give an update on the Office of Science.

ROLL CALL

Committee Members Present:

Dr. Martin J. Greenwald, Chair (MIT)
Prof. Riccardo Betti, Vice-Chair (Univ. of Rochester)
Dr. Richard W. Callis (General Atomics)
Dr. Bruce Cohen (LLNL)
Prof. Raymond J. Fonck (Univ. of Wisconsin)
Dr. Amanda Hubbard (MIT)
Dr. Hantao Ji (PPPL)
Dr. Christopher J. Keane (LLNL)
Dr. Ramon Leeper (SNL)

Committee Members Absent:

Dr. Kathryn McCarthy (INL)
Prof. Edward Thomas, Jr. (Auburn Univ.)

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Dr. Dale M. Meade (Princeton)
Dr. Ellen Meeks (Reaction Design)
Prof. Farrokh Najmabadi (UC San Diego)
Prof. Robert Rosner (Univ. of Chicago)
Dr. Nermin Uckan (ORNL)
Dr. Steven Zinkle (ORNL)

Ex-officio Members Present:

Prof. Steven Allen (APS/DPP)
Mr. Lee C. Cadwallader (ANS/FED)

Ex-officio Member Absent:

Dr. John W. Steadman (IEEE-USA)

DOE DOE/SC Attendees:

Dr. W.F. Brinkman, Director, Office of Science
Dr. Patricia Dehmer, Deputy Director for
Science Programs
Dr. Ed Synakowski, Associate Director for Fusion
Energy Sciences
Mr. Albert L. Opdenaker III (Committee DFO)
Dr. Sam Barish
Ms. Laura Biven
Ms. Kin Chao
Dr. Steve Eckstrand
Dr. Jim Glowienka
Dr. Marcos Huerta
Mr. Dan Lehman
Dr. John Mandrekas
Dr. Randall Lavolette
Mr. Gene Nardella
Dr. Karen Pao
Mr. Peter Pappano
Dr. Nirmol Podder
Dr. Abhay Ram
Dr. Ann Satsangi
Mr. John Sauter
Dr. Francis Thio
Mr. Tom Vanek

Other Attendees:

Ms. Arti Garg, OMB
Mr. Mark Haynes, Concordia Power
Dr. Chuck Kessel, PPPL
Ms. Julie Groeninger, PPPL
Dr. Gerald Navratil, Columbia Univ.
Dr. Hutch Neilson, PPPL
Dr. Erol Oktay, Retired/DOE
Dr. Miklos Porkolab, MIT
Dr. Stewart Prager, PPPL
Dr. Michael Roberts, RI, LLC
Dr. Tony Taylor, GA
Dr. James Van Dam, IFS, Texas
Mr. Les Wagner, Consultant
Dr. James R. Wilson, Princeton Univ.

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[DOE Perspectives Dr. W.F. Brinkman, Director, Office of Science](#)

Dr. W.F. Brinkman, Director, Office of Science

- Expressed the view that the Office of Science (OS) was facing a challenging time with regard to the budget. He noted that:
 - For the 2011 budget they received a constant budget with a little less than 2010.
 - Last year they cut \$50 million for 2011 which was an improvement to the previous year when \$1 billion was cut.
 - New attitude in Washington where the concept of remaining constant was being upheld and considered good.
 - Situation represented a very different level of funding than in the past several years.

- Noted from the Fusion Energy Sciences point of view some important things had happened over the past two years.

- Discussed ITER (International Thermonuclear Experimental Reactor):
 - ITER had an excellent team with Dr. Osamu Motojima at the top.
 - Of the opinion that the prospects for ITER had improved because of the team with Dr. Motojima taking a strong leadership role.
 - The Japanese were experiencing some problems due to the earthquake.
 - The commitment of the Europeans was strong.
 - The U.S. budget was going to be strained because beginning in 2013 ITER has to grow into a large project. From the American point of view it would require \$200 to \$300 million a year. Emphasized that it was a large amount of money and that the community would have to work together, and convince the Hill and White House to ensure it stays on track.
 - Recommended that the scientific community ensure that the funds went to ITER and were not drawn from other areas which could result in a backlash.
 - Stated that ITER's burning plasma was an important step in trying to get to a real fusion reactor.
 - Encouraged members to talk to their Congressmen and Senators and advocate.

Dr. Brinkman was asked about the construction budget profile, and how many years the project would require the sum of \$300 million for. Dr. Brinkman responded approximately three years but the fact that the project was in a position to go was important.

Dr. Greenwald noted that there was an increase in fusion in the Congressional budget. He asked if he had any understanding of that. Dr. Brinkman responded that Congress had given them what they had asked for. They asked for \$105 million in FY12 but he noted that that had to go up from there. Dr. Brinkman stated that Fusion Energy Sciences (FES) had a fair bit of support on the Hill.

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[FES Perspectives; A New Charge Dr. Ed Synakowski, Associate Director for Fusion Energy Sciences - Due to technical difficulties encountered during the early portion of the meeting, we were unable to record the audio portion of the presentation made by Dr. Ed Synakowski. We apologize for this inconvenience. The essence of his presentation can be found in the slides that he presented, which are available as attachments in the minutes.](#)

[FES Perspectives; A New Charge Dr. Ed Synakowski - Slides](#)

Dr. Ed Synakowski, *Associate Director for Fusion Energy Sciences*

- Offered an update on the Fusion Energy Sciences Program, a snapshot of ITER and new charges.

Developments within the Office

- Welcomed the next research division director, Dr. James Van Dam, to Fusion Energy Sciences and gave highlights of his education and career.
- Made other staff announcements:
 - Post for SES leadership position of facilities, operations and projects division would come after the formal reorganization of the division was completed.
 - Other new hires have included Ed Stevens (Project Manager from NASA (National Aeronautics and Space Administration)); Ann Satsangi (General Plasma Science) (GPS); Sean Finnegan (GPS and HEDLP (High Energy Density Laboratory Plasmas)); Pete Pappano (Materials scientist) and Pam Miller (Program analyst, budget formulation, personnel).
- Introduced the new FES organizational structure and how it reflected their goals as a community.
 - Broken into two operating principles with two divisions (1) research and (2) facilities, operations and projects.
 - Within the research division these actions were anticipated:
 - Program managers would constitute teams that would interface with the community establishing goals and metrics, and monitor progress on targeted goals.

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- Teams would reflect fusion energy science and the goals which needed to be pursued in future years.
- The facilities, operations and projects divisions would maintain and develop a consistent approach in major facility operations and project management.
- Detailed two aims of this organizational change, one being to better reflect work that is done and support the work and functions required of a national program. The second was to create a flexible template that would promote the cross-fertilization of ideas and expertise.
- Provided an update of solicitations:
 - 41 proposals were received for the theory solicitation and these were being reviewed. Decisions would be made before September 30, 2011.
 - The joint FES/ASCR (Advanced Scientific Computing Research) SciDAC (Scientific Discovery through Advanced Computing) solicitation should be published in early August. Tentative due dates are September 9th for pre-applications and October 26th for full proposals.
 - The NSTX Diagnostics collaboration solicitations should be published in early August. Tentative dates are mid-September for pre-applications and October 18th for full proposals.
 - The joint FES/NNSA (National Nuclear Security Administration) High Energy Density Laboratory Plasmas solicitations should be published in mid August. Letters of intent due October 1 and full proposals due October 15.
 - Materials solicitation is planned for late FY11 and will be published in September. Proposals will be due in late fall or early winter.

Update of the ITER Construction Site

- Provided an update of ITER:
 - Council meeting last June and construction is proceeding well.
 - One of the leading questions concerned ITER payments and the EU budgetary system.
 - Another major question was the impact of the Japanese disasters on that country's ability to deliver.

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- Director General Motojima stated that he wanted to keep the delay from the disasters to a maximum of one year, so first plasma in 2020.
- Dr. Synakowski and Ned Sauthoff, Director, U.S. ITER Organization are part of a task group working on modifying the schedule.
- Slides of the Tokamak Complex excavation site in June 2011 were shown.
- Slides were shown of the sites of the 500 seat amphitheatre of the future ITER headquarters and one of the two 38.3 meter-long steel beams destined for the Poloidal Field Coil Winding Facility's 25 ton traveling crane.

New Charge Given to FESAC

Discussed and presented the new charge given to the FESAC by Dr. Brinkman. The new charge is composed of three elements. The first two elements could naturally be dealt with by one FESAC subcommittee, with a second subcommittee required for the third element. The report from FESAC on the results of the committee's work on the three elements is required to be presented to DOE no later than January 31, 2012.

First Element of the Charge

- The first element of the charge is: "What areas of research on new international facilities provide compelling scientific opportunities for U.S. researchers over the next 10-20 years? Look at opportunities in long-pulse, steady-state research in superconducting advanced tokamaks and stellarators; in steady-state plasma confinement and control science; and in plasma-wall interactions."
- Noted that the committee should focus its efforts on new and emerging superconducting facilities in Asia and Europe, such as the East Tokamak in China, the KSTAR tokamak in South Korea, and the Wendelstein 7-X stellarator in Germany.
- Advised that the scope of the work on this charge should be narrower rather than broader, that is for the sake of this charge we are looking at tokamaks and stellarators. Other international opportunities will be studied at a later date.

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Second Element of the Charge

- The second element of the charge is: "What research modes would best facilitate international research collaborations in plasma and fusion sciences: Consider modes already used by these communities as well as those used by other research communities that have significant international collaborations."
- Noted that the committee should examine what we can learn from other scientific fields such as high energy physics and nuclear physics, and others that have had to undergo a transition and become significantly involved in overseas research efforts.
- Stated that committee members are encouraged to engage members of these other fields of science and representatives from universities where international efforts have been both successful and where initiatives may have failed.
- Encouraged committee members to share their observations about international collaborations of which they are aware, and determine what we may be able to learn from the other fields of science.

Third Element of the Charge

- The third element of the charge is: "What areas of research in materials science and technology provide compelling opportunities for U.S. researchers in the near term and in the ITER era? Please focus on research needed to fill gaps in order to create the basis for a DEMO and specify technical requirements in greater detail than provided in the MFE (Magnetic Fusion Energy) ReNeW (Research Needs Workshop) report. Also, your assessment of the risks associated with research paths with different degrees of experimental study vs. computation as a proxy to experiment will be of value."
- Asked them to consider the near-term and the long-term and what could be done with existing facilities, new facilities and emergent international facilities.
- Asked them to consider experiments and the role of computation, identify 2-3 different pathways and what are the risks of following each path.
- Asked them to identify 2-3 paths with varying emphases on massively parallel computing with risks associated with each.

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- Noted they should consider materials, nuclear, non-nuclear, differential and integrated and harnessing fusion power.

COMMITTEE DISCUSSION

Dr. Riccardo Betti noted the budget constraints that would affect the program and push the U.S. into the position of looking at opportunities abroad. His concern was that this meant that leadership would also be abroad. He asked what he would do if he did not have those budget constraints. Dr. Synakowski responded (inaudible).

Dr. Betti noted that materials science is a long-term issue for fusion. He stated that plasma physics was not a done deal. He added that they thought they would have plasma that produced its own heat and own current and this was not realistic at the moment. He thought rather than concentrating on the long-term issue that assumed they would have the burning plasma, he thought they should focus their efforts on making sure that they could achieve the burning plasma. Dr. Synakowski responded (inaudible).

Dr. Hantao Ji asked about the first two charges. He thought that it was important that the U.S. work well with the other partners but said he wasn't clear about the intention of the collaboration. He thought for collaboration to happen you would have your own strong base program, and then the other partners would have a strong program with a different emphasis. Then each program would collaborate and help each other. He asked about the best ways to collaborate and the intentions of the U.S. in 10 or 20 years. Dr. Synakowski responded (inaudible). Dr. Ji asked about outcomes with regard to charge one and two. Dr. Synakowski responded (inaudible).

Dr. Greenwald noted that in the wording of the charge he would have liked to see "strategic opportunities" rather than "scientific opportunities" even though "scientific opportunities" was also important. He noted that the issue should be looked at in a broad context and hoped that this was going to be part of what they needed. He thought they should be strategic as well as tactical. Dr. Synakowski said they would pursue the singular scientific opportunity here and that the strategic viewpoint was healthy.

A member asked if he could clarify whether they were looking for any input on HEDLP. Dr. Synakowski responded (inaudible).

Dr. Amanda Hubbard asked for clarification. She said when they are asked to look at fields where they have almost completely off-shored the research it sets off the alarm bells that they might be seeing their

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vision for the future fusion program. She hoped that that was not what they intended. She thought without strong expertise in the U.S. they would have nothing to bring to the table. She asked if he could clarify and set minds at ease and explain the balance maybe ten years down the road. Dr. Synakowski responded (inaudible).

Dr. Raymond Fonck noted that in reading the charge there appeared to be a presumption that there was a need to take research offshore together with certain value judgments as to what was or was not important. He would have liked the issue of what research is done offshore studied carefully to address the issue of balance. He said if the U.S. has to be a niche player, what niche would they choose, and how does this charge address choosing that niche? Dr. Synakowski responded (inaudible).

Dr. Dale Meade asked how many years did they think they would be working with the run-up of the ITER budget over constraints on the fusion budget; how many years they would be working at squeezing through this tight knothole. He mentioned the many decisions that would have to be made would affect their future long term, what would things look like once they had squeezed through. He was pleased to hear that Dr. Synakowski described his vision for a fusion nuclear science facility as a goal and believed this would assist in framing some of the decisions. Dr. Synakowski responded that he had talked about something much broader than the offhand comments he made. Dr. Meade thought the work requested in the charges did not allow a great amount of time but would set in motion a direction that would be in place for several years. Dr. Synakowski clarified that the charge was asking about technical opportunities and he did endorse the idea of looking at this strategically. He noted that the challenge and opportunity associated with international collaboration was rich and complex and required certainty about their future to really answer some of the members' questions.

Dr. Ramon Leeper asked Dr. Synakowski about strategic options. He responded that there was a range of strategic options. He noted that there was a significant range of options that could arise domestically. He noted that if in the future the committee wanted to go beyond the technical opportunities for the fusion program he would welcome that decision of them taking a more strategic view.

Dr. Bruce Cohen made two points: (1) The new charge on international collaborations might be used to provide feedback from the community and commentary that should be useful to DOE Fusion Energy Sciences in its planning with respect to funding work in international collaborations and perhaps helping the office in its thinking leading to a new solicitation later in FY2012 in the international collaborations area; (2) he did not feel threatened that FES was moving the fusion research program offshore by focusing more attention on international collaborations and that FES was trying to do the right thing in taking advantage of important off-shore facilities.

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Dr. Betti stated that in the charge letter the leadership in the experiments and facilities would be abroad due to the budget. He asked about retaining the leadership in predictive capability and plasma simulations as these would not require the same amount of funding for a large facility. He asked if this was something that the U.S. could do. He asked if they were ensuring that they retain at least a leadership in the predictive capability. In addition to that issue he asked about the fusion simulation project. Dr. Synakowski responded that within budget constraints the answer was yes, he agreed.

Dr. Robert Rosner asked about the issue of reliability with international collaborations, considering the U.S. past experiences which he noted were not always positive. He mentioned space projects with a comparable size to what they were talking about. He said that Congress was in the midst of trying to kill the James Webb Space Telescope in the context of the Europeans having spent about a billion Euros. He asked about how the office was thinking about the risk analysis of going in that direction for large projects. Dr. Synakowski clarified that he was talking about the risk stateside. He did not have a definitive answer for that and noted that they were living it 'in spades' with ITER.

Dr. Greenwald noted that there was a public perception problem with ITER, a negative perception. He thought that there were communication problems in that when they communicate they gloss over issues rather than opening up to the difficulties and challenges. He urged them to be more open about the challenges and issues so that the real story gets out to the public as opposed to negative rumors. Dr. Synakowski agreed with him. Dr. Greenwald noted that the U.S. was different than other cultures that treated communication with the public and politicians differently, being less open and accessible. If the U.S. public was treated that way could begin to perceive the project in a negative way.

[Break](#)

The Advisory Committee recessed for a ten minute break.

[Briefing on the report Policies and Practices Influencing the Dissemination of Research Results Dr. Bruce I. Cohen, FESAC Subcommittee Chair, Lawrence Livermore National Laboratory](#)

[Presentation: Briefing on the report Policies and Practices Influencing the Dissemination of Research Results Dr. Bruce Cohen - Slides](#)

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Dr. Bruce I. Cohen, *FESAC Subcommittee Chair, Lawrence Livermore National Laboratory*

- Noted he was presenting on a FESAC panel report in response to a charge from the Office of Science. Noted that the report addressed the assessment of the policies and practices influencing dissemination of research results.
- Gave names for the members of the panel who were given the assignment which was an assessment or a fact-finding exercise.
- Explained that the charge was motivated by the America COMPETES Reauthorization Act of 2010. Noted that this federal legislation has a section that instructed the Department of Energy (DOE) among others, to have research disseminated in such a way as to assist American industry and manufacturing.
- Stated that Dr. Brinkman wanted to know from all offices within the OS how research results were disseminated. Noted that research results included scholarly papers and publications, public presentations, reports, software and digital data.
- Reviewed all the questions that were asked by panel members relating to the dissemination of research results including the executive summary.
- Stated that the FES like others in the OS had well-developed practices. Noted that the principal investigator (PI) had the most responsibility for executing the policies. Advised that the institutions helped with the policy.
- Noted that there was attention given to intellectual property. Stated that the DOE had a long history in dealing with intellectual property so the public could benefit. Explained that when institutions retained the rights to the material that it became a better way to get it out to the public.
- Discussed the issue of digital data which currently had the least amount of policy in existence. Practice evolves constantly due to the fact that digital data and devices and the media change constantly.
- Reviewed the process of what the panel did:

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- Made up of appointees suggested by Dr. Greenwald and Dr. Cohen and broadly representative of the FES research community including universities, national laboratories and corporate entities.
- A questionnaire was developed from the charge and all panels members agreed to assist.
- Each member did their own fact-finding.
- Dr. Cohen assembled the input into a document subsequent to vetting an outline of what they intended to do and the process with Dr. Greenwald and the panel members.
- The draft report was written and they did iterations with the panel.
- Discussed the outline of the panel report:
 - First part was the introduction, the process, overview and organization.
 - Main areas of the report included publications and reports, conference presentations, digital data, software and issues and challenges.
 - For publications and reports there was very little policy from the DOE. He considered that the community was self-organized with publications and reports getting information into the public forum through publications and journals.
 - Intellectual property, copyrights and patents was a mature process with plenty of policy. In addition there was additional institutional resources to assist the PI to know how manage the process.
 - Conference presentations had similar types of policies and practices with no vetting, different than publications with peer review for quality control.
 - With digital data he noted that major research groups have self-organized and have policy statements on how collaborations handled digital data, rules etc. and access is controlled.
 - He noted that the FES community did not have a lot of experience with requests from outside the community for access. He thought that this was an area about which the DOE should consider how access was given and the cost of that access. Noted that there could be conflicts between the Freedom of Information Act and America COMPETES Act involving abusive

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requests for access. Currently there were no protections against abusive requests for access to data.

- Another issue was the unintended consequences of a policy of promoting access to digital data. Stated this was complicated in that one would have to explain how the data was organized and what software dependencies there are to analyze the data. There would be a cost to the researcher to support the person making the request. The issue was raised as to whether this would be part of the researcher's obligation under the research grant. Thought that there was no guidance about long-term issues for access. There was also the issue of evolving technology affecting set policy for access to digital data.

[Discussion of the report by the full committee Dr. Martin Greenwald, FESAC Chair
Massachusetts Institute of Technology](#)

Dr. Greenwald thanked Dr. Cohen and his panel for efficiently dealing with the charge.

Dr. Rosner noted that a review took place a decade ago but thought that the issue not discussed then and now this report was reflecting an issue of the isolation of the FES community from the rest of the physics community. He thought that the dissemination of results from a practical point of view was all about ensuring that the rest of the physics community was aware of their research. He considered this a long-standing problem for their community. Dr. Cohen responded that no one introduced that issue and he agreed that maybe that was part of the problem. He said he did not know how to respond to the statement but thought they shared the same practices. They had annual meetings where presentations are given in a public forum. They published in major journals, also available to the rest of the physics community and he continued to elaborate. He thought that the FES community in his opinion was not different to the physics community. Dr. Rosner gave an example of fewer speakers from their specific community in colloquia compared to speakers from the general physics community. Dr. Cohen agreed with him but thought the discussion was orthogonal to the conditions of the charge. Dr. Greenwald agreed with him but thought it was an important issue that he would like to put on a future agenda for discussion.

Dr. Meade said he did a great job with the panel. He considered data extremely important as it was the product of their research and it should be disseminated, archived and preserved. He discussed archiving or legacy data and thought that having access to raw data was important as it would allow them the opportunity to investigate it again and see if there were alternate interpretations. He thought that

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there should be a well-defined policy on legacy data. He thought if there were key experiments that they should do a better job preserving them. He thought it might be helpful to follow up with institutions to determine what their data retention policies are. He thought they should consider the issue of access to ITER data and review the policy documents to ensure they had access, not only to the physics data but data on the project going forward. Dr. Cohen related an anecdote about team collaborations and how they handled data within the collaboration. He noted the tenets were similar but details varied.

Dr. Greenwald noted that they should consider intellectual property and publications policies and standards which are different nationally and internationally and this would be a challenge. This issue had come up already with ITER.

Dr. Ji discussed legacy data and noted that sometimes you did not know what was important so the issue was what data should be kept. He considered that perhaps all data should be kept and this was especially true for experimental data. He thought that there was a huge amount of simulation data in the U.S. and this raised also the question of storage for the simulation data. Dr. Cohen responded that the panel did not address the policy across the board about how long data was kept, whether it was from numerical simulation or experiment. Dr. Greenwald noted that all the offices had the same charge so information about how they handled that issue would be available when their investigations were complete.

Dr. Ellen Meeks asked about software and the importance of validated simulation for moving a program forward. She thought part of that was the ability to use that software and be able to apply it in a meaningful way. She noted in the documents that it stated they would not fund anybody to do that. She considered that unrealistic that a person that would come up with an algorithm and code was the same one who would maintain it in the long term. She thought the DOE should consider a user facility type of approach in the same way that technicians would support a user facility to think about having professionals involved in supporting and maintaining software. She thought the costs initially spent would be offset by the benefits of moving modeling forward.

Dr. Christopher Keane, after talking with people from other offices thought that there was a common thread, with them saying after 12 to 18 months all the data was released and it was often just put up on the web. This dissemination costs money. He asked what Dr. Cohen's sense of that was. He asked if they had discussed this automatic 12 to 18 months automatic time out period for data dissemination. He noted it was very common in other communities. Dr. Cohen responded that his sense was that none of their data was put on a public website. Somebody had to make a request to the originators of the

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data. He thought releasing data in that manner would mean it would have to be in a format that was self-describing, and this got more into the issue of resource implications.

Dr. Ramon Leeper brought up the archiving of digital data and stated it was not just the raw data but the meta-data about the data. He thought there should be more use of relational databases. He thought that these databases should be used because after a year you might not remember the calibration file. He thought that would create quality problems and it would come up when data was re-analyzed at a later time. He asked Dr. Cohen if they had considered these issues. Dr. Cohen replied it came up under issues when a lack of uniformity of policy was noticed. He stated the charge did not ask them to go there but to review.

Dr. Synakowski thanked Dr. Cohen for the report. He asked whether during any of his discussions any comments came up with regard to existing international efforts, anything to do with real life situations. Dr. Cohen said no. He said that there was some discussion about data within collaboration groups in their own facilities but he didn't hear anyone complaining about international standards causing friction with U.S. standards.

Dr. Greenwald said he would like them to vote and asked how many were in favor of accepting this report and forwarding it to the OS? The vote was unanimously in favor.

[Briefing on the Fusion Nuclear Sciences Pathway Assessment activity Dr. Charles Kessel, FNSPA Leader](#)

[Presentation - Briefing on the Fusion Nuclear Sciences Pathway Assessment activity Dr. Charles Kessel - Slides](#)

Dr. Charles Kessel, FNSPA Leader

- Gave an update and provided details of their progress:
 - Kick-off meeting in July 2010 and discussions at FNST (Fusion Nuclear Science and Technology) meeting at UCLA in August 2010.

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- Charter was established. And topical groups were established to identify required R&D identified for a 5-10 year period.
- Four meetings were completed covering:
 - Materials science and technology – December 2010, and May 2011
 - Power extraction and tritium sustainability issues, and PFC/PMI (Plasma Facing Component) (Plasma Material Interaction) - January 2011
 - Enabling technologies, design activities, and safety and environment - March 2011
 - All topical groups recently provided reports on their writing and structure of reporting
- Groups also discussed issues in series of conference calls.
- Construction of a DEMO power plant parameter table and an exercise to examine the "missions" on a path to DEMO.
- Provided a report outline:
 - Introduction and DEMO projection table of parameters.
 - FNS topical areas R&D specification, detailing five areas
 - Facilities list and timelines after collecting facility information from topical areas.
 - Plasma duration and sustainment and keeping track of plasma issues.
 - Leveraging opportunities including international collaborations and useful inter-agency relationships.
 - FNSF and DEMO design activities.
 - Pathway to FNS facilities and DEMO missions and metrics.
- Introduced the FNS-PA core group and also reflected members under topical groups.
- Discussed the DEMO/power plant parameter table noting that its purpose was to provide a long-term vision, a vector direction and carried some uncertainty. Noted that looking back from the

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DEMO/power plant that their R&D was moving in a direction consistent with their vision. Discussed the plasma parameters both with moderate and aggressive visions.

- Discussed materials science and power extraction/tritium, a first topical area and R&D example. Noted it was led by R. Kurtz and B. Wirth. Listed some subtopics including: structural materials; PFC, breeding/blankets; tritium; insulating, diagnostics; corrosion, compatibility; and design criteria, licensing and safety, high temperature. Noted their focus is single effects to few effects to material science including non-nuclear and neutron irradiation effects. Noted that some subgroups needed a timeline to focus their R&D.
- Discussed the near-term (5 years) structural materials and reviewed the RAFM (Reduced Activation Ferritic Martensitic) Steels, ODS or Nanostructured Ferritic Alloys, Tungsten Alloys and Vacuum Vessel Steels.
- Discussed the long-term (5-15 years) structural materials and reviewed the RAFM Steels, ODS Alloys and Tungsten Alloys. Reviewed also SiC (Silicon Carbide) Composites and Vanadium Alloys.
- Listed critical resource needs including research scientists and engineers and materials science facilities. Also listed further needs including non-nuclear structural integrity benchmarking facilities and other facilities (such as extensive computational resources). Included fission reactors and a fusion relevant neutron source as critical resources.
- Discussed another topical area, power extraction and tritium sustainability: blanket science. Listed immediate research needs. Noted that the area was led by N. Morley, M. Abdou and S. Willms. Reviewed four separate sub-tasks. Noted that for medium term research (5 – 10 years) six main areas were identified.
- Discussed another topic in the report, plasma duration and sustainment. Did not identify specific R&D but listed critical plasma physics areas that affected the FNS mission's success.
- Reviewed design activities as part of their R&D. Described the graphic showing full device and subsystem design parts.
- Discussed the examination of possible FNS steps/missions along the path to DEMO which was still in progress. Reviewed a table showing a series of metrics and six steps and the DEMO.

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COMMITTEE DISCUSSION

Dr. Nermin Uckan noted that they didn't receive a copy of his graphs. She asked if there was a charge for this group. She noted that she was not part of the working group and was not familiar with what the six steps represented. Dr. Greenwald stated that there was a difference between the brief that Dr. Kessel and his group were given when they began and the formal FESAC charge before us. He asked Dr. Synakowski to comment on the first. Dr. Synakowski responded that he didn't recall writing down something analogous to the FESAC charge that was talked about. He said that the FESAC charge captured most of what they talked about as the exercise was launched. The group was asked to focus on the gaps that existed in the world program that would enable them to get to a DEMO. Dr. Synakowski said it was a remarkable body of work that Dr. Kessel was putting together.

Dr. Rosner asked if the group had looked at other communities that had some similar science and engineering interests. Dr. Kessel responded in particular looking at experiments on high DPA (displacement per atom) rates that went into the several hundreds and he noted that the Russians were doing such experiments at the behest of American companies. Dr. Rosner asked if they were looking for collaborators who were likely to have the same interests. Dr. Kessel responded yes, adding that this would fall into the idea leveraging opportunities they had previously discussed; where they were asking people to review what was out there, including what U.S. institutions, like basic energy sciences, are doing.

Dr. Betti noted that this was a long-term project. He asked Dr. Kessel how much of his plan for FNS (fusion nuclear science) would change if instead of ITER he had a copper machine burning plasma which could be built relatively quickly. He asked if that would be more difficult to go ahead if burning plasma came quicker. Dr. Kessel responded that in reviewing the amount of research required in certain areas it would be quite significant. He noted that they did not have the knowledge base to go out and build blankets to put in a nuclear machine. He stated that there was a significant amount of non-nuclear research that would have to go on first before they would consider taking a step to a FNS facility. Technical details regarding this issue were discussed further.

A member asked for more detail on the multi-step road to DEMO analysis which would assist in quantifying some risk-benefit analysis. Dr. Kessel responded that they were still trying to fill the table out. He said they began with some rudimentary goals and proceeded to examine the information in technical detail. He noted that it should not be considered six separate machines but was more six steps or phases in a single machine.

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Dr. Hubbard asked if he was trying to identify a fast program or what was realistic on how soon they could have an FNS machine online to answer these questions. He was also asked if that was part of his report. Dr. Kessel said no, it was not part of their report. He noted that the timeline was uncertain and he explained that many people had difficulty in identifying what R&D they should address without some vision of where FNS be. As a result he stated that they did provide rough guidance of a period of time, for example 15 to 20 years.

[Lunch](#)

[Briefing on the report International Collaboration Opportunities for the US FES Program Dr. Michael Zarnstorff, Deputy Director for Research, Princeton Plasma Physics Laboratory](#)

[Presentation - Briefing on the report International Collaboration Opportunities for the US FES Program Dr. Michael Zarnstorff - Slides](#)

Dr. Michael Zarnstorff, Deputy Director for Research, Princeton Plasma Physics Laboratory

- Advised he was reporting the work of a task group under the US BPO (United States Burning Plasma Organization).
- Outlined the main areas to be discussed during the presentation including: the purpose of the study; criteria, methods & challenges; ReNeW issues for international collaboration; assessment opportunities for enhanced collaboration; and timescales and findings.
- Outlined the charge which was to evaluate and prioritize the opportunities for U.S. collaboration with the main international facilities including: EAST, KSTAR, JET and JT60SA.
- Cited the reasons for the motivation for international collaboration.
 - ITER, because it intrinsically is an international collaboration.
 - High priority ReNeW and other issues required capabilities not available in the U.S. such as long-pulse, superconducting coils, stellarators and larger scale and burning plasmas.
 - Fact that the U.S. had received invitations to partner on new international facilities with shared responsibility and financing giving some examples as: Wendelsein 7-X: whole program, JET: Extension past 2014 & DT program and BA: IFMIF & JT-60SA.

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- Outlined the criteria for choosing opportunities for collaboration.
 - Address and resolve critical fusion issues. ReNeW and FESAC reports used in identifying such issues. In addition issues that cannot be resolved in present U.S. facilities.
 - Opportunities that would maintain and develop key U.S. strengths.
 - Opportunities that would prepare the U.S. for participation in ITER and further steps toward fusion energy.
 - The collaborative opportunities should have significant impact and therefore be valued.
- Reviewed the methods for enhanced collaboration, how the collaborations could be effective and successful.
 - Where collaboration addresses U.S. priorities and involves the U.S. community resources have to be contributed.
 - For key goals to be achieved the U.S. would need to make substantial investments including responsibility for parts of a program.
 - The U.S. would need to dedicate staff and equipment.
 - Maintain continuous engagement over a period of time to build relationships and a knowledge base.
 - To develop partnerships such as ITER.
 - To be successful it should be synergistic for both parties, both benefiting, including the hosting facility and program. U.S. would need to maintain ongoing expertise.
 - Collaboration should be well structured from the beginning with open communication with parties.
- Explained the challenges to an international collaboration.
 - Different programs have different goals and constraints. The host sets the priorities and there the U.S. has a loss of control.

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- Planning a strong requirement to maintain and develop U.S. scientific leadership. There are explicit agreements with host for responsibilities, the use of resources to explore new ideas and the coordination of domestic activities to maintain expertise and value, bringing knowledge to the U.S. program.
- It is challenging for U.S. personnel with families and there is the risk for potential loss of relocated personnel.
- Reviewed the technical capabilities of the international facilities with an emphasis on magnetic confinement devices as per the charge.
- Defined the key characteristics available in international machines that were relevant for the ReNeW issues. Noted what was important in these machines or what could they bring to their ability to address ReNeW issues. Identified some of the top-level ones as: steady-state/very long pulse: SC coils; large scale tokamaks & stellarators – closer to burning plasmas; DT plasmas; other ITER-like characteristics such as PFC materials or in-vessel control coils; novel divertor geometries, 2D & 3D; actively cooled internal components, thermally equilibrated, high temp; and remote maintenance.
- Reviewed the ReNeW issues only accessible by international facilities, current or under construction. Noted that across the board there were issues that needed to participate in international collaboration if they were to go forward in the near term. Stated that some issues were not covered by international facilities and these represented opportunities for a vibrant domestic program.
- Reviewed an assessment of each of the confinement facilities, examining each from different directions such as what were their technical capabilities and what were their development plans. Asked also what was their technical importance to the U.S. program? Looked at the opportunities for enhanced U.S. collaboration or what could the U.S. contribute to make the facility more effective.
- Reviewed the evaluation table in Section 4, in particular which machine could address issues and on what time scale. Reviewed the Facility Evolution Timescales and commented on the many opportunities available for participation.
- Reviewed the opportunities for enhanced collaboration with the highest impact including JET, W 7-X, EAST and EAST and KSTAR followed by JT-60SA.

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- Reviewed the decision timelines:
 - JET invitation, a decision needs to be made quickly as JET is running out of time.
 - EAST is moving quickly, it has an aggressive program. They are petitioning the U.S. to help as well as other international partners. Resources need to be given.
 - W-7X has extended an invitation for U.S. partnership. The program has decided to participate not at the partnership level but is making capital contributions.
 - KSTAR collaboration is having a big impact but can be strengthened with increased funding.
 - JT-60SA is a longer level and a decision has to be made whether the U.S. wants to get into the broader approach soon or later. A strategy has to be determined.

COMMITTEE DISCUSSION

Dr. Fonck mentioned JET and asked if they did not have ITER prototype plans for ELM (edge localized modes) suppression coils. Dr. Zarnstorff responded that they have $n = 2$ coils but noted that they were not sufficient and there is only one in the poloidal direction. Dr. Fonck asked within their schedule was there any time to do anything else. Dr. Zarnstorff responded that in the report there was a discussion about that issue. He confirmed that they had already worked with them and there was a project to evaluate the feasibility of installing a set of R&P coils into JET for both RWM and ELM suppression. Noted that the conclusion of the study was a feasibility study and a practicality study and said that yes, you could do it. Stated that the cost was \$60 million and the conclusion was it was doable.

Dr. Fonck asked if a partnership opportunity existed for EAST or did they just want help here and there. Dr. Zarnstorff responded that they had not been invited help in such an explicit way, and do not think of it in terms of co-ownership. Dr. Synakowski said that there was a high potential for collaboration, and Dr. Zarnstorff indicated that his sense was the same, and that they had offered third shift usage of their machine. As of yet no substantive discussion had occurred on this front, but he believed that more of a sense of co ownership might evolve naturally if the US had more involvement.

Dr. Meade asked when one would say "long pulse", what was long pulse. He asked if he could be more specific than just the number of clock seconds. Dr. Zarnstorff responded that the members of the team had limited time so did not do any simulations. He noted that some of them were available in the literature. He said that it was different for different ReNeW issues. Dr. Meade wanted to clarify that long pulse was not steady-state. Dr. Zarnstorff agreed but said that some of the machines in principal

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could operate steady state if upgraded. Dr. Meade said there were some issues that needed to be addressed in a steady-state. Dr. Zarnstorff said that some of the machines in principle could operate steady-state. Dr. Meade brought up the issue of the facility evolution curve. He thought it would be useful to look at the duration of the pulse and also noted that power densities were important for addressing some of the issues.

Dr. Meade asked what partnership meant on JET and W7-X. Dr. Zarnstorff responded that you would then be a member of the decision-making process in a decision-making body, so you would be contributing at the level where they would give you a seat at the table. He elaborated on the European relationship with JET where the U.S. was not a member of the team but had to be vouched for. Dr. Meade said that was really what he was asking about, the JET sensitivity about U.S. participation. Dr. Zarnstorff confirmed that their offer was that the U.S. would be part of the decision process and would be a member of the team with full rights.

Dr. Synakowski urged that they think about the scientific axes under which the facilities map if they were thinking about what works best for the U.S. and also thinking more broadly than U.S. interests. He thought that they should think about fusion on a global scale and then the U.S. interests and opportunities would fall out and be obvious. He noted he understood the role of niches but sometimes the importance of finding one was overblown. He thought that sometimes there was a higher value in overlapping or competing interest where juices might really get flowing. His view was they ought ensure there was constructive coupling with the overall program goal.

Dr. Ellen Meeks asked about the issue of intellectual property regarding the collaborations. She also asked about one of the comments during the presentation when it was stated that we're interested in science and they're interested in technology. She thought that the U.S. community should also be considering technology. Dr. Zarnstorff stated that the issue of intellectual property comes up over and over in the ITER discussions and their approach in ITER as well as in the other collaborations is different in how much they value or try to conserve intellectual property. He did not think that the U.S. was very focused about it compared to the other partners. He thought that many of the partners were focused on fusion energy in a much shorter timescale than the U.S. and that was relevant to intellectual property rights.

Dr. Betti stated that he was concerned about the charge given to the FESAC saying that nothing was going to be built in the U.S. for the next 20 years. He noted that the machines that Dr. Zarnstorff was discussing were not large devices (EAST and KSTAR) and yet they would be the cutting edge of fusion physics. He asked why could the U.S., even with a flat budget build something at this level and then shut down several old machines and build a new one. He asked why that would be inconceivable. Dr.

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Synakowski responded that the math did not add up, that they could not support the facility construction for the device class that he was talking about. Dr. Synakowski added that certain things had to be taken into consideration such as budget unknowns for the Office of Science and the growing costs of ITER and other projects. He added it was not just an FES issue but an Office of Science issue and their focus had to be on ITER success, and these other smaller machines operation was already in discussion in long term planning as it was. These boundaries meant that talking about non-ITER portfolio projects had no legs.

Dr. Hubbard underscored mention of the personnel difficulties with international collaboration, and indicated that this was particularly severe due to the number of two-career couples, and that relocation could lead to loss, and that they had to think of work force development.

Dr. Ji asked for clarification about the criteria used for what defines a critical area for collaboration. Dr. Zarnstorff indicated that the Greenwall panel report as a surrogate.

[Discussion of the new charge Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology](#)

Dr. Greenwald noted that he would like to say a few words and then spend about half an hour talking about the international charge and then a subsequent half an hour on the materials and nuclear science charge.

- Noted that they are talking about one letter and two charges so there were two panels. On the international panel he had asked Dr. Meade to be Chair and he agreed. Dr. Meade would be forming his committee as soon as possible.
- Noted for the second charge they were envisioning zero order continuity which was to say Dr. Kessel would continue to lead the effort transitioning from independent to a FESAC-chartered activity.
- Stated that a number of FESAC members had been asked to join or participate in different ways. Dr. Farrokh Najmabadi had agreed to be a deputy which would help provide contact on the committee and Dr. Steven Zinkle and Dr. Richard Callis had agreed to join to provide a stronger connection.

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- Stated that Dr. Kessel might make some small changes in his group in the short term.

Dr. Greenwald asked Dr. Meade if he had anything to say otherwise they could go ahead and continue the discussion on the charge.

Dr. Meade noted that it was an important task that needed to be done quickly in the period of six months. He said it would require the help of a lot of people. Stated they have a lot of material to use as a starting point, the Opportunities and Priorities Panel Report, ReNeW, the report that Dr. Zarnstorff just presented. He added that the challenge would be addressing some of the questions asked in the last session and choosing which of them presented the greatest opportunity and how they quantified that and addressed the cost for doing a meaningful and effective collaboration. He thought during the next few years there would be a number of collaborations so it would be good to have a plan laid out that might have a five-year timeframe. He said he would first develop a work plan first, then form a committee and identify the tasks that needed to be carried out to respond to the charge.

Dr. Synakowski thought the most important thing was clarifying where the opportunities were. He thought that a starting point might be what present U.S. capabilities are and the more uneasy starting point was to look at the question of whether there was a significant reduction in U.S. domestic capability experimentally.

Dr. Greenwald thought it was an opportunity to not just look at it tactically but strategically and so he hoped that the committee could take a broad view at what benefits both the U.S. and the world program.

Dr. Synakowski said that strategic ideas drawn with a broad brush would be welcome and more useful perhaps than having a particular plan outlined. He suggested strategic ideas outlining two or three different kinds of futures noting the benefits and the risks.

Dr. Cohen stated that Dr. Meade used the word “plan” in what he was setting out to do. He thought that explicit plans were what the office controlled but the charge was asking for an assessment of areas and opportunities. He noted that did not preclude ranking what was important but he did not think that creating a plan of how to pursue this within the program did not sound like what the charge was asking for.

Dr. Fonck noted that looking for strategic opportunities made perfect sense but he suggested caution hearing an undercurrent that somehow with U.S. budget concerns that this might be a way to offload costs. He thought that this would not work and instead international collaborations would be just as expensive as domestic activities.

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Dr. Keane noted that the ICF program had been involved in major collaborations for a long time. He thought that the experience had been that it was expensive but very good. There were also other impacts besides the technical aspects. They had looked at it through the ReNeW lens but also it could have subtle effects, it could change the direction of activities via the interactions that collaborations produce. He thought looking at it strategically was important in the long term.

Dr. Uckan suggested that with international collaborations sometimes staff became a part of that project or organization rather than identifying with their own country. She suggested the result could sometimes be that that employees would become more of an asset to the project than an asset to their own organization or country. Dr. Synakowski agreed that the sociology of collaborations was complex and fraught with risk.

Dr. Fonck noted that a similar problem can occur with national collaborations and that they should ensure that national collaborations could be successful before assuming international collaborations would work well. He thought the sociological issues had to be studied beforehand. Dr. Synakowski stated that the charge was asking them to look at that issue and he thought that they should look at the national experience with collaborations. Dr. Greenwald added that the role of universities and the training of students was very tied up with that and they should include their roles in any discussions.

Dr. Ji stated that the charge was a half-year exercise which was very fast. He wanted to support the broader view and wanted to point out that the criteria to be used to select topics and areas was important because there should be some standards which should be made clear to the community.

A member noted that in Dr. Zarnstorff's presentation he chose the ReNeW and opportunities report to compare what they could use the international machines for. He noted that they should not lose sight of the fact that in the next ten years ITER would be starting up and they needed to ensure they had leadership capabilities there and the international machines could be a stepping stone to achieve that. He thought that should be incorporated in Dr. Meade's review of what opportunities there were.

Dr. Hubbard commented about Dr. Synakowski's remarks about not looking specifically at U.S. interests in the collaborations, just in advancing fusion. She said they were trying to determine how to spend U.S. taxpayer's money and she thought at some point they needed to look at and see what would be good for the U.S. program and position them well. Dr. Synakowski responded that everyone carried a sense of urgency about fusion and if the international community was successful then it would be of a lesser importance in determining individual countries' interests. He stated it was important to have a global view but he agreed it was a complex challenge.

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Dr Greenwald asked that they now move on to discuss the second part of the charge. He reminded the members that it was an exercise to develop a plan for fusion nuclear sciences pathways and materials research. He noted that they should assume that long-range plans were going to be re-visited many times before it got executed. He made this point to emphasize that they should not worry excessively about details.

Before the discussion Dr. Kessel commented that they would like to be allowed to complete the report. He said they have contributors completing the writing of individual sections now and they would like to assemble the information to completion. He noted the other issue was getting information out and that they would set up a website soon, available to FESAC members and the public if they decided to do that.

Dr. Fonck agreed Dr. Kessel's group had done a great job however it seemed they would go on to activity which would build off their own work to make a FESAC report. He thought it appeared that the committee was vetting its own work. He was uncomfortable with that as a FESAC report. Dr. Synakowski said one of the reasons for bringing it in was to have an inclusion of fresh ideas. Dr. Fonck asked whether there should be a separate committee to look it over and vet it. Dr. Synakowski responded that a separate group to review and vet it was another idea not particularly well formed. He said that early on they had discussed the possibility of if there were different strategies implicit there could be some sort of red team, blue team examination of those strategies. He stated that would bring in a larger group of people.

Dr. Kessel responded that the report from the beginning was a technical informational report so they were not proposing strategies and they were asked not to make the report as plans for FES. He said that there was discussion of having a critical review of the report by people who were not on the committee. He said FESAC could serve as the committee or they could appoint one. He said there was also an intention to have community input once it was written. He said that as for metrics for judging the actual fusion nuclear science facility(s), they would probably get into it on the surface level. FESAC participation would be useful at that point. He thought that if there were new things to do after the completion of the report then the group could be restructured.

Dr. Greenwald again emphasized the biggest impact would be on short-term program decisions. He thought that long-term plans were important insofar as they affected what was done in the short term.

Dr. Fonck thought that that sounded like an expediency argument. He said that when he was in charge of the BPO (Burning Plasma Organization) and they were asked to respond to Congress' demand for a plan for U.S. participation in ITER they constituted a panel and completed that and they brought it to FESAC for their input. He stated he was of mixed minds on the issue but he thought there was a

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precedent. He asked if they used the argument for near-term issues with some people saying there was not much of a controversy then there would not be a clear path for long-term planning and instead groups of shorter-term reports presented. Dr. Greenwald confirmed that the report they were writing now was not a FESAC report. Dr. Fonck stated he understood that but that there would be a FESAC report to the charge. Dr. Greenwald agreed that it would try to address the specific charge they had been given.

Dr. Cohen noted that they had had two major studies addressing the area and now they were folding it into a FESAC charge. He said that Dr. Synakowski wanted vetting and critiquing. He said that there was not a 100 percent mapping of the Kessel group report to their charge and therefore the FESAC group led by Dr. Kessel would have to ensure they understood what Dr. Synakowski was looking for and see how much of their report mapped on to it and what was missing.

A member asked if Dr. Synakowski was looking for a roadmap on how they would get from where they were now to filling the gaps in the area of the charge. He said that when they were doing ReNeW they were told not to make a roadmap. He said if that was now what they were asking, it would be beneficial to know that. Dr. Synakowski responded that ReNeW was different. The charge was asking for, in part, possible paths to get there and risks associated with the paths, this wasn't asked for with ReNeW.

Dr. Hubbard asked what they were looking for as a response to question 3 of the charge, is this 90 percent level the same as what Dr. Kessel's group has done or whether it was a small subset. Did it include a number of things that they had not done. Dr. Synakowski responded that what Dr. Kessel and the group had done was something of a superset of the charge. He noted that a lot of work had been laid out in developing the rollback look. He thought it was important that this had been laid out, such that these gaps can be clarify the gaps and identify what was important. Much of this work, especially that in the R&D section, maps well to the charge.

Dr. Meade asked about the constitution of the FESAC panel. He said it was important for Dr. Kessel and his group to complete the report. Then he thought it would be good to establish a new FESAC panel to be named. He suggested you could have members from the original panel. Dr. Greenwald said that a wholesale change would not make sense as you would lose your expertise. Dr. Meade said he did not advocate a wholesale change. He did think though that there should be enough new members that one would feel comfortable about there being an independent review and vetting of the report. Dr. Meade asked about a part where they stated they would like information on some of the near-term R&D so plans could be made for funding and solicitations could be initiated. He asked if that required that this be completed by January. Dr. Synakowski said the reply to the charge was January 31.

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Dr. Ji proposed a cleanly separate FESAC panel to review Dr. Kessel's report, and to add missing parts for the charge, in order to complete the report quickly answering the charge by the deadline.

Dr. Fonck asked what a full FESAC panel would do differently than Dr. Kessel's group had done. He thought there was very little difference between the charge and what Dr. Kessel's group had been asked to do. He wondered what form the FESAC report would take. He asked that if what they needed was some idea of what near-term opportunities would be for materials solicitation or technology, then would it suffice to have Dr. Kessel's group report reviewed by FESAC? Would they then consider it reasonable though it was not a FESAC report. Dr. Fonck stated he did not understand the need. Dr. Synakowski responded that from one perspective he could take advice from FESAC whereas he could not take technical advice from the activity that Dr. Kessel was leading. Dr. Greenwald stated that there was an opportunity to synthesize findings, recommendations and advice then the FESAC panel would be the right vehicle to do it.

Dr. Zinkle commented that Dr. Greenwald had well characterized the distinction between what the charge was versus what Dr. Kessel's panel had been doing. The charge would synthesize the results using resources such as those put together by Dr. Kessel. He noted then there was the risk assessment which was not being handled currently and some other prioritization issues. So the panel would use those types of resources and synthesize that information into something that could be presented as advice.

[Break](#)

The Advisory Committee recessed for a 15 minute break.

[Update on ITER Project Status Tom Vanek, Senior Policy Advisor, Fusion Energy Sciences](#)

[Presentation - Update on ITER Project Status Tom Vanek - Slides](#)

Tom Vanek, *Senior Policy Advisor, Fusion Energy Sciences*

- Advised that he had been involved with ITER since its inception.
- Showed a diagram of the ITER machine and stated it was probably rev 16 at this point. Confirmed that the design was complete and they were ready to proceed with construction.

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- Noted that in his last presentation he discussed significant progress made mainly in the area of the management of the project. Added that progress had continued and began with domestic progress where large contracts had been awarded including the CS magnet contract representing 8 percent of the U.S. ITER hardware commitment.
- Discussed the change taking place from R&D to talking to industry and getting them heavily involved.
- Advised that in April they had a project assessment review team (a Lehman Review) visit Oak Ridge. Stated that during a three-day review they looked at all aspects of the planning and management for U.S. contributions to ITER.
- Noted that their comments were that the team at Oak Ridge needed to continue to be aggressive in preparing for U.S. commitments to ITER. Said that a follow-up was planned in the fall in early November.
- Stated that the question they were facing was how did it affect CD 2 (Critical Decision-2)? Stated that currently they were operating under CD1 for which they had an established range of costs for the U.S. contributions to ITER that went from \$1.45 to \$2.2 billion dollars. Advised that since that CD1 milestone they had schedule slippage and some additional scope added to the U.S. contributions. Noted that they also had a Lehman recommendation that they increase their contingency.
- Stated that Dr. Synakowski had mentioned the appointment of the Management Assessor (MA) which was one of the agenda items at IC-8 in June. Explained that the MA was a representative of the Indian government audit agency and he said that interactions to date had been very positive. They were looking forward to his report in IC-9 in November.
- Stated that the most significant event since his last presentation was the Japanese earthquake which occurred in mid March. He noted that after initial investigations they determined that damage to infrastructure and loss of life was more localized than expected. Reviewed the position with regard to damage at the ITER sites in Japan. Noted that one of the effects had been the question of how well the Japanese could fulfill their commitment in the near and intermediate terms and how that would affect the delivery of Japanese and some EU components to ITER. Stated that for the U.S. the question was how it would affect their performance on the CS conductor, a critical path item for the Japanese, feeding into a critical path item of CS magnets.

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- Discussed the EU funding which was also significant. Stated the U.S. request for 2010 for ITER was \$105 million, up \$25 million if you looked at the baseline number of FY11. Noted the final number was \$80 million for FY11, down from \$135 in FY10.
- Noted that they were trying to mesh their domestic budget and planning process with the IO and with other members. Stated they were trying to assess how delays in Japan and how delays by EU due to lack of funding would affect the final delivery schedule.
- Said they were trying to limit all delays to one year. Stated that the DG had pledged to try to keep the delay to no more than one additional year taking them to sometime during 2020.
- Noted that whatever profile they agreed to, each of the seven members had to come up with a funding in their systems to meet those commitments.
- Stated that they were looking for November's IC-9 meeting to approve a new baseline schedule. Noted that the Scheduled Task Group (STG) was looking at schedule delays and they were finding that it might not be possible to compile all the information from all members into a coherent product and provide a final baseline for approval at the ITER council meeting.
- Emphasized that they needed to convince Congress and the Administration that fusion deserved continued support for the country's energy future.
- Discussed the damage in Japan and said it was not as significant as first feared. Noted that a lot of resources had been diverted towards recovery. Explained they were trying to isolate the difficulties between what was caused by the earthquake and the tsunami and what was caused by funding difficulties within the Japanese government. Advised they had offered assistance to the Japanese government, technical assistance and material assistance. Noted that there was an ongoing discussion between the U.S. and Japan and concurrently with Japan and other members of ITER to determine if there should be an appropriate redistribution of tasks that would accelerate the schedule.
- Stated that for the EU they were roughly 1.3 billion Euros short for the funding required for 2012 and 2013. Noted that they had not created a plan that had received approval by the council's ministers or by the European Parliament. He explained that the EU was funded directly by contributions from the member states. Stated that the framework proposal for 2014 through 2020 the EU Commission had proposed that the EU receive authority to tax and ITER and portions of the European space program had been put in that fund (contingent fund) and the

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fund was contingent upon approval of the direct taxation authority. Stated that he did not necessarily think that the member states would go along with the tax. Thought that the EU would have to put the expense for ITER and the space program into their core funded program.

- Commented on how well the management and council was working in ITER. Noted that the U.S. relationship with the other members was still strong.

COMMITTEE DISCUSSION

Dr. Rosner asked about Mr. Vanek's comment that in the fall it might not be possible to come up with a finalized schedule for the project. He added that there was a suggestion that someone would not deliver the goods. He asked who that was. Mr. Vanek responded that the areas of uncertainty were really related to what was mentioned, the Japanese and the EU. Dr. Rosner asked about the challenges listed saying the challenges were political, fiscal and economic. He asked if the Lehman Review got the U.S. part of the project to increase their contingency, he added that it would suggest to him that it also was a technical issue. Mr. Vanek responded that the Lehman committee was concerned that many ITER components had never been built before. He noted that no one would want to go above their financial cap and when there was uncertainty you want to ensure that you have room in case there was a difficulty. He noted that their contingency was 40 percent. There was some discussion about the management of the project being mainly under EU and Japanese control. He said that for domestic management they were probably ahead of the other members in understanding their scope.

Dr. Fonck asked if there was a delay due to the situation in Japan and if it would impact the U.S. CD-2 schedule. Mr. Vanek said that the U.S. would have liked to deliver along a schedule that met the IO requirements and lead dates but also met theirs. Stated that if the IO schedule was not further changed he thought they had a schedule now that would align with that one-year delay. Dr. Fonck asked if the budget estimates for CD-2 would be okay by then. Mr. Vanek said they were pretty well in hand. Dr. Fonck asked who would make the final decision on the EU thrust for direct taxing authority. Mr. Vanek replied it was a proposal from the EU commission that would have to get through the Council of Ministers which was the ministers from the 27 members and the European Parliament.

A member asked if the issues for the Japanese were budgetary or were they technical issues as well. Mr. Vanek replied that there was an issue of the spec on the cable which he noted right now was spec to go to 60,000 cycles. He elaborated on a technical explanation of this issue. He confirmed there were ongoing meetings about the issue.

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Dr. Ji noted that it would be good to have more periodic updates about what was going on at ITER, more streamlined information, perhaps weekly updates. Mr. Vanek took his point but said that there was periodic information posted on the USIPO (United States ITER Project Office) website. He said the IO had a weekly ITER news line that was full of information and was at www.iter.org

[Public Comment Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology](#)

Dr. Greenwald noted that public comment was the next item on the agenda and there are two speakers. He listed Dr. Hutch Neilson and Dr. Rob Goldston.

Hutch Neilson, PPPL

- Stated that they needed a roadmap to commercial MFE . Said that it might seem at odds with discouraging news of a constrained budget, but in any environment this was necessary.
- Stated that they focus on ITER which was ongoing, and though it was important to focus on the next step he believed it important to understand the path all the way to commercial MFE.
- Explained that it was important to have a plan that could be explained and used to make the case for fusion for any level of effort.
- Noted that fusion, ITER was something that would constantly have to be explained, defended, and justified on an ongoing basis. Added that part of the story was explaining what ITER lead to, what came after and what would come in addition to ITER. Thought it was important to have the whole picture.
- Said that groups taking an interest in MFE ask when, how much was it going to cost, what were the benefits, what were the risks so he noted that they needed to be able to give thoughtful answers.
- Stated that he thought a framework was needed for ordering priorities, targeting international collaborations and managing risks.
- Advised of an organized International Workshop MFE Roadmapping in the ITER Era at Princeton, New Jersey, September 7 – 10, 2011. Reviewed the topics of the workshop and focus and gave details of the planning and contributing team.

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COMMITTEE DISCUSSION

Dr. Uckan asked who was running the workshop, and who commissioned it. Mr. Neilson responded that the Princeton Plasma Physics Laboratory took the initiative to organize the workshop. He noted that they were doing it as part of their responsibility to serve the community, not for the purpose of an individual laboratory.

Dr. Rob Goldston

- Stated that ReNeW had five themes: burning plasma, steady state, plasma materials interactions, fusion nuclear science and configuration optimization.
- Stated using the above set it seemed that the Pathways Study has focused on fusion nuclear science and the others were serving nuclear science, (how do we get there?) and then within fusion nuclear science (what do we do?).
- Noted that he looked forward to getting a final version of the report. Suggested that they not change the committee until the existing report is complete.
- Stated that the new FESAC charge was about the near and medium-term plasma material interaction and fusion nuclear science issues. Stated that it was notably different than the Pathways Study. Thought it should build off the Pathways report but thought it might need a different mix of people.

COMMITTEE DISCUSSION

Dr. Hubbard asked whether Dr. Kessel's report was going to include just theme four or themes three and four. Dr. Synakowski replied for Dr. Kessel as he was on the road. He said that maybe the emphasis they had was derived from the particular approach they took.

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[FESAC discussions and preparation of the letter to DOE completing the research results charge Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology](#)

Dr. Greenwald noted the last order of business was approving a cover letter for the report that Dr. Cohen talked about. Noted that he had drafted one and that he would just go through and read it to the committee. He read the letter and asked if there were any disagreements or suggestions. Dr. Greenwald requested a motion to approve the letter.

A motion was given and seconded with no objections.

Dr. Greenwald advised they had completed the agenda but asked if committee members or Dr. Synakowski had any comments.

Dr. Synakowski thanked the committee for their discussions of substantive and important issues during the meeting. He referred to the two new charges and said that they were vehicles to begin important discussions on those issues and would develop. He thought that the international collaboration issue was out there and being discussed seriously. He noted that the materials science issue was evolving and becoming a FESAC enterprise, and was also critically important. Stated that the intention was to use the input and advance things and modify the constraints.

Dr. Rosner stated he was struck by the discussions and thought that they were taking an approach of considering what the U.S. would do internationally before considering the domestic program. He asked how they were thinking about that, was his impression incorrect. Dr. Synakowski responded that his wording right now was probably framed by a department where the environment was a challenging one. He stated that longer term challenges affect plans and that no matter what they do internationally including ITER they view it all as additive.

Dr. Greenwald thought that was a good point and something they may want to keep in mind when discussing things. He added that when he has had discussions with policymakers they are keen on the question of international competitiveness for the U.S. in high tech areas.

Dr. Synakowski stated that ITER when complete would be the largest project completed in the Office of Science. He thought supporting it in these extraordinary times required the highest level of support and they were receiving that support.

Dr. Greenwald thanked everybody and closed the meeting.

