FUSION ENERGY SCIENCES ADVISORY COMMITTEE
OFFICE OF SCIENCE

Bolger Center, 9600 Newbridge Drive
Potomac, MD 20854
Friday, March 15, 2013 at 9:00 am.

Agenda Friday, March 15, 2013

Time	Topic	Page	Speaker
9:00	Welcome, Meeting Agenda and Logistics	2	Dr. Martin Greenwald, FESAC Chair, Massachusetts Institute of Technology
9:05	DOE/FES Perspectives	3	Dr. Ed Synakowski, Associate Director for Fusion Energy Sciences
9:50	Break		
10:05	Presentation of the Report from the Subcommittee Dealing with the Charge on Prioritization of Scientific User Facilities	9	Dr. John Sarff, Subcommittee Chair, University of Wisconsin
12:00	Lunch		
	Office Of Science, Statement On Digital Data Management	24	Dr. Laura Biven, Senior Science and Technology Advisor, Office of the Deputy Director for Science Programs
1:00	Public Comment	30	
1:30	Discussion of the Subcommittee Report on Prioritization of Scientific User Facilities	34	Dr. Martin Greenwald, FESAC Chair, Massachusetts Institute of Technology
	Preparation of the Letter to Transmit the FESAC Report on Prioritization of Scientific User Facilities to DOE	40	Dr. Martin Greenwald, FESAC Chair, Massachusetts Institute of Technology
4:00	Adjourn	40	

FRIDAY, MARCH 15, 2013

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

WELCOME

Dr. Greenwald began the meeting with several announcements. He asked visitors to ensure they signed in as it was important for official records. He noted that regarding lunch, there was a buffet luncheon available in the building and tickets were available at the registration desk. He asked members of the audience who wanted to make public comments to contact Albert Opdenaker to sign up and added it was preferable to arrange that by midday. He stated finally that the schedule for public comment would change and it would now take place between the two agenda items scheduled for the afternoon which would be approximately 2:30 p.m.

ROLL CALL

Committee/Voting Members Present:
Dr. Martin J. Greenwald, Chair (MIT)
Dr. Riccardo Betti, Vice-Chair (U. of Rochester)
Dr. Bruce Cohen* (LLNL)
Dr. Amanda Hubbard (MIT)
Dr. Hantao Ji (PPPL)
Dr. Christopher J. Keane (LLNL)
Dr. Kathryn McCarthy* (INL)
Dr. Dale M. Meade (Princeton)
Dr. Farrokh Najmabadi (UC San Diego)
Dr. Robert Rosner (U. of Chicago)
Prof. Edward Thomas, Jr. (Auburn U.)
Dr. Nermin Uckan (ORNL)
Dr. Steven Zinkle (ORNL)

Committee/Voting Members Absent:
Dr. Richard W. Callis (General Atomics)
Dr. Raymond J. Fonck (U WI)
Dr. Ramon Leeper (SNL)
Dr. Ellen Meeks (Reaction Design, LLC)

*Attended via conference call

Liasons/ex officios Present:

Liasons/ex officios Absent:
Dr. Fred Skiff (APS/DPP)
Dr. John W. Steadman (IEEE-USA)
Dr. Minami Yoda (ANS/FED)

DOE DOE/SC Attendees:
Dr. Ed Synakowski, Associate Director, FES, Committee DFO
Dr. James Van Dam, Director, Research Division
Dr. Sam Barish
Dr. Curtis Bolton
Dr. Steve Eckstrand
Dr. Sean Finnegan

Other Attendees:
Dr. Jeff Binder, ORNL
Dr. Richard Buttery, GA
Dr. Steve Dean, FPA
Mr. Mark Haynes, Concordia Power
Dr. Arnold Kritz, Lehigh U
Dr. Earl Marmar, MIT

Dr. John Glowienka
Dr. John Mandrekas
Mr. Gene Nardella
Mr. Albert L. Opdenaker III
Dr. Nirmol Podder
Dr. Kathleen Ratcliff
Dr. Ann Satsangi
Mr. Edward Stevens
Prof. Gerald Navratil, Columbia U
Dr. Miklos Porkolab, MIT
Dr. Stewart Prager, PPPL
Dr. Roger Raman, U of WA
Prof. John Sarff, U WI
Dr. Tony Taylor, GA
Dr. Mike Zarnstorff, PPPL

DOE/FES PERSPECTIVES

Dr. Ed Synakowski, ***Associate Director of the Office of Science, for Fusion Energy Sciences***

- Noted that the slides for his presentation were short and he acknowledged that did not reflect the state of play in the community given the unusual events going on with regard to the budget.
- Stated that as a consequence he knew there would be many questions but that there was only so much he could say at the present time.
- Referred to the agenda of the meeting and acknowledged there was a great deal of interest with regard to ITER (International Thermonuclear Experimental Reactor) and noted that they had decided not to have an ITER presentation at the current meeting because it was felt it would be more useful to hear about ITER within the context of the FY 2014 budget proposal. He said it would be more impactful and useful to hear about ITER at the next meeting yet to be scheduled subsequent to the budget rollout.
- Thanked the committee members for their efforts in attending and in particular John Sarff and Don Rej for leading the effort with regard to the production of the report concerning an assessment of facility priorities in a very compressed timeline.
- Stated that he would discuss the factual situation as far as he knew it with regard to the CR (Continuing Resolution). He acknowledged that it was more or less uncharted territory with regard to the sequestration and therefore he might make some errors but would advise the committee of the situation as he saw it:
    - To date the federal government is operating under a six-month CR until March 27, 2013.
    - The CR enacted funding defines an upper boundary on the total Office of Science (SC) funding which is an upper boundary of funding very close to the FY 2012 level.
    - The SC is executing the CR using a very conservative approach which is taking the lowest of (1) FY 2012 appropriated budget (2) the administration's FY 2013 budget request (3) the House mark and (4) the Senate mark.
    - He stated for FES (Fusion Energy Sciences) the ITER part of the program was being treated conservatively with a spending rate equivalent to FY 2012 and for the non-ITER part of the program the spending rate would be governed by the lessor of the House and the Senate which would be in effect the Senate.
    - The SC program offices were given 47% of their CR funding for the first six months noting that no-cost extensions had been processed and many first-time new awards under solicitations have been held up.
- Stated that a full-year CR was deemed likely and noted the following:

  - It is expected to be enacted on March 22, 2013 and will define the final appropriation for the full year.
  - The sequestration would then be applied to that appropriation.
  - The SC individual office allocations would then be decided.
- Stated that since March 1, 2013 sequestration was already in effect. With regard to this it was stated that:
  - The SC budget was reduced by $245 million overall out of a total close to $5 billion. In their planning they were assuming levels about 5% lower than the overall administration request in FY 2013.
  - There is a lot of ongoing activity pertaining to assessments in the field. He said with regard to the 5% relating to the FES budget it would be approximately $18 million. He acknowledged over a period of six months it would create significant impacts.
  - When the final appropriation is in hand a budget approach including sequestration would be finalized. He reiterated that the effects would be broad.
- Stated that Dr. Brinkman gave testimony to the (HEWD) House Energy and Water Development Subcommittee on March 5, 2013. He noted that the hearing was concerned with the impacts of sequestration since under normal circumstances this testimony would focus on the budget that would have been submitted to Congress and that budget had not yet been submitted. He said that Dr. Brinkman's written testimony was available at http://science.energy.gov/~/media/sc-1/pdf/2013/030513_Brinkman_SEWA.pdf
- Commented on some extracts from the written testimony which he felt were notable:
  - The first concerned sequestration and he quoted: "There will be impacts to our programs, facilities and construction projects that affect not just the progress of the science we steward, but also the everyday lives of the researchers, institutions, and business we support."
  - The second concerned the effects on FES in particular and he quoted: "In the Fusion Energy Sciences, sequestration will impact both domestic research facilities and funding for U.S.-made hardware for the international ITER project. We are still assessing the proper balance of reductions in these two areas. Funding levels for ITER below the FY13 Budget request will impact our ability to meet U.S. hardware delivery dates in support of the ITER construction schedule."
  - His concluding comments included: "Overall, the impacts to facilities operations at our laboratories will have an impact on university and private sector research. Over 25,000 scientists nationwide, and across many fields, rely on Office of Science user facilities for their research. While the impact is difficult to quantify, the scientific progress of many researchers will be slowed by user facility budget reductions."
- Noted that Dr. William Brinkman and Dr. Patricia Dehmer were not present as they were involved in the preparation of the budget for Congress and also developing the SC's approach to sequestration.
- Stated that the release of the FY 2014 administration budget had been significantly delayed. He noted that by law it was supposed to be published on the first Tuesday of February. He said that with regard to this budget:
  - They had received the final pass-back on the SC budget levels from the OMB (Office of Management and Budget) on March 1, 2013.
  - He stated that it was anticipated that Congress would receive the president's budget on April 8, 2013.

- Stated that it was his understanding that:
    - A month from the enacting of the final appropriation the department would have one month to give a spend-plan to Congress. He acknowledged that this was technically a one-line statement but FES would have to develop a more detailed spend-plan.
    - He said he had not yet received confirmation but he thought the approach would be developing the spend-plan in concert so the department would be ready to discuss details when that one-line summary would go to Congress within 30 days following March 22, 2013 which he thought would be in late April.
    - He said that when that had been finalized they would be able to talk about it at the next FESAC meeting. He said at that meeting they would be able to talk about both the FY 2014 and FY 2013 budgets in a detailed approach in probably the latter part of April.
- Welcomed the report and thanked those who had worked so hard on the facility priorities report including Dr. John Sarff (chair) and Dr. Don Rej (vice-chair). Stated that despite present constraints the SC was proceeding with the development of a new prioritized list of scientific facilities for the next decade. He noted that it might seem ironic and difficult that they would discuss those issues in the shadow of difficult budget discussions but he emphasized that the lessons learned by the most successful offices in the SC was to be prepared. He noted that although they would have no way of knowing the changes that could occur in the atmosphere on the Hill but the SC should be prepared to take advantage of all opportunities.

COMMITTEE DISCUSSION

Dr. Greenwald noted that one or more FESAC members were dialed in. He was not sure if they could participate directly but asked them to send emails to him and he would relay the questions.

Dr. Dale Meade referred to the sequestration and asked how much flexibility there was at the SC level with regard to the 5%. He asked if it was fixed at that level for the SC but did it then filter down to the different program offices which could have different allocations. Dr.Synakowski responded that he was not grounded well enough in his knowledge to be able to comment on that. He said the SC number was the number he had shown them and he said the CFO had designated the control point to be the individual offices, in other words they would all operate at 5%. He added however, that if there were to be allocations otherwise between the offices that would require an extraordinary step.

Dr. Riccardo Betti noted that the ITER U.S. contribution was supposed to go up by roughly $50 million in FY 2013 in the president's budget but since it was never enacted he asked if it did actually go up by $50 million. Dr. Synakowski responded that there was no budget for FY 2013 yet. Dr. Betti said he understood but asked if there was no change. Dr. Synakowski responded that they had been spending at the FY 2012 level or slightly more conservatively than that level.

Dr. Greenwald stated that he was disappointed that they were not hearing about ITER even though the budget issues had not been resolved. He said it was at present the largest element in the FES program and poised to grow even larger. He said that it was important that FESAC needed to hear regular reports on the status, cost schedules and technical issues because the project was interacting with everything else that the department was doing. He added that in particular they were hearing from people in Cadarache, France that there were schedule delays and noted that many things were in a state of flux. Dr. Synakowski responded that there was a plan that had been developed and approved within

the administration and it accounted for a realistic assessment of the ITER schedule. He acknowledged his points but stated it was his judgment given all the things in play and the nature of what there would be to report that it would be more useful to wait until after the budget rollout. Dr. Greenwald stated he was just suggesting that at least once a year there should be a fairly free-ranging and open discussion of the status of the program as it impacted everyone. He added that it was also a good idea as many FESAC members received queries from colleagues and the media. He said also that especially with regard to the media providing responses stating that the committee did not know was often interpreted to be more negative that providing the actual facts. He stated that it was important to have transparency with the ITER process as it had not characteristically been known for it in the past.

A member referred to the FY 2015 activities and asked if there was a schedule that Dr. Synakowski had in mind for FY 2015 planning. Dr. Synakowski responded that he was not aware of what the plans were within the SC regarding FY 2015 but they were beginning to discuss it within the SC. He noted that there was a plan with regard to how the FES would get input. The member said that without knowing the FY 2013 budget or the FY 2014 budget how would the SC plan for FY 2015? Dr. Synakowski responded that the SC would try to do its best as they had to plan. He acknowledged that this was difficult with so many hypothetical scenarios.

Dr. Betti asked about the DOE (Department of Energy) if it would fund ITER in the future considering the escalating costs together with the fact that the budgets would be flat. He said that people within the community did not know what was going to happen. He asked if the plan was being developed and if it was going to be revealed. Dr. Synakowski responded that there was a plan that had been developed in the administration and he stated that he would be in a position to discuss it after the FY 2014 budget rollout. Dr. Betti asked if it was going to be a plan for the long-term for ITER funding not just for the FY 2014 year. Dr. Synakowski responded that he would discuss it in the FY 2014 budget rollout. He acknowledged that he would prefer not to respond in that way but he had to on that particular topic. He added that there had been a tremendous amount of work done regarding the plan.

Dr. Amanda Hubbard supported Dr. Greenwald's call for more open information with regard to ITER. She noted that it might always be the case where the committee might not know the budget for more than one year out and often the current year. She said that Dr. Synakowski had told the committee that there was a tradeoff between annual spending and total cost and profiles. She said it might be helpful for FESAC to understand those tradeoffs. She said if the SC could not show a point could it show curves or families of curves, some way to convey that. She said that the SC must have those types of multiple scenarios and perhaps it could show the committee the curves and then FESAC would see where they would place at a later date. She thought it might be one way for FESAC to get a sense of the tradeoffs otherwise there was a feeling of being in the dark. She said if they continued with the budget process as it was they might never know the five-year spending profile and this was a request that had been made before and was once again being raised. Dr. Synakowski responded that that was recognized and a dilemma that it faced was that projects typically in the SC were base-lined over a long period of time. He said that it recognized though that there were risks associated with the project given its international character and reliance on things that the SC did not control and this would all add risk in the long-term. He continued that the plan that they would be hearing about was more of a hybrid approach with respect to how the SC normally operated with the focus on a near-term time horizon.

Dr. Hubbard referred to the CR and noted that her understanding of it was that they had backtracked to the FY 2012 minus 5%. She said that the SC had made major shifts within a roughly flat budget between the FY 2012 and FY 2013 budget. She asked if they should assume that they were basically returning to the program element allocation of FY 2012 less 5% or what was he thinking? Dr. Synakowski responded that he was not prepared to comment on details on that but noted that that was not a requirement in developing the budget that would go forward.

Dr. Hantao Ji noted that he understood the situation in that they could not do too much. He said however that he felt the community and SC were reacting rather passively to the budget situation. He said that they had no control over the numbers as they would have to work with the numbers they were given. He continued that the other side of the story involved the question, should they do more active planning or what was their vision for a 10-year or 20-year period and for the future. He said that would not change that quickly and added that there were also different visions from different countries as well. He suggested that they take a positive or more active approach to map out what was needed or a general strategy, a general approach with multiple scenarios under different budgetary constraints. He stated that then, whatever the circumstances they would be more prepared and could use those scenarios to predict or establish reactions. He thought that they did not have positive visions and generally for the future the planning was vague. He stated that whatever budgetary situation evolved the community might feel more prepared if they had an established scenario that could be applied to that budget result.

Dr. Synakowski responded that in terms of strategic planning there was not a written document. He said in terms of the values that would go into driving the end points of a strategic plan he noted that he had been quite clear about the office view of where they needed to go which was a balance between pursuing the burning plasma opportunities presented in the world and preparing the U.S. to be as ready as possible for that while stewarding general plasma science. He acknowledged that the details were a tougher question. He said that in terms of the practicalities of writing a plan with the seismic shifts going on regarding the fundamental assumptions that would gird U.S. science for the next several years and the current debate, he continued there was no solid ground to stand on.

Dr. Ji referred to the panel that had used ReNeW (Research Needs Workshop) and had identified five thrusts which were the most important. Dr. Synakowski noted that what they had now was the Rosner Report, the International Opportunities Report and Dr. Steven Zinkle's report on materials, so a significant amount of input. He said his hope was to begin developing this information, internally, about an appropriate bases setting with such a plan. He said that although it might appear that he was contrary in his responses he shared Dr. Ji's opinion of the value of that approach.

A member noted that he was curious about the issue of contingency with ITER. He said that many of the partners, especially the European partners by law were not allowed to carry contingency in their budgets. He said that it seemed to him that the exposure they had was twofold, one being that the U.S. did traditionally carry contingency depending on analyses of risks for projects. He continued but then there were risks associated with the fact that the others did not carry contingency. He asked how the SC looked at contingency for the U.S. contribution. Dr. Synakowski stated that no plan would get past Dan Lehman without what he would regard as adequate contingency. He agreed that the SC anticipated budgets might be higher than what some of the partners might quote on a similar amount of work. He said that basically you would have an aggressive element of the plan and the U.S. Office of ITER had

approved this and was in concert with FES that had approved it within the administration. It would have scope contingency and that could be moved consistent with what they considered a realistic assessment of what ITER need dates would be but he acknowledged that it did add a significant burden to the overall budget request. He stated that there was a keen requirement within the department about how a project's success or failure was measured. He said that they had to develop a plan that was robust with regard to all these other considerations about what other international partners were doing. He added that the plan that they would be hearing about reflected an awareness of what had transpired in the long run but was focusing on the near-term horizon. He noted that ITER was treated no differently than other U.S. projects with respect to contingency. He commented that with regard to the plan there was a lot of discussion during its development with significantly different opinions throughout the administration about how it should be addressed and what had prevailed was the SC perspective on planning with sufficient contingency.

A member noted that his comments paralleled those of Dr. Greenwald and Dr. Hubbard. He said that not only the larger aspects of the programs for ITER and domestic fusion experiments but also smaller parts of the budget affected, for example, the theory program and the basic plasma program. He said that many researchers across the country were involved in smaller parts of the program and many had similar questions about decisions being made. He noted that again this concerned transparency and many were interested in knowing the balances and how these decisions were being made. Dr. Synakowski responded that the way the budget was constructed now he felt they were not serving anyone well with the degree of granularity in the budget. He continued that what he was talking about was recasting things along a new bases-set with fewer axes in the budget so that the unifying principles were clear to the community and also enabled a better explanation when defending a budget with a budget examiner on the Hill. He said that with this recasting of the elements of the budget there would be an improved understanding of why certain things are grouped together and why from a physics standpoint they were important. He stated that the SC recognized the vulnerability of the individual PI (Principal Investigator), smaller university scale experiments. He said the large ensemble of them might not have a strong, coherent voice when budgets are threatened and he stated that the SC would then try to take on the mantle of being the spokesperson of that group, noting the importance of that class of science. He acknowledged he was not sure how that group would be reflected in future planning but the vulnerability was recognized by the SC and they wanted to strengthen the coherence of the program to reduce that vulnerability.

Dr. Greenwald noted he wanted to follow-up on a question previously raised by Dr. Ji. He acknowledged there were many contingencies in the budget. He referred to the report from the panel of Dr. Rosner which addressed some of those contingencies. He asked how the SC was using that information which formed a sense of the community in the planning. Dr. Synakowski asked what contingencies. Dr. Greenwald responded what might happen in the budget, in that they did not know what would happen over the next few years and there were different scenarios running under different cases. He continued that as the SC was proceeding with the process, how was the SC using that report? Dr. Synakowski responded that it was difficult to say precisely. He said the value set had been recognized and expressed. He said that other factors that would go into it were the size of budget elements and noted it was a multi-variable process.

Dr. Steven Zinkle referred to information that the SC had received about a year ago regarding the international facilities. He said that the exercise that was on the agenda for the current meeting was

dealing with domestic facilities. He asked if the expectation was that the SC would be taking the two reports and making decisions based on thinking that some aspects that would be best for international participation and some that would be for domestic. He asked what kind of timescale the SC was considering. Dr. Synakowski acknowledged it was a timely question but responded that he did not have a precise answer.

Dr. Greenwald noted that Dr. Synakowski's presentation and the questions had taken a shorter amount of time than the agenda allowed. He suggested beginning with the presentation by Dr. Sarff and then taking a break about 11:00 a.m.

PRESENTATION OF THE REPORT FROM THE SUBCOMMITTEE DEALING WITH THE CHARGE ON PRIORITIZATION OF SCIENTIFIC USER FACILITIES

Dr. John Sarff, *Subcommittee Chair, University of Wisconsin-Madison*

- Took the opportunity to convey his personal thanks to the subcommittee members for working so diligently in addition to giving up free time to produce a report that was due within such a short turnaround time.
- Reminded the committee members of the context and referred to Dr. Brinkman's letter of December 20, 2012 which stated the goal as: "Formulate a prioritization of scientific facilities for the ten year time frame 2014-2024 across the Office of Science based on (1) the ability of the facility to contribute to world-leading science, (2) the readiness of facility construction, and (3) an estimated construction and operations cost of the facility."
- Stated that this involved a three-step process and they were:
    - Step 1 – FES and other offices provided lists for (1) proposed new scientific user facilities or major upgrades and (2) existing scientific user facilities
    - Step 2 – FACA (Federal Advisory Committee Act) subcommittees review the lists with subtracting from or adding to as appropriate. To explain how the facilities are framed there was a request to reference relevant planning documents and decadal studies and to consider only those that required a minimum investment of $100 million, so a process focused on the capabilities that would require a relatively large investment.
    - Step 3 – Will be decided at some future point. The DOE/SC Director will prioritize the proposed new facilities and major upgrades across scientific disciplines according to the assessment of scientific promise, readiness and the cost of construction and operation.
- Stated that the subcommittee was responsible for putting forth for consideration facilities in that context. Noted that they had two objectives, to provide a list and the list would need to be categorized with regard to world-leading science and readiness.
- Referred to the charge which referred specifically to the work set out for the subcommittee and noted it would be outlined to provide context.
- Noted that the subcommittee was asked to prepare a list and then assign each of the facilities on the list, of existing, proposed and new/upgrades as well as a category with a short justification but not to rank order the facilities.
- Referred to the first requirement of world-leading science there were criteria guidelines and he reviewed these criteria:

  - Extent to which the facility/upgrade would answer the most important scientific questions.
  - Other ways or other facilities that would be able to answer important questions.
  - Would contribute to many or few areas of research.
  - Will create synergies within a field or among fields of research.
  - What level of demand exists within the (sometimes many) scientific communities that use the facility.
  - Place each one of the facilities in the four categories: (a) absolutely central; (b) important: (c) lower priority: and (d) don't know enough yet.
- Referred to the parallel categorization with regard to readiness of the facility for construction (proposed new and upgrade only). The guidelines suggested are:
  - Whether the concept of the facility has been formally studied.
  - Level of confidence that the technical challenges involved in building the facility can be met.
  - Sufficiency of R & D performed to date to assure technical feasibility.
  - Extent to which the cost to build and operate the facility is understood.
  - With those guidelines in mind to place the facilities in a category: (a) ready to initiate construction; (b) significant scientific/engineering challenges to resolve before initiating construction; and (c) mission and technical requirements not yet fully defined.
- Stated with those criteria and guidelines the subcommittee was formed just before the last FESAC meeting on January 31, 2013 and he listed what the subcommittee had done:
  - Had six conference calls
  - First in-person meeting on Friday, February 1, 2013 in Gaithersburg during which they had representatives from FES, received guidance from the DOE General Counsel on issues with regard to conflict of interest (COI) and discussed the organization for how they would proceed. He added that by the time of the last FESAC meeting they had already issued a call for white papers so in the time between the first in-person meeting the subcommittee had received white papers and went through an evaluation and had phone calls which helped to provide a context for the second face-to-face meeting.
  - Second in-person meeting was held over March 2nd and 3rd also in Gaithersburg. He noted that the subcommittee had winnowed down all information combined in the white papers and planning documents to further focus on obtaining agreement as to what should be on the list. He noted they had developed strawman new facilities based on: advanced MFE (Magnetic Fusion Energy) alternates; materials for fusion; high energy density laboratory plasma research; integrated toroidal plasma-material-interaction (PMI) facility; and fusion nuclear science facility. He stated that they also discussed the existing facilities as per the charge.
  - Noted the number of emails which were approaching 1,000 reflecting the intensity and interest of the subcommittee.
- Commented on the issue of COI and noted that at their initial meeting the subcommittee had met with the DOE General Counsel, Brian Plesser as well as Dr. James Van Dam and Gene Nardella. Stated that they had discussions and had presented some scenarios trying to anticipate the things that the subcommittee would have to deal with in a specific way.
- Noted that Dr. Van Dam had captured many of the issues reflecting the level of detail that they had talked about in the context of COI. He explained that the list encompassed many situations regarding COI including the DOE's major concern of direct financial interest; considerations of

subcommittee members if they are consultants or users of facilities; considerations of members concerning a science mission with regard to facilities; issues around white papers; members' relationships with facilities if upgrades are discussed; competing proposals if members are affiliated with specific facilities; and finally how members should recuse themselves.

- Provided some additional summary on what the subcommittee did to resolve the COI issues:
    - Subcommittee members decided not to be co-authors on white papers.
    - Members declared their "direct" and "potential" conflicts of interest on all facilities under discussion. A "direct" COI arises primarily by the member's employer relationship as the COI emphasis is on financial gain.
    - Members were recused from discussion and voting for facilities on which they had a direct COI. He provided some examples of a "direct" COI as when they were considering the DIII-D or NSTXU facilities and then provided the names and stated that when those facilities were discussed they recused themselves or if it was a conference call they were off the call. He explained that a "potential" COI would be more like advocacy.
    - He stated that it was managed well but was a significant impact on the work. He described one situation where a gap was exposed by having a common email for list-serve to deal with the large numbers of emails. He noted that members could recuse and identify themselves at meetings and with teleconferences. This proved an issue with emails and it was resolved and a new email procedure was adopted to recuse members with a direct COI.
- Stated the facilities that were provided to FESAC from FES or under Step 1 of the charge under proposed new and upgraded facilities:
    - Fusion nuclear science facility (FNSF)
    - Materials initiative (two smaller facilities)
    - Quasi-axisymmetric stellarator experiment (QUASAR)
    - Upgrade of the DIII-D National Fusion Facility
- Noted under existing facilities:
    - DIII-D National Fusion Facility (General Atomics)
    - Upgraded National Spherical Torus Experiment, NSTX-U at (PPPL) Princeton Plasma Physics Laboratory
- Stated that the Alcator C-Mod (MIT) was not on the list of existing facilities and was consistent with the DOE plans to cease C-Mod operation as described in the President's FY 2013 budget proposal. Explained that Alcator C-Mod was not an existing facility in the context of the charge.
- Stated that ITER was not included on the FES lists and made the following comments:
    - The contents of Dr. Synakowski's letter: "As we all appreciate, ITER is unique not only in the world-leading science it is expected to accomplish but in how it is being conducted under an international agreement with seven members. As a consequence SC leadership has determine that ITER is not to be considered in this exercise."
    - The subcommittee interpreted this as strong DOE support for the burning plasma science enabled by ITER that defines the present frontier in fusion research using magnetically confined plasmas.
    - An assessment of ITER is therefore not included in the report although it was acknowledged that ITER provided a backdrop to understand facilities.
- Stated that the subcommittee had to decide what facilities could be considered and how did the subcommittee consider them needed to be set as a framework to be able to proceed.

- Noted that there was a large number of planning reports, approximately 12 listed in the executive summary that framed the context for the span of the kinds of research that is done in fusion energy sciences, the kinds of facilities that are needed to address gaps and research needs etc. He said it was that documentation that provided the strongest technical base on which the subcommittee could stand. He noted that if all the facility needs were totaled in those reports it was about 20 to 30.
- Stated that in order to frame their work they recognized four strategic goals that FES would take on in terms of what framed the breadth of the research that is stewarded by FES.
- Listed the four strategic goals and emphasized certain phrases as they represented four categories to understand facilities:
    - Advance the fundamental science of *magnetically confined plasmas* to develop the predictive capability needed for a sustainable fusion energy source;
    - Pursue scientific opportunities and grand challenges in *high energy density plasma science* to explore the feasibility of the inertial confinement approach as a fusion energy source, to better understand our universe, and to enhance national security and economic competitiveness;
    - Support the development of the scientific understanding required to design and deploy the *materials needed to support a burning plasma environment;*
    - Increase the fundamental understanding of *basic plasma science*, including both burning plasma and low temperature plasma science and engineering, to enhance economic competiveness and to create opportunities for a broader range of science-based applications.
- Noted that FES supported a large, diverse science but stated there was no way for the subcommittee to understand whether any one category was more important than the other so all equal in some sense.
- Stated that in order to proceed the subcommittee focused their attention on the strategic goals and opportunities within those strategic goals and it provided a framework.
- Referred to the facilities, the new and upgrades specifically and what they are and the subcommittee considered that they mapped to two of the strategic goals, to magnetically confined plasmas and materials needed to support a burning plasma environment. They considered that the other two goals were not represented in facilities that they received.
- Stated that the subcommittee wanted to be able to look at what had been proposed and what the needs were more broadly within those four strategic goals. He noted that they could have gone to the various reports with a view to creating a list but the subcommittee also wanted to engage the community and speak specifically to facilities that people were thinking about.
- Noted that they issued a call for white papers to obtain a broader perspective on opportunities for facilities:
    - Announcement went out to the community with only two weeks' notice for short four-page white papers due February 14, 2013 and with specific instructions asking that they connect the papers back to the planning documents and to provide specific information aligned to what would be needed to address the charge.
    - The subcommittee solicited white papers explicitly from DIII-D, NSTX-U and Alcator C-Mod to support a parallel and uniform assessment process.
    - The process yielded 37 white papers and broken down by strategic goal area: 1 for basic plasma science; 8 for high-energy-density laboratory plasma science; 9 for materials for

the burning plasma environment; 18 for magnetically confined plasmas; and 1 other. He advised that all papers were available on http://burningplasma.org/fsff.html

- Noted the importance of developing an objective evaluation of the white papers and stated the world-leading science criteria developed by the subcommittee utilized the guidelines provided in the charge and they were further adapted in their general context and framed them more specifically as appropriate for FES. Each was framed for the facility/upgrade:
    - Address research needs identified in recent planning for at least one of FES's strategic goals: MFE, HEDLP (High Energy Density Laboratory Plasmas), materials for fusion, basic plasma science.
    - Resolve key scientific questions that are critical to development steps toward fusion power production.
    - Create opportunities for discoveries in plasma and fusion science.
    - Provide unique capabilities.
    - Enhance or maintain scientific leadership by the U.S.
    - Provide a cost-effective approach to answering important scientific questions.
    - Does facility support a broad community of researchers?
    - Does facility create synergies through multi-disciplinary research?
- Noted the readiness criteria developed by the subcommittee:
    - At what level are mission and facility requirements documented?
    - At what level are facility concepts developed?
    - At what level are technical risks analyzed and R&D plans documented?
    - When could requisite R&D realistically be completed to initiate project?
    - At what level are cost estimates for R&D, project, and operations documented?
    - At what level are the schedules for R&D and the project documented?
    - Have all of the above elements undergone independent peer review?
- Confirmed that although the white papers provided a basis for the subcommittee to understand the context of facility options they formed only one piece of the information that was used. So the decisions on the recommended facilities are framed by the composite information in the planning documents, the proposed facility/upgrade facilities received from FES together with the white papers.
- Commented on facility cost filter:
    - Dr. Brinkman's charge letter directed that the cost for the exercise was a minimum of $100 million, so larger user facilities.
    - In Dr. Synakowski's letter to FESAC he advised that the subcommittee could consider facilities or upgrades that were below the $100 million level but $20 million was too low. He summarized that $100 million qualifies, $50 million is acceptable and $20 million is too low.
    - Despite the given range it was noted that the facility cost was a substantial filter that eliminated many smaller facilities identified in planning documents, white papers and the "Materials Initiative" received from FES.
    - He referred members to the final list and the costs qualified as per Dr. Brinkman's cost criteria but they were all also at the lower end of that with only one billion-dollar-plus facility on the list. There is nothing below $100 million. He stated that lower-cost facilities are important for FES research generally and he noted that was true for all strategic areas. But they are recognized as particularly important for "materials for a burning plasma environment" and "basic plasma science".

- Showed the list of both existing and new/upgraded facilities that they were proposing. He noted that they would provide strong options to enable world-leading science for FES' strategic goals.
- Discussed the facilities under (existing):
    - DIII-D National Fusion Facility – Under world-leading science rated as (a) absolutely critical. He noted the mission is to establish the scientific basis for the optimization of the tokamak approach to fusion: resolve critical issues for burning plasma science; develop the physics basis for steady-state operation; and develop the scientific and technical basis for FNSF. He noted it was the largest fusion experiment in the U.S. and one of the premier tokamak facilities in the world. He stated it provided critical support for the success of ITER as it would: reduce the risk and consequences of sudden plasma termination; develop high performance confinement regimes; and improve understanding of 3D magnetic field interactions with the plasma.
    - Upgraded National Spherical Torus Experiment, NSTX-U (existing) – Under world-leading science rated as (a) absolutely critical. He noted the mission is to develop the tokamak physics basis with unique capabilities to explore the low aspect ratio regime with: high normalized plasma pressure (beta); and advanced plasma boundary control and materials. He stated it was presently undergoing a major upgrade to double the range of key plasma and device parameters. He stated it had multiple contributions to advancing fusion plasma science with: contributions critical to ITER, e.g. energetic particle physics; develop new solutions for the plasma-material interface; and establish the physics basis for an FNSF.
- Discussed Alcator C-Mod and stated the future of Alcator C-Mod was uncertain. He stated that the completed Report of the FESAC Subcommittee on the Priorities of the Magnetic Fusion Energy Science Program chaired by Dr. Robert Rosner recommended that if FES funding at the FY 2012 became available then "roughly one-third of the restored funds of $12 million per year should be deployed for a three to five year period of operation of C-Mod to resolve high-priority topics on ITER-relevant boundary and divertor physics and might include upgrades as required to accomplish these goals." He confirmed that the subcommittee concurred with the assessment and recommendation.
- Discussed the facilities under new or upgraded:
    - Fusion Material Irradiation Facility – Under world-leading science rated as (a) absolutely critical and readiness rated as (a) ready to initiate construction. He stated the mission is to provide a new laboratory that produces a high flux of fusion-relevant neutrons on material samples, thereby transforming nuclear materials science. He noted the facility will fill a gap in providing an irradiation volume >0.4 liters and high availability >70%. He stated that it supports frontier materials science that aims to predict material performance with high confidence and allow the design of new materials with improved performance.
    - Fusion Nuclear Science Facility – Under world-leading science rated as (a) absolutely critical and readiness rated as (b) significant scientific/engineering challenges to resolve. He noted the mission is to provide first-ever integrated and controlled fusion environment that resolves strong couplings of: high performance plasma core; plasma-material interactions; and fusion neutron science and extreme material alteration. He stated that the FNSF is a minimally sized toroidal device producing a fusion neutron flux prototypical of a reactor. He noted it was a staged operation beginning with non-nuclear

phase to resolve key challenges of the plasma-material interface with subsequent nuclear stages to reveal material alterations in an intense neutron environment.

- Multi-Petawatt Science Facility – Under world-leading science rated as (b) important and readiness rated as (b) significant scientific/engineering challenges to resolve. He noted the mission is to produce the highest focused-laser intensity ever and use that capability to expand the frontier of high energy density plasma science. He stated it was an opportunity to leverage U.S. expertise and surpass planned capabilities elsewhere in the world.
- Quasi-Symmetric Stellarator Facility – Under world-leading science rated as (a) absolutely critical and readiness rated as (b) significant scientific/engineering challenges to resolve. He noted the mission is to explore the confinement-optimized quasi-symmetric stellarator as one means of addressing the high priority need for controlled steady-state, disruption-free fusion plasmas. He stated the facility capitalized on U.S. leadership in designed 3D plasma confinement systems that possess 2D-like symmetry and the access to spontaneous plasma flows and improved confinement regimes. With regard to science noted the juxtaposition of scientific investigation using distinct magnetic geometries leading to a deeper, predictive understanding of confinement in all high-performance toroidal plasmas.
- Upgrade to the DIII-D National Fusion Facility – Under world-leading science rated as (b) important and readiness rated as (a) ready to initiate construction. He stated the mission did not change from the existing facility, previously mentioned, with the upgrade but the facility capability would be significantly enhanced. The four ingredients to the upgrade are:
  - Explore the physics of burning plasmas through increased direct heating of electrons.
  - Investigate conditions for steady-state operation using a combination of enhanced off-axis neutral beam power and electron cyclotron current drive
  - Develop the 3D optimization of the tokamak configuration for edge stability and plasma rotation control using new magnetic perturbation coils.
  - Resolve the plasma disruption problem for the tokamak using advanced stability control and new plasma quench mitigation systems.
- The upgraded DIII-D facility will have much greater capability to support the science critical to the success of ITER and to the establishment of the physics basis for FNSF.

- Discussed how the subcommittee determined the categorization of world-leading science for the facilities on the list. He noted that the subcommittee was recommending facilities that they judged to have world-leading capability to meet the high standards defined by science criteria and that met the parameters for the exercise.
- Stated that the distinction between “absolutely central” and “important” related primarily to the relative impact of a facility in the world context for two of the criteria:
  - Facility/upgrade resolves key scientific questions that are critical to development steps toward fusion power production and
  - Facility/upgrade provides unique capabilities.
- Stated that they had an objective analysis using the white papers but overall evaluation and voting remained subjective informed by the objective evaluation as best they could do it in addition to the subcommittee members’ understanding of what is in planning reports and what is happening in the world.

- Presented a case analysis, a PMI (Plasma Material Interface) challenge as way of showing members the subcommittee's process and the types of discussion and challenges that they faced in taking all the information and drawing up a list of five. He stated they had cast it as a case analysis for the important challenge of plasma material interactions. He discussed the process:
    - Facilities needed to advance the scientific understanding of PMI.
    - This was discussed in recent reports such as "Opportunities for Fusion Materials Science and Technology Research Now and During the ITER Era by S. Zinkle et al., §3.2.1.1
    - Those sections proposed:
        - Smaller facilities: linear plasma devices, magnetized plasma RF test stand, microwave test stand, high heat flux facilities, liquid metal PFCs testing
        - Existing toroidal confinement devices: U.S. short-pulse tokamaks, Asian long-pulse tokamaks, ITER
        - Non-nuclear PFC/PMI very long-pulse confinement device
        - Fusion nuclear science facility (FNSF, which can include a D-D early phase of operation for PMI/PFC research
- He gave this as an example of a planning document that talked about the science and framed it in the context of what facilities were needed.
- Stated that some of the recommended facilities on the list are related to this framework such as: Existing tokamaks: DIII-D and NSTX-U; upgraded DIII-D; and Multi-phase FNSF.
- Stated a list of the issues that arose in the subcommittee's discussions:
    - No small facilities due to cost threshold.
    - Upgrade to DIII-D is focused on core plasma control not the extreme boundary (advanced materials, divertor, etc) but the committee was informed that DIII-D had a longer term vision for the area in 6-10 years from now.
    - Alcator C-Mod may not operate further; was leading U.S. effort on the front-runner material, tungsten, including novel experiments with elevated material temperature.
    - Lack of programmatic clarity on the optimal sequence that begins with long-pulse PMI/PFC and evolves to fusion nuclear science.
    - Planning documents assume the major step to a long-pulse PMI or FNSF will need nearer term contributions from research supported by test stands and existing facilities.
    - What other FES strategic areas of research have similar interdependencies of a variety of facilities at different times and scales?

Dr. Greenwald thanked Dr. Sarff and all the subcommittee members for their hard work on the report.

BREAK

The Fusion Energy Sciences Advisory Committee recessed for a 15 minute break.

Dr. Greenwald stated that a discussion of Dr. Sarff's report would now follow. He noted that there had been an addition to the agenda after the lunch break. There would be a short briefing on data management policy by Dr. Laura Biven.

COMMITTEE DISCUSSION

Dr. Greenwald suggested that they begin the process by having members give their initial reactions and questions about the report and the process.

Dr. Robert Rosner congratulated the subcommittee members on completing it so expeditiously while navigating the many obstacles on the way. He referred to the last slide in which they referred to thinking about the PMI issue broadly across FES. He asked about facilities within the SC generally and in the PMI case in particular beyond the SC, for example NE (Nuclear Energy) which had a great interest in High DPA facilities. He said that there was a general interest in the United States of coming back to the capability that the U.S. had 20 years ago for High DPA material testing. He asked for Dr. Sarff's comments. Dr. Sarff referred to the charge and noted it was a parallel process for all the offices in the SC. He referred to the guidelines in the charge, referencing world-leading science in which they were asked to identify synergies within the community and broad community. He noted that the process was happening office by office, FACA committee by FACA committee and subcommittee by subcommittee and although the charge asked for identification of facilities that were capable of crossing multiple disciplines that discussion was frustrated by the parallelism. He said the issue was raised in the white papers but there was limited time. He suggested it was something perhaps that they could do next. He acknowledged with budget constraints it was important for the SC to identify those needs.

Dr. Synakowski asked if he could add to that response. He referred to the High DPA work. He said they had talked within the SC about the potential leverage points between agencies, between NE and NNSA (National Nuclear Security Administration) and the SC in a FNSF and what the potential would be for sharing costs as the mission spaces overlapped. He stated that the discussions had not been resolved but he thought that there was enough evidence that he thought there were leading political questions around the issue. He acknowledged that when budgets are tight and using precious budget authority the question would come up as which agency really owned this. He said another question would be which lab owned it. He thought those departmental, political questions needed to be addressed.

Dr. Zinkle thanked the subcommittee for its hard work in the preparation of the report. He referred to the $100 million threshold in the charge letter and thought his interpretation was different than the one used by the panel. He referred to the charge letter where it said, if you wish to add facilities or upgrades please consider only those that require a minimum investment of $100 million. He said that for the list provided by FES, from his understanding, they should have been subtracting if they were not world-leading science. He said the guidance that was given was that only if facilities were added, that should be under $100 million and then there was also the physicist's factor of 2. He asked if the subcommittee had considered that distinction in the charge letter when taking facilities off the FES list. Dr. Sarff responded that his reading of the charge letter was that FESAC could add to or subtract from the list but additions in particular should be at the $100 million. He said that his understanding of the charge meant that subtraction did not require specific considerations other than the importance that FESAC attributed to any facility.
Dr. Zinkle said that in the report they had mentioned they had subtracted some facilities due to a cost threshold not due to science impact. He said that appeared to be inconsistent with the charge letter. Dr. Sarff responded it was a combination of factors. He explained the difficulties and challenges the subcommittee had faced in considering the importance of smaller facilities and having one large facility form a composite of smaller facilities.

Dr. Greenwald noted that it was a discussion about priorities for major new facilities which was different than priorities for programs. Dr. Synakowski noted that what was driving the charge was the issue of where the U.S. was with respect to this class of science internationally and was the U.S. at risk. He said when Dr. Brinkman would be making an assessment that fiducial would be on his mind. He said that prior to issuing the charge he was encouraged to encourage the subcommittee to consider smaller ensembles. He said this was suggested bearing in mind issues like their sense of readiness in opportunity and leverage opportunity in the case of the nuclear science aspect, with BES. He said it was put forward as they considered it worthy. He acknowledged that what was being put forward was defendable. He said perhaps he had provided some strong views on the class of science and the necessity of the smaller facilities.

Dr. Zinkle referred to the 37 white papers and asked if there was a subset that was judged by the subcommittee to be world-class science but fell below a cost threshold. Dr. Sarff responded that in drafting the executive summary they attempted to explain different perspectives to explain what was not on the list and he noted that that could be problematic. He thought that this was why the discussion with regard to PMI was revealing because there was a clear need expressed in thoughtful documents and research needs for facilities that would struggle in the exercise.

Dr. Meade referred to the smaller facilities that might form a scientific hub or center and he said in BES (Basic Energy Sciences) they did have a facilities category and had innovation hubs and scientific centers and these were classified as facilities. He noted that they realized this particular way of combining smaller physical facilities into a larger, intellectual facility. He said perhaps a broader definition of facilities might have helped with addressing some problems that might be more evident in the fusion program as many of the scientific issues in FES were more tightly integrated with other issues than some other fields. He thought that the facilities defined by the subcommittee were good but he thought there was a missing class that he thought were very important. Dr. Synakowski responded that they should not consider the charge as being the answer to the question of what is everything that FES needed. He said this was just an answer to the question concerning a specific class of facility and the question, where are the opportunities. He said there are questions along the lines of opportunities for hub-like facilities that they could be asking. Dr. Greenwald agreed and suggested that perhaps that was something that could be added by way of a statement on introducing the answer to the charge that clearly, not all elements of the program in the science areas but just the ones coming under the criteria of the charge.

Professor Farrokh Najmabadi referred to the readiness column on the tables, the three categories and specifically category (b). He said he thought it could be read two ways. He said one was the situation where you would state, I don't know how to build these components I have to go and basically do R&D to build the machine and the other was scientifically I'm not ready to build the machine because either I cannot test anything with it or I don't have the science to ensure the machine operates. He asked which way the subcommittee read it and did they want to make a distinction. Dr. Sarff responded that they interpreted "ready to initiate construction" as to use the planning process and the way in which facilities get done in the SC, the critical decision process. He said the interpretation was that a facility would be ready for CD-0 (Critical Decision), so if they would perceive it to be ready for CD-0 then it would be ready. He said the third one was speaking to mission and technical requirements which were not known. He said that (b) was in between. He thought it might be easier to categorize if one knew what (a) and (c)

means. He stated that in none of their cases had they used (c). He explained their process of deciding to use (b) but noted that they did not go into great depth in interpreting (b). Dr. Greenwald acknowledged that this might be a failing in the charge. He referred to the description of criteria for readiness and noted it tended to be formal having to do with documentation which he agreed was the nature of the CD process but he said there was an underlying technical readiness which was more important considering the time frame for the exercise was ten years. Dr. Sarff responded that in the case of FNSF the way that the subcommittee interpreted it and the framework of the charge was that what would have to happen in the ten-year timeframe was to get started on the CD process. He continued that they interpreted that timeframe as a facility would get a start in a formal way. He noted that different interpretations were an issue that the SC might have to deal with at some point.

Professor Najmabadi noted that the report did not provide reasonable wording on why the subcommittee thought specific facilities provided world-leading science and did not elaborate on the facility itself. He acknowledged that there was a short deadline but he thought this might be improved. He suggested they might also want to add indices to say what the facilities were. Dr. Zinkle thought the subcommittee report should be a stand-alone document as it was unrealistic to expect the reader would refer back to the white papers. Dr. Greenwald acknowledged that it was not clear what the capabilities, costs and mission were of the facilities being proposed to the IFMIF (International Fusion Materials Irradiation Facility) mission costs and capabilities that were discussed. He thought that was important to understand to see how it would fit into an international context.

Dr. Nermin Uckan noted she read the report before the presentation and she said she understood the science and the technology but she stated she was lost on the fusion materials. She asked if they were talking about IFMIF and if so, that was international. She asked the question of what? She said she also could not determine when because that size of facility if it was not identified how would one come up with a facility in ten years that would cost $100-200 million? She said this was unclear. Was it a U.S-leading facility or would the U.S. be part of the international ITER-like activity. She said the IFMIF facility appeared to be written up in a more vague way. Dr. Sarff responded that with regard to IFMIF they had written the facility description to identify the mission, to describe the facility in the terms of the metrics needed framed by the planning documents and then they commented on readiness. He said in the white papers there were obvious candidates and one that was an obvious candidate that was not in the white papers was IFMIF. He said that they had cast the facility in a generic way in that it did not pick one of the proposed options. He said that for the subcommittee of 12 members to take information set out on four pages written in two weeks and to pick an option as well as making it more specific was problematic. Professor Najmabadi said they did not want an option but a general description of what the facility would be. Dr. Greenwald suggested a small table with concrete options and stated that these are the options that have been proposed, note the characteristics and pointers to other documents or white papers.

Dr. Edward Thomas referred to their process and said that they had alluded to some of the mission of the irradiation facility and the FNSF and the fact that the boundary between those two was merged somewhat in that some of the mission of the irradiation facility could be incorporated into FNSF. He said that given the scales of the budgets with the IFMIF being $100 million and the FNSF $100 - $200 million was one to four billion dollars. He asked what the decision and discussion process was about those. Dr. Sarff responded that the IFMIF was the kind of facility which in planning documentation was to understand sample materials and he elaborated. He stated that FNSF was beyond that and noted that it

was the integrative facility that was the whole device, not far away from a fusion reactor. He said they were very distinct missions, one was to understand, qualify, predict, invent materials that would be appropriate to put into for example and would be an important leading step but the FNSF would be the place where you would further test so they were not one and the same.

Dr. Betti referred to the FNSF and the process that went into deciding the rating and how the subcommittee used Dr. Rosner's report because that report rated materials science of that kind as second tier in terms of priorities. He said that the subcommittee had rated that as absolutely central in the next ten years. He said bearing that in mind he asked how the subcommittee used the Rosner Report in their thought processes. Related to that question he referred to the science rating of the FNSF and the upgrade to DIII-D he said one received an (a) and the other a (b) and detailed further. He asked how the subcommittee had discussed that issue. Dr. Sarff responded to the first question and stated that they had paid attention to all the reports including the Rosner Report. He referred to priority and said that with regard to the Rosner Report, that charge had a scope of the near-term in charge questions 1 and 2 with question 3 having a longer timeframe. He continued that his understanding of that report was they emphasized that the prioritization of the thrusts was not an overall prioritization but was cast in the context of the timeframe. He said it was important to interpret that prioritization in that context. He said that for the current charge their timeframe was the next decade so the timeframe extended beyond the Rosner Report. Dr. Zinkle added that there was also a strong emphasis in the Rosner Report making ITER successful that was the differentiator that caused several to go into the middle category.

Dr. Greenwald referred to the issue of priorities and stated that it was a theme they needed to address. He stated that he had some issues with that response. He stated that there were five categories into which they had grouped their facility proposals. He said four ended up in the final report and one did not. He stated that the one that was omitted was generally speaking the PMI issue. He said it was true the Rosner Report had identified those PMI issues as important in two of its four facility-related categories. He said that it was true that in the 2007 reports they were near the top. He said it was striking that the subcommittee had punted on that issue, that they had not addressed what he saw as a critical need and prerequisite for an FNSF. He thought that was surprising given its overall priority for the program. Dr. Sarff responded that part of the reason they had seen the case study on PMI was to help understand both the challenge and engaging the understanding of what the framework was identifying facilities. He acknowledged it was also a topic of current strong interest. He said what the Zinkle et al. report said was that there was a need in order to understand PMI there was a range of facilities from smaller facilities focused on single effects to existing toroidal confinement facilities which included short-pulse U.S. facilities, long-pulse tokamaks being developed in Asia and then ITER. The report then spoke to two future facilities, one a PMI focus and then FNSF. He said the nature of the charge tended not to bring the smaller facilities in, in the way that it had been talked about and recognized in the report.

Dr. Greenwald noted that the PMI test stand was one of a large spectrum and probably the only one that did not reach the limit of $50 million. He stated that they did not state that facilities were needed for PMI and they needed to be a variety of sizes and times and here are some options and suggested missions. He thought that suggested a lapse. Dr. Sarff responded and said to skip to the bottom two, the long-pulse PMI or FNSF and stated that the facility option that they had put forward was explicitly a multi-state facility where for the first stage its emphasis was PMI. He stated that again to emphasize the facilities that are on the list the subcommittee viewed their technical basis stands primarily on planning

documents. He said it was problematic to try to suggest something that did not have a stronger technical analysis behind it as the basis for talking about something. Dr. Greenwald said that if they were saying that their response to PMI was the first stage of an FNSF how well documented was that that it was the right answer. He wondered why the subcommittee had chosen a path that he did not think represented a community consensus and as result ignored one of the most important issues facing them. Dr. Sarff agreed that there was not a community consensus and he continued that was one of the bullets on the issues. He said for this issue what was the appropriate sequencing to that capability that they wanted to have from PMI to nuclear. He said that sequencing was not documented.

Dr. Betti asked if they had received any white papers about a large-scale facility under $1 million or $50 million and above about PMI. Dr. Sarff responded that the white papers that they received on PMI were PMI test stands, long-pulse toroidal facilities, short-pulse toroidal facilities in the form of an upgrade to the upgrade of NSTX which they called NSTX-PMI, an upgrade or new facility that came from the MIT group that reused the facilities that they recognized as Alcator.

Dr. Uckan said that in terms of the FNSF first stage to commit to FNSF as a facility that would be a billion-dollar facility and then you doing PMI which is important to that, tying to a much bigger project that would never get started to do that first stage. She said it is as if the subcommittee was saying I am going to build ITER just to do the ion confinement only and then if I prove it and then I will go to all the other phases. She said ITER would never get approved using that logic. Dr. Synakowski stated that a staged-approach was something that the present director of the SC had sympathy for based on experience in the industrial setting. He noted that Dr. Brinkman often found that this was the only way that critical problems were solved, i.e. where you would build something where you would have to confront it head-on. Dr. Synakowski said he was not necessarily endorsing that but had some sympathy for it and was reflecting. He said that Dr. Brinkman's point of view was that something that would take on a more complex mission rather than parsing it into several separate missions. He continued that from the point of view of the politics he felt that each one of the quanta of things was a very visible thing and so if there could be a sensible union of mission under one facility umbrella he thought it was worthwhile for the community to consider it.

Dr. Greenwald said he thought there was no consensus on the issue (of addressing PMI issues as the first stage of an FNSF) and he stated that there were strong, technical reasons why that in this case was not appropriate including the fact that you would have to license such a facility and he said if you could not demonstrate that you had any credible solution for PMI issue could you obtain a licensing. He said he considered it an active and open discussion but he still considered it not addressed. He said the subcommittee had essentially said we have the solution in hand which is that this will be the first stage of an FNSF. He said for example, with the stellarators and with FNSF itself the subcommittee had not said we have solution, this is what we are going to do. He said they had defined the mission and the options. Dr. Sarff returned to the Zinkle et al. analysis in which the discussion of required facilities were laid out, a set of smaller facilities, existing tokamaks that included the U.S. ITER and in that context that set of facilities would provide the science necessary to succeed.

Dr. Meade acknowledged it was an issue the fusion community had been discussing for a long time. He said that the subcommittee had looked at it as indicated in the last two view graphs. He said that with regard to PMI he said there were many facilities in the U.S. and internationally that were focusing on this. He said the Asian facilities were coming online and would be able to address some of the issues. He

said that also JT60-SA was coming online pursuing this. He stated that the question was whether or not there would be a separate DD facility in the $100 million-plus category added to the existing capabilities that they already had. He said that with many large projects over the years each time they had done the design for the new machines there was great agony over the PFC problem and on each one they did not have what they needed on hand when it was started. He said the same could be said for when they started ITER. He said that he supported the notion of focusing the efforts on existing facilities throughout the world and on making this an emphasis on the first stage of an FNSF.

Dr. Greenwald noted that his concern was that the report gives the impression that this is a settled issue but he viewed it as far as settled.

Dr. Hubbard asked if he could clarify the $1 to $4 billion that was mentioned for the cost. She asked if that was for phase one or the entire nuclear project? Dr. Sarff responded it was an error and should read $2 to $4 billion. He said that they did not get into detailed cost analyses but relied on the numbers provided to the subcommittee through white papers. He said that those amounts spanned the range from the first stage to multi-stage. Dr. Hubbard asked if $4 billion would do the multi-stage nuclear mission. She thought it might be too low. She thought that the first phase would be something closer to the $2 to $4 billion ballpark and she said that she thought that was too expensive for the PMI mission. She said that she was disturbed by the lack of a PMI-focused facility on the list. Dr. Sarff referred to the cost and said the technical answer was that the white papers gave the subcommittee numbers which had some range and they did not do a detailed cost analysis. He said for questions relating to the costs he would say look to the white papers. Dr. Sarff said that they had talked about the long-pulse PMI and with the backdrop of Dr. Synakowski's discussion of the charge whether or not they would want to put on the list a separate facility for long-pulse PMI with an unclear cost and FNSF for which the options clearly extended to $4 billion. He referred to the appropriate number of facilities on the list and said it came back to the right number as well as the nature of the facility. He said their attempt with the FNSF would be to capture the grand challenges associated with PMI all the way to nuclear.

Dr. Zinkle referred to the comment regarding separate effects versus integral effects he said the obvious Bell lab analogy for Dr. Brinkman was before Bell labs made an integrated circuit they had to go to the transistor and before they did the transistor they were doing semi-conductor physics of various types. He said there was in any field of science a starting point with single effects and then work up to integrated effects. He though fusion would be no different from that. He said on the materials irradiation, on the PMI issue and all these other things looking at single effects types of issues before one would build the big, integrated facility was the standard way of doing science. He said in the report there appeared to be an inconsistency in that they were not indicating where the PMI facilities to do the single effects or simple multiple-effect test were and instead they were going to the integrated component, full-up FNSF to handle all the things. He wondered if FNSF was really at a category (b) in terms of its readiness levels when there were a lot of the fundamental issues where they did not know about how this would be configured. He said they were far from a CD-0 and therefore did not have a good idea of the cost range.

Dr. Ji thought that there was not enough long-term planning with short deadlines for the preparation, responses and submission of the report. He said that he thought they should focus on what they could do during the next week.

Dr. Synakowski said if FESAC needed a real blue sky object to focus on then FNSF would be it. He said their attempt to bridge this, divide and be responsive was to offer an ensemble of smaller things as well. He said that as he understood the community views there appeared to be a stronger consensus for something like an FNSF rather than on the possible paths and requirements to get there. He said that he did not know how the community would have come to a consensus on that view during the allotted time. He said that he did not think that they could have responsively done more than was done on the topic. He said that if facilities had a (b) on the readiness he did not necessarily consider it a demotion and a sign that something was really not ready to go and so therefore had less of a chance of being promoted into the final group to be developed. He thought it was more an opportunity to say that there was a significant program need but the community did not have a consensus for how to get there but there were many vibrant, viable ideas for doing so. He said that some fell below the $100 million threshold and some were above but there was no consensus as to what should be done and the subcommittee could not come to a consensus view. He wondered if there was a point either in the report or the letter that accompanied the report that would make that point.

Dr. Sarff stated that what Dr. Synakowski had just said was consistent with the subcommittee's view that something like FNSF represented a facility as well as a programmatic sense. He said that in order to do an FNSF it implied that you would have to have in place certain capabilities that are resolved through things like existing facilities in the world, possibly new facilities that are small etc. He said the subcommittee had made that assumption that that would be there. He said that they had stopped short of describing that in the executive summary because it was talking about things that were not there and programmatic needs beyond the charge in the sense of just trying to identify the facility. He said that how would one frame a discussion in an executive summary that would speak to larger needs. He encouraged members that when they would ask about adding to that how much they wanted completeness in regard to a technical analysis.

Dr. Synakowski said that a SC announcement had come out via email from Dr. Brinkman and the title was it's time for me to move on. He said some of the main points included Dr. Brinkman's comments which said now that the new DOE leadership is taking place I'm writing to let you know that I will be moving on. He continued, my last day at DOE will be Friday April 12, 2013 and between now and that date I will be transitioning and taking some personal time and will be away from the office much of the time between March 22nd and April 12th. He continued, as I leave office my biggest concern remains the erosion of science funding in the United States when most of the industrialized countries of the world are increasing funding. When I came to DOE I started with the principle that I've used when I changed positions in the past, namely that I should assume that all the people in my organization are good at their jobs. There is no question that the staff in the SC has lived up to that initial expectation. We have made some changes but overall I believe the SC is a very sound organization today. Dr. Synakowski quoted: "So what did we accomplish? Actually a lot, many new exciting scientific advances have occurred. The first x-ray free electron laser, the Higgs particle was discovered, strongly-enhanced use of simulation materials science discovery of new aspects of the nature of the quark-gluon plasma and a host of new results and possible energy technologies have been discovered to mention a few." Then he goes on to say: "ITER has a new leadership team in place and construction is well on its way. Overall our international collaborations have increased and we have sharpened our focus in making these strategically important." He said that Dr. Brinkman's mention of fusion and ITER was at a very high place and higher than that is his concern about the erosion of their investments nationally.

LUNCH

The Fusion Energy Sciences Advisory Committee recessed for lunch.

Dr. Greenwald stated that the presentation was a follow-up of a briefing given a year and a half ago as the government was grappling with treatment of data coming from sponsored research. He stated that this briefing is an update in policy.

OFFICE OF SCIENCE, STATEMENT ON DIGITAL DATA MANAGEMENT

Dr. Laura Biven, ***Senior Science and Technology Advisor, Office of the Deputy Director for Science Programs (SC-2)***

- Stated that she would be providing an update on a conversation started during the summer of 2011. She added that at that time FESAC accepted a report detailing the ways in which federally-funded research was disseminated.
- Said that was the charge given to all six of the federal advisory committees for the SC.
- Stated that the process began in the summer of 2011 when the SC was then beginning to consider their responsibilities in terms of stewarding the data coming from federally-funded research.
- Noted that the SC has a policy that will come into effect October 1, 2013.
- Stated that the policy would be referred to as Office of Science Statement on Digital Data Management.
- Said that the text of the statement was still being finalized but the requirements and principles to be discussed were firm.
- Stated for clarification that what was being discussed today would apply only to proposals coming to the SC for research funding. She stated that it did not apply to proposals to a user facility for time on that facility and also it did not apply to SBIR/STTR awards (Small Business Innovation Research)/(Small Business Technology Transfer).
- Referred to the OSTP (Office of Science and Technology Policy) which put out guidance to the agencies on February 22, 2013 and stated that her presentation was consistent with that guidance.
- Noted that they considered the input from FESAC in 2011 in addition to comments from other federal advisory committees and public comment.
- Clarified that she was discussing digital research data.
- Defined and stated that digital research data is data that is required to validate research findings.
- Stated that data management reflected all stages but the current focus was on data sharing and preservation.
- Noted that several groups would be impacted by the policy including new requirements for PIs and research institutions and new responsibilities for reviewers and program staff.
- Discussed their approach in several ways: policy specific to the SC, its needs and missions; give programs in the SC maximum flexibility to implement the policy; be consistent with administration priorities and took into account input from research community; and finally took into account the policies of other research-funding agencies.

- Reviewed the policy and outlined three main principles.
- Discussed the three requirements that appeared in the Office of Science Statement:
    - Requirement 1 – All research proposals submitted to the Office of Science for research funding would need to include a two-page Data Management Plan (DMP). She said at a minimum DMPs must describe how data sharing and preservation will enable validation of results or how results could be validated if data is not shared or preserved.
    - Requirement 2 – The DMPs must provide a plan for making all research data displayed in publications resulting from the proposed research digitally accessible at the time of publication. This includes data displayed in charts, figures or images. It could be provided as supplemental information to a published article or through other means.
    - Requirement 3 – Researchers that plan to work at an Office of Science User Facility as part of the proposed research should consult the published data policy of that facility. They are working with user facilities to ensure that they have a published data policy.
- Stated that the requirements were set at the SC level and there might be additional requirements set by the program, sub-program or within the FOA (Funding Opportunity Announcement), depending on specific disciplines.
- Noted that the DMPs formed an integral part of the research proposal and would be reviewed as such.
- Provided in presentation a glossary of terms including digital research data and research data as defined by the OMB (Office of Management and Budget) Circular A110.

COMMITTEE DISCUSSION

Dr. Greenwald referred to Requirement 2 and asked whether if all the major journals that the members worked with developed their own plans for making data in the publications accessible to the public, would that meet that requirement. Dr. Biven responded yes. Dr. Greenwald asked if any particular journal did not develop a policy would the individual research PIs be responsible. Dr. Biven responded yes they would be responsible. She stated that it could be housed somewhere else in an institution repository and noted that they were also thinking of possible options of what infrastructure the DOE could provide.

Dr. Christopher Keane asked if there had been any discussion within the rest of the department about trying to have a policy, such as the NNSA or other offices or was it solely the SC now. Dr. Biven responded the statements given applied only to the SC. She said that she had had conversations within other offices in the department and she said that the whole department was on the hook for responding to the guidance from OSTP and they would be coordinating with them.

A member raised the issue of public access to journal articles and how it would affect the publications. Dr. Biven responded that the OSTP addressed two things in terms of what they considered results of federally-funding research, data (addressed at this presentation) and journal articles. She said that the presentation and principles and policy presented were consistent with the data side of that OSTP memo. The other side dealing with public access to journal articles she agreed was more contentious. She said that at the present time the DOE did not have a firm plan about how to proceed but they did have a plan to engage with the stakeholders to ensure that public access could be achieved in a way that was not detrimental to the scientific community.

Dr. Hubbard raised the issue for FES and it concerned international research data under shared projects. She asked if it implied making raw data from those projects publically available. She wondered if that would raise issue with the international partners. Dr. Biven responded that the Office of High Energy Physics was planning to deal with that issue. She stated that with existing collaborations they decided to respect the bylaws of those collaborations in terms of data management. She said that people applying to the SC for funding to participate in those collaborations could simply refer to those bylaws. She suggested that FES could go a similar way.

A member referred to Requirement 1 and said with many user facilities there was a time-out period or a period of time for the PIs to analyze their data and write papers before they publish, a period of time before the data has to be released. He asked if that was envisioned to be of that or was there a period that the PI would have for exclusive use of his or her data before being released. Dr. Biven responded that just how they did not impose a time scale for preservation they also did not impose a shorter time scale for embargo periods. She said the thinking was that it would be concurrent with publication and if not, then the PI would provide an explanation for why.

Dr. Greenwald suggested that it was important that universities and laboratories be very involved in the process as opposed to the burden falling upon individual PIs to ensure proper curation of data.

DISCUSSION OF THE SUBCOMMITTEE REPORT ON PRIORITIZATION OF SCIENTIFIC USER FACILITIES

Dr. Keane commented that discussion on small facilities with HED (High Energy Density) was an important one. He said there was a recommendation about eight years ago in various reports to have an intermediate scale facility. He said that the influence of those previous proposals could be seen in the report. He said the whole issue of smaller facilities was important for HED. He said that what the subcommittee had submitted with regard to HED could be thought of in four classes. He asked how did they come to the decision as to who was involved in it on the subcommittee and looking at the high-peak power solids laser issues only and how he settled on the 200 petawatt level? Dr. Sarff responded it was 10 to 100. He said the white papers provided a way for the subcommittee to set a menu from which they began a process. He said that the world-leading science was the leading criteria and they went through the evaluation and the evaluation process for all the white papers and inherent to the papers the science which had been discussed in the planning reports provided a focus. He said after the process it was the petawatt laser that rose to the top. He said they had to make sense for a decision on the number of facilities and organized around those four strategic areas. He said they picked one that the subcommittee ranked high in its discovery science and that was where the focus turned to. He said they had to be cognizant of the fact that they had to be realistic in the number of facilities to place on their list. Dr. Keane asked if there were other experts consulted outside of the subcommittee with regard to the evaluations. Dr. Sarff responded that the subcommittee was an MFE-weighted committee and noted that they had put together a two-page description for a facility which he considered remarkable science especially taking COIs into account. He discussed the petawatt facility and discussed their reasons for the differences between the absolutely essential versus important.

Dr. Ji acknowledged that the committee had a difficult job considering the time limits and the amount of material. He noted it was important to get ready as a community for what they would do in a five, ten and twenty-year time scale with a general strategy and planning process. He referred to the process of the subcommittee and asked about the process they had gone through to select the five facilities. He said they had already described the COIs, the sites, the readiness but he asked if Dr. Sarff could describe the process then members would understand the results. He thought it could be included in the introduction or summary. He said he was expecting that C-Mod would be part of an existing facility. Dr. Sarff responded to the question regarding process. He said that the charge had asked for a short letter with a list of facilities that were categorized and he said to provide context for that there was a report but although he was hearing a request to learn more about the process he wondered how much should be included in the executive summary. He said the process was not what was requested. He said that they had tried to include within the executive summary the key elements which had framed the process. Dr. Synakowski said that the report would reach the SC and there would be a discussion at that point. He said that they would probably not be able to include all the details about their process in the executive summary.

Dr. Zinkle suggested some simple changes that could be made into an appendix like the two tables of some of the criteria that they were using for science impact and readiness. Dr. Sarff said that he had had some discussion with some of the members of the subcommittee and they had discussed including an appendix where they would do a mapping between the facilities and the white papers because the white papers did provide technical information in terms of metrics. He emphasized that the white papers were an ad hoc process that they chose to inform them but was not necessarily complete. He said the evaluation of the white papers was useful but did not define the process.

Dr. Greenwald said there were two issues. He thought that things like process and criteria fit well into appendices. He said the other had to do with the definitions of what the facilities chosen were and he thought there needed to be more discussion. Dr. Sarff emphasized that the due date was March 22nd and he asked what it was that was sufficient to compel DOE, the SC and its various offices to have compelling items for FES on the list.

Dr. Sarff responded to Dr. Ji's question about C-Mod. He said the status of C-Mod was not resolved. He said the subcommittee decided that in order to support some level of conversation that they would invite a white paper from the C-Mod leadership to put it alongside or parallel and to have the opportunity to discuss it. He said in the end the subcommittee recognized that it was difficult to call it an existing facility in the context of the charge. He said that they saw in C-Mod capabilities that were important in the PMI area. He said they decided to include the discussion of C-Mod on the report by echoing back on a recent more in-depth analysis in the Rosner Report.

Dr. Hubbard referred to the five facilities on the list and said four of them were the ones that FES gave to the subcommittee. She asked if the subcommittee had given the selection from FES special deference or were they all treated equally. She said there was only one new one on the list and it had not received an (a) in either category. She said out of 37 white papers was there really only one that deserved to be on the list and she asked if there were none that could have received an (a) in world-leading science. She commented whether the readiness CD-0 criteria would have in effect ruled out right away anything that was new or innovative in response to the proposal. She wondered if Dr. Sarff could give the members a sense of how strong was the consensus that these were the right five facilities. She

suggested adding one or two more as it would give leeway to discuss and prioritize within the community and the SC in the next few months. She thought it might make sense to include a few additional facilities on the list as they could be deducted but it was a better starting point than not being on the list for consideration at all.

Dr. Sarff acknowledged the subcommittee was paying attention to what was happening in the other offices. He agreed and thought that it was an important perspective for FESAC to be considering because the real competition was at the SC level. He said many of the communities were handing the process differently. He referred to Nuclear Energy and noted that they had three or four on their list all of which had CD-1 or CD-2. He stated that they were very well along, very clearly identified and community vetted. He referred to BES and said they also a short list and again all were very far along. He said his own view was that given the times and the fact that the ultimate list was probably similar to the list they saw in 2003 that had 20 to 25, for FES to put forward a list of ten, who would sort that out? He said it would be given to the SC and through a process they would whittle it down. He said he would like to see a longer list because when he would look at the planning documents he saw lots of good justification for other facilities to be added. He added that a longer list conveyed recognition that the subcommittee recognized that the discussion for facilities was worthwhile. He said the subcommittee felt compelled to make a responsible list that would stand a chance to get two or three maybe on the ultimate list which they felt was the reality.

Dr. Zinkle mentioned some possible things to be considering for the report including some simple, visual figure for each of the things that would convey that they were truly world-leading or of world-class kind of capabilities. He described some of the content of the BESAC (Burning Energy Sciences Advisory Committee) report. He suggested some ideas for improving the subcommittee's report to convey the idea that facilities were world-class. Dr. Sarff referred to the two-page descriptions and said they were eager to keep in mind that they needed something that people who would be less informed about the details would be able to comprehend. He said to that end they tried to be concise and clear about the facility and to expose how that would lead to world-leading science. He said they did have some key metrics like the petawatt laser one. He gave another example, the stellarator and said its uniqueness was in U.S. leadership in taking 3D-magnetic fields and making them appear 2D, and using this example explained how they could not capture everything but had tried to use a combination of words and numbers.

Dr. Zinkle said he had some concerns regarding the cost estimate for FNSF. He said it did not seem credible and he wondered if there were enough cautionary words as it seemed to be way before CD-0. He thought that it should be conveyed in the report that it was not a well-founded cost estimate. He acknowledged that they had to include an estimate as per the charge but he thought that they should convey the fact that the thought process was far from complete on FNSF and therefore there was a much greater degree of uncertainty compared to the other facilities. Dr. Sarff said in principle they could do that. He explained that some of that information regarding the cost estimate originated from the white papers and elaborated further. He said the criticism was fair but in terms of the context of the charge he said it was not that clear on whether cost was needed in the exercise. He said he thought the SC wanted to have more of a basic sense of the scale rather than a precise cost. He said that (c) said mission and technical requirements not fully defined so he said he was comfortable with FNSF fitting into the (b) category where it stated that more work had to be done to understand cost. Dr. Greenwald said that FNSF because it was so large and there was a lot of uncertainty that he thought it was possible

that the facility could be a $10 or $20 billion. He said they knew from ITER the price that was often paid when costs were low-balled.

Dr. Betti referred to the multi-petawatt facility and said he articulated well the assessment of the science impact with two metrics one was the relevance to fusion power and general discovery science. He said they had combined the two into one metric, one category. He asked why not produce two categories. Dr. Sarff responded that the best facility options had met high criteria in multiple ways. He said the issue of sub-categorizing some parts was not obvious that it was in the charge. He said the charge asked for a list of facilities categorized in a particular way. Dr. Betti wondered if it would be difficult for the SC to give an assessment as they were totally different things. Dr. Sarff responded that the subcommittee had felt compelled to provide what they were asked to do which was to provide a single categorization.

Dr. Ji asked questions regarding the meanings of various categories (a), (b) and (c). Dr. Sarff explained how his committee had approached the process. Dr. Greenwald commented that he was sympathetic with regard to the challenge with regard to the time deadlines and the fact that certain aspects of the charge were not well formulated. He urged that in cases like this where specific things were asked for and then giving that information to the community under such a short time period was perhaps not going to produce the best advice. He considered that Dr. Sarff and the subcommittee charged with this work were put into a difficult position. He thought that there was a huge range under category (b) and using such information might lead to incorrect decision-making in terms of their expectations. Dr. Synakowski noted that the SC was cognizant of these facts.

Dr. Greenwald stated that they would finish up on the general comments. They would then complete the Public Comment and would follow that by discussing what changes the committee would recommend. He noted that they would need consensus on those and then vote on the changes for the report. He said that following that they would have to prepare a letter.

Dr. Keane referred to the petawatt system and noted that the subcommittee had recommended a 10 to 100 petawatt system. He asked if it was difficult rating it as the ready to execute rating of (b). Dr. Sarff responded that part of the reason for putting it into category (b) was there was limited representation on the subcommittee on that and those particular members had urged that there needed to be a community discussion that would inform what the next best step would be. He said that was partly why it was (b). He said that if they looked at the white papers at specific options it appeared borderline as to whether some of those would be CD-0. He said that the facility they were referring to was not specific and there were specific examples of how to do that and within that aggregate it was (b).

Dr. Meade commented about the discussion, about the process and the difficulties of the short time constraints and difficulties associated with the lack of an overall technical roadmap. He said that this current process was an improvement compared to prior exercises to develop SC facilities lists.

Dr. Synakowski commented that the presentation and performance of Dr. Sarff showed that the SC had made a very wise choice. He said that considering all the constraints that had been identified the subcommittee had developed a mature process very rapidly. He referred to a comment about the DIII-D upgrade package and he said the SC intention of putting that forward was in looking at other offices that had been more liberal about what they had described as upgrades and by comparison FES tended to be

fairly conservative. He said that he had discussed the issue within the SC and Dr. Dehmer had talked about what packages could be included and how they might be characterized and had indicated to him that this would be well received. He said that it might be good for FES to look in a broad sense at ensembles of upgrades like that on a particular facility. He referred to the petawatt facility and distinguishing between fusion and science, he said that he believed the subcommittee had basically looked at the mapping of a particular facility or upgrade proposal on to the mission elements. He said if they mapped to more than one they ranked higher.

Dr. Synakowski acknowledged that they would have an opportunity to discuss within the SC because of the tension imbalance between fusion mission and broader classes of science which was always apparent particularly under tight budget times. He said the process had been very useful for the SC and he thought the number of proposals was about right. He commented overall that if a particular facility description was not exactly right or the precise mission of an FNSF was not exact it was still a valuable exercise if one or more ended up on the list and then stimulated a further discussion on the correct thing to do, then it was a success. He congratulated and thanked Dr. Sarff and his subcommittee again on doing a great job, both gathering information and then making sound judgments. Dr. Sarff thanked Dr. Synakowski on behalf of his subcommittee. He said the committee had worked extremely hard and given all the tensions of the passion that each member brought to the science they were very anxious and passionate about the list. He noted again it was a committee effort.

BREAK

The Fusion Energy Sciences Advisory Committee recessed for a 15 minute break.

PUBLIC COMMENT

Dr. Mike Zarnstorff, *Princeton Plasma Physics Laboratory*

- Stated that the report should be technically correct and understandable to the community and represented a sensible response to the charge.
- Said the next step was in effect a competition at the SC level which had been touched on previously.
- Commented for that reason they needed to ensure that the report was reviewed critically to ensure that the report would be able to communicate well to non-experts as they would be involved in the evaluation and comparison of other facility proposals in other fields.
- Considered that the important issue was getting FES facilities on the list so for that reason concise descriptions showing scientific value of the facilities was important.

Dr. Steve Dean, *Fusion Power Associates*

- Stated that he had been involved in some similar processes in the past and he knew that the primary purpose of the exercise was to alert the administration to potential, big-ticket construction items that might be coming up in the future.

- Noted that within that context he considered it a red herring to put into the exercise the existing facilities. He acknowledged that the charge suggested that but he thought it confused the issues and the topics if they had included.
- Said that the subcommittee had included five new facilities and two of the three existing facilities.
- Referred to the exclusion of Alcator C by the subcommittee that had said it could not include that an existing facility in the context of the charge. He stated it was an existing facility and he considered it an affront and inappropriate to the Alcator program to not list it. He thought it should have been included.
- Stated it was a subcommittee report but it would become a FESAC report. He said that FESAC was aware that the process leading to the Rosner Report began a year ago because of budget issues for FY 2013 and one of the big community issues had to do with the proposal to terminate the Alcator C.
- Considered this a major issue in the community and thought it deserved a more careful consideration rather than having the conditions of a charge make that determination.
- Stated that the members of FESAC should recognize that the community supported Alcator C and the Rosner subcommittee had supported it for three to five years and acknowledged its important work.
- Stated that FESAC in accepting the report and transmitting it to DOE absolutely should insist that Alcator C-Mod be put in the table as an existing facility with a two-pager otherwise he would consider the committee doing a disservice to the community.

Dr. Richard Buttery, *General Atomics*

- Stated his concern about the national program and how the report would interact with it.
- Said he wanted to focus on two numbers, the first $400 million, the amount being spent on the program and secondly, 50-run days on world-class facilities.
- Stated that it seemed to him an unprecedented limit on the amount of science they would get for that amount of money.
- Noted that he had worked on the JET facility which had cost about a quarter of the U.S. program and typically in a program year they would do 150, 200 or 300 sessions, 8-hour sessions on the facility. He stated in the U.S. for four times the money they would get 50-run days.
- Expressed his concern for DIII-D in which FY 2013 funding was below the level they needed to run. He stated that they were running because they had saved some money during FY 2012, had turned off the heating system, frozen refurbishments and frozen upgrades on the machine.
- Stated that if that level of funding continued they were looking at losing one third of the scientific staff at the facility and they had already informed their collaborators of that risk.
- Stated how did the report interact with the situation in the U.S. program and in DIII-D?
- Noted that the panel had ranked some of the options going forward as (b) but not central. He added that these options would be compared to other subcommittee reports going to the SC where he expected that the majority of their recommendations for facilities to proceed were ranked as (a) absolutely central. He said with the rankings submitted by the subcommittee as is, it would hamper the ability of FES to secure the SC resources on near-term options.
- Said if they did not get those options it would be equivalent to recommending a freeze on the program.

- Described the repercussions for not moving ahead with an upgrade for DIII-D and noted their disappointment with the way the subcommittee wrote the report notwithstanding additional information and clarification they had sought about DIII-D and research capabilities.
- Recommended that FESAC should consider recommending rating an (a) for all its proposals. He added with the budget allocation of $400 million he suggested $100 for ITER and $300 million for the domestic program.

Dr. Stewart Prager, *Princeton Plasma Physics Laboratory*

- Stated that Dr. Sarff's subcommittee had done an excellent job.
- Stated that they had recommended machines in the $100 million category and in the multi-billion-dollar category spanning almost two orders of magnitude in cost with nothing in between.
- Said that that was discussed in the report for example with a PMI facility which would fall in the in between category for approximately $1 billion. He said remaining silent on anything in the billion-dollar category makes a statement that there would be no great opportunities in that category. He added that it also was saying that in order to get to a fusion reactor you would need only an FNSF and $100 million devices. He considered that a debatable issue.
- Stated it was clear as to the reasoning behind it, possibly no need, the fact that it was being done elsewhere internationally or whether it was out of the scope of the study.
- Stated that with regard to a PMI facility it had been discussed and options were suggested as it might be best done as the first stage of FNSF or in a separate facility that would either precede or would run in parallel with an FNSF. He noted there was no consensus on this.
- Said there was no agreement on whether one was needed. He said in his opinion it made sense.
- Stated that the report by Dr. Sarff and his subcommittee was reasonable in concluding it was better to do it in the first stage. He stated that Dr. Rosner and his subcommittee suggested it was better to do it in a separate facility. He said there was two separate views by FESAC panels.
- Suggested that there were diverging views because there had been no study on the simple question which was what is the cost benefit ratio of doing it as a first-stage or in a separate facility? He said it was important to make a decision as discussions had been going on for five years. He stated that Dr. Sarff and his subcommittee had done as well as they could considering they were hampered by the fact that they were only opinion-based as opposed to being based on a study.
- Agreed with the comments that C-Mod was an existing facility and should be evaluated as one.
- Agreed with the subcommittee's comments on stellarators in that it made sense planning a next-step stellarator in the $100 million category and to look at all design concepts and see what was best.
- Stated at PPPL they had NCSX renamed QUASAR which could be continued to completion. He said the question of whether QUASAR was the best or was there something better was an issue that should be considered within a six to twelve-month timeframe in a serious study.
- Thought that FESAC should do more. He said other committees would meet multiple times in a year but FESAC now met twice a year or one and a half times a year for one day which he considered insufficient and provided examples of reports being completed but no reaction or input from the SC. He suggested it was having a negative impact on the community.

Dr. Greenwald responded and agreed that he would like a response to the committee reports but also sufficient time to consider their impact. He said that had not happened and was an important part of the process. An audience member said that in other committees they had an apparatus in place designed to elicit community response to the way the field should evolve. Dr. Greenwald agreed and said that the FACA laws had been interpreted for FESAC in as strict a way as possible in order to minimize the freedom of action of the committee. He said charges were prepared without input from the committee and were usually final when presented. He stated the reinterpreted COI rules had also made the process more difficult. He noted that the frequency of meetings and the production of the agenda were all done according to law but all in a way to minimize the impact.

Dr. Meade noted that the SC has several advisory committees and each had a charter. He said the charter for FESAC was significantly different from the charter for BESAC and High Energy Physics and NSAC. He said for FESAC they were supposed to respond only to charges whereas other committees provided other information. Dr. Meade suggested that some changes should be made to FESAC's charter to provide more freedom.

Dr. Miklos Porkolab, *Massachusetts Institute of Technology*

- Thanked Dr. Sarff and his subcommittee for completing a difficult report.
- Thanked Dr. Dean for speaking up for C-Mod. He agreed with the comments from Dr. Buttery and Dr. Prager with regard to DIII-D.
- Noted that Dr. Buttery had made an excellent point in that $250 and $290 million on the domestic program, in ten weeks, a year on one machine.
- Said that in 2012 they had run two machines and C-Mod had run more than 14 weeks and now the productivity would be cut more than a factor of two down going from 26-28 weeks down to 10 weeks.
- Said that the U.S. was saying they are the leading fusion science program in the world but the productivity did not reflect that.
- Said that they had an outstanding research science community and some of the best graduate students preparing for the future and he considered that they were now letting them down.
- Dismayed to see that C-Mod was not included as an existing facility. He said the reference of a facility as not existing that was actually there ready to go, tuned up, with a full staff and 30 graduate students did not make sense.
- Referred to Dr. Synakowski's comments that Dr. Brinkman had testified to the Energy Subcommittee of Appropriations in the House and when questioned about C-Mod Dr. Brinkman responded that C-Mod was on hold. He commented that the facility could only be on hold if one acknowledged that it existed.
- Thanked the subcommittee members for noting the key contributions of C-Mod including that to ITER.
- Discussed some of the recent science research and breakthroughs with regard to C-Mod.
- Referred to the educational aspect of C-Mod and noted that there were 30 PhD. students and said that the whole educational program in plasma physics was at risk. He provided some of the consequences that would happen if C-Mod was closed down.

Dr. Betti asked the committee if there were any members who would object to instructing the subcommittee to put C-Mod back on the list of existing facilities with an explanatory paragraph. Dr.

Greenwald said if he was asking for a vote he and Dr. Hubbard could not be involved. He suggested that it be brought up during the discussion about revisions to the report.

Dr. Tony Taylor, *General Atomics*

- Thanked FESAC for allowing him the opportunity to make some comments.
- Agreed with Dr. Buttery and Dr. Porkolab that it was deplorable that there were only 50 days of experimental operation in the U.S. facilities in 2013. He said, notwithstanding that fact he thanked the DOE for those days and noted they would do their best with the resources they had.
- Referred to a comment made by Dr. Sarff in response to a question. He said Dr. Sarff had said if he had included the divertor upgrade on DIII-D with the other upgrades that that would move DIII-D further along toward an (a). He explained that they had made a conscious decision when they submitted the white paper to not include the divertor in the four-pager. He said they had been looking at divertor upgrades since they had started a study on it in 2008 and said it was so different from DIII-D that they had started it using private funds. He said about two years ago the ideas were discussed with DOE. He stated that unfortunately they took some data and the data they had and the design did not match perfectly. He said that when they decided to submit the paper everything they had was shovel ready except the divertor. He said within another few years they could resolve the discrepancy and come up with an optimized divertor for DIII-D.
- Said that it was also an opportunity to make progress with handling PMI.
- Recommended that since the subcommittee had come back to General Atomics and asked for a clarification which was provided and which stated that they were not ready to do the divertor at the moment and was not shovel-ready but would be ready in a few years, that FESAC consider the two-staged approach of the upgrades on DIII-D in their deliberations.

DISCUSSION OF THE SUBCOMMITTEE REPORT ON PRIORITIZATION OF SCIENTIFIC USER FACILITIES - CONTINUED

Dr. Greenwald stated that he had heard four general comments that he considered substantive that the committee would need to deal with, to ask the subcommittee to either incorporate or change. He said there were also several smaller ideas that had been brought up such as cost with regard to FNSF and whether the evaluation criteria should go into the appendices. He said he would be sending out an email to FESAC members before March 18, 2013 asking for any small changes they would consider non-substantive to forward to Dr. Sarff for them to incorporate. He noted that the four substantive issues were: (1) some clarification about smaller facilities (not to change the report but deal with it in the cover letter); (2) the clarity in the proposed facilities (particularly materials, FNSF and stellarators where the experts on the subcommittee could not be sure what specifically were being proposed); (3) whether a PMI option should be added as a sixth facility; and (4) the recommendation made by Dr. Betti to put C-Mod back on to the list of existing facilities.

Dr. Ji raised the question of the ratings of the facilities, specifically (b) the readiness, which he did not consider clear. Dr. Sarff noted that the charge was clear, it had asked for a short list of facilities which are categorized for world-leading science (a), (b), (c) or (d) and for readiness (a), (b) and (c). There was some discussion about the readiness ratings of FNSF. Dr. Greenwald expressed the view that the charge

was flawed in that the categorization was more problematic than helpful. Dr. Greenwald suggested dealing with the issue by adding a statement saying that it would explain it was not the ideal set of categories because the range was huge. Dr. Hubbard suggested retaining the rating but including a sentence or two in the write-up saying that with this much work, this kind of an evaluation it would be ready and provide a sense of time and say what remained to be ready so it would not change the rating but would give a better understanding. Dr. Greenwald suggested the way to deal with the issue was to provide a statement at the bottom of the table saying (b) is a very broad category, see the write-ups for the details.

Dr. Greenwald proposed (1) the clarification of the role of smaller facilities be put not in the report but in the cover letter. He read his suggested statement: "Throughout the process the urgent need for new and upgraded facilities was clear. It was also clear that smaller facilities below the cost scale specified in the charge will also be crucial." He said this would mean that those facilities excluded by construction of the charge are not excluded by their scientific justification. Dr. Uckan was concerned that the cover letter was addressed to only the director of the SC and would be separated from the report. Dr. Greenwald responded that it was a public document and was included with the report and charge. Dr. Sarff stated that in one of drafts of the executive summary, in the paragraph that would speak to the cost they had a sentence that was eventually edited and removed that stated in essence that low-cost facilities are particularly impactful in the areas of materials for fusion and basic science. He said the edited section stated, and therefore it is clear that planning processes in addition to this are required. He said it was removed as there was a concern for the context and the emphasis on only materials and basic plasma science and that this would imply that was not important for the other areas. He said given the feedback he said he thought he would be able to convince the subcommittee that that sentence could go back in. Dr. Greenwald asked if there was any objection to that and there was none.

Dr. Greenwald referred to issue (2) regarding comments regarding stellarators, the FNSF and materials that it had not been clear to the FESAC members including experts as to what was being proposed, i.e. as they had been taken as a non-specific facility proposal or a generic proposal to address a mission which he thought appropriate but he thought insofar as they had in mind a number of options and that was used for the ratings and the costing, he thought it would be helpful to include them. He gave an example with materials and said if you had participation in IFMIF as one of the options and the facility at Los Alamos as another one with a small table that would say these are the options. Dr. Sarff suggested that they could add an appendix which was a table and that table would have the proposed new facilities and upgrades and next to it would be a column that would indicate the white papers that spoke to that. He said the white papers would provide the context for it. He said he was concerned if they missed a facility and was comfortable with the idea of a mapping on to the white papers. Dr. Betti suggested he could add "such as" in front of it so it would leave it open. Dr. Sarff said if they had an explicit list they could point to the white papers to provide context for how they framed it. He said they should try to be specific because if they had missed something there would be potential implications. Dr. Greenwald thought it was better to miss one than not include any. Dr. Sarff said if that was their consensus then they would do that. Dr. Greenwald said they would leave the decision regarding the form up to the subcommittee but it should be clear in the body of the text. Dr. Sarff said that he heard in the main body of the text and the place to do that would be in the two-pagers where it cited where its reasonable specific facility proposals that are out there. He said they could do the "such as" facility x, facility y, facility z, as proposals. Dr. Greenwald said the last one was fine too. He said completeness in appendices and references was always useful.

A member suggested using pictures or figures to make the arguments stronger. The member suggested figures like the HEDLP figure which he thought might be the closest example. He said replacing the Materials Irradiation Multi-Scale Modeling figure with a helium DPA figure. Dr. Greenwald said they could ask the subcommittee to work on that but he thought FESAC members who have ideas should send them by March 18, 2013 whether it was a phrase that strengthened it or a graphic or table, giving specific instances in each case. He said he would consider that a small technical change, the committee did not need to review those changes.

Dr. Greenwald referred to issue (3) concerning the PMI and whether it should be added as a sixth facility. He said a number of people had requested that it be added and it had also been brought up in the public comment by several speakers. Dr. Greenwald asked if there was any discussion. Dr. Uckan asked how the subcommittee would handle it, a generic two-pager. Dr. Greenwald thought yes, to treat it like the others. Dr. Sarff encouraged the members to have a discussion framed in the context of supposing they did add a PMI facility and imagine a two-page description completely analogous to the ones that were already part of the report with a mission, a facility description, a connection to planning documents and a categorization in world-leading science and readiness. He commented further that the PMI issue was wide-ranging all the way from test stands to a long-pulse toroidal facility that would operate for thousands of seconds. He said if the committee members wanted to direct the subcommittee in principle they could put something together but noted if they were going to add a facility to the list he projected that they would have to specify as much as they could what that facility was in that framework and its categorization. He said also, in fairness to the subcommittee that this was within the FESAC realm to do it but they would need to circumvent a committee discussion to debate the conclusion on that.

Dr. Hubbard said she supported it and said she thought it should be a confinement facility with a mission to actually come up with PMI solutions. She said there was room for debate and flexibility in the write-up as to whether this would tackle the short-pulse solutions or the long ones which would have a spectrum in terms of cost. Dr. Sarff asked about the range. Dr. Greenwald said they were not ready to make that distinction but would have to be “such as” etc. Dr. Sarff said when he thought about readiness the mission was not clear especially if one went back to planning documents he did not see it. Dr. Sarff said that facility would probably come up with a category in readiness of (c) and there was some debate as to whether or not it would be an (a) or an (b) in world-leading science because it would be compared with existing facilities. He said the thing they were talking about at one second would have a possibility of categorization of (b) and readiness of (c). He asked if they wanted that on the list.

Dr. Zinkle said that when he had read the report that had jumped out at him as many previous panels had put a very high priority for a PMI facility or facilities. He said the report had several slides concerning PMI but did not have a lot to say about PMI. He said something should be included in the report indicating that there were strong opinions in the community about the exact formulation of what the facility should be but should capture the point that this needed more community deliberations. Dr. Sarff said he would be happy to write up something that would capture the essence of the last two slides. He said that PMI was not absent in the report. It was there in the context of existing facilities. He asked the members if they were concluding that NSTX-U and DIII-D were not doing PMI or concluding that a multi-stage FNSF for the first stage was explicitly described as advancing PMI. He asked what was missing. Dr. Zinkle said that did not seem logical in terms of the pulse length and duty cycle considerations versus

other longer-pulse types of facilities. He said that was reasonable but he was emphasizing within the planning documentation and what he was saying was that he had tried himself to look for that and he reminded him that NSTX was testing the Snowflake Divertor and there was a possibility in the future that DIII-D would do something else. Dr. Zinkle noted that there was a divergence of opinions among the world's experts about the exact formulation. He asked if that could be captured. Dr. Sarff responded that if the comment about PMI was included in an executive summary it might affect how the others would be viewed.

Dr. Greenwald referred to the long-pulse lifetime issues that had no solution at present so the thought that they could design and get licensed in FNSF statement did not seem credible. He continued for the report to dismiss that because the ideas were not mature enough seemed an oversight. He said that they had received at least two white papers on long-pulse and said he did not understand why given the importance of the issues and the potential impact on a roadmap. Dr. Sarff said the long-pulse PMI was in their facilities and was called the first stage of FNSF. Dr. Greenwald said they had made a technical judgment on what the right path was but that was not a community consensus.

Dr. Najmabadi agreed with the facility prioritization and the fact that they did not have a PMI system in it. He said there were a lot of international facilities dedicated to it and he wanted to see some results before moving ahead and building a large facility. He agreed with Dr. Greenwald and Dr. Zinkle that PMI had been highlighted so he thought they should have a paragraph explaining why they did not list the facility. He said that they had decided they would have the two-phase nuclear facility that did divertor work. He stated that they would never get the machine licensed if they had not proven it. He said that he did not think they should go ahead and build new facilities until they had results for some machines.

Dr. Hubbard said she thought the paragraph that said how they would tackle the PMI issue on FNSF was advice that that FESAC should not be giving to FES as she thought it was bad advice. She acknowledged it was the decision that the subcommittee came to but did not have community consensus. She added that many PMI experts also had to recuse themselves from much of the discussion due to COIs. She said the report would take everything off the table until 2024 and she thought it was a mistake to not leave that door open in the planning process. She thought a PMI-focused facility probably would be required. She thought it at least should be brought to a vote.

Dr. Greenwald said there appeared to be three options and they needed to vote on which option it would be. He added they were not exclusive. He said option one was to do nothing, to leave the report mum on the issue. He said option two was to include a description relating to the slides and he said they should point to that under the section in which they had introduced their facilities so they would have a description indicating this is our final result with a table on page four. He said there should be a footnote that PMI was a contentious issue, see the appendix for the discussion. He stated the third option was to actually ask for the inclusion of a sixth PMI facility. He said members could vote for two and three but not one and either of the other two. Dr. Greenwald asked members what their choices were with respect to the three.

Dr. Sarff noted that what he had heard the members ask for was that they would create an appendix and that appendix would describe the important challenge of PMI and summarize in the context alluding to, for example, probably literally framed as an example looking to the Zinkle et al. report. It would be an appendix that would capture the essence of the last two slides. He said that would be referred to

with some sentence that the challenge for PMI was important and then in some way connect it to where they had introduced the table.

Dr. Betti made a suggestion with regard to the appendix. He said the subcommittee had discussed the issue at length and they had included PMI in the report and had a plan for PMI that included existing facilities, international facilities and the FNSF. He said if they could articulate the whole plan in the appendix in more detail that would provide the clear description of the PMI plan that the subcommittee was proposing. Dr. Sarff responded that he would do it the way he had tried to frame it in the last two paragraphs that said that planning documentation which had articulated the kinds of facilities that were needed and speak to those facilities in the context of the charge and probably with some sense of a conclusion that the precise suite of facilities that were needed to solve the PMI challenge had not been adequately addressed in the planning documentation.

Because of COI issues, Dr. Greenwald asked Dr. Betti to take over the discussion regarding item (4). Dr. Betti said that he did not understand why Alcator C-Mod could not be listed in the report. He noted that he had not heard any compelling reason why it should not be listed as an existing facility. Dr. Sarff responded that it should be reasonably clear why it came out the way it did in the report. He said that FESAC had the right to add it as an existing facility. He said that he felt he owed it to the subcommittee to say if FESAC wanted to add Alcator C-Mod it was at this executive order level where they were saying C-Mod is an existing facility and you would like the subcommittee to include it in the table and to draft a two-pager that was analogous to the other two existing facilities. He said they were prepared to be able to do that because they had asked for white papers. He said they also needed to categorize it in an executive fashion. He said they could not just ask the subcommittee to include C-Mod as an existing facility and then the subcommittee should consider its category. Dr. Betti asked if the subcommittee had been instructed not to include it. Dr. Sarff responded that in effect they had been told that it was not an existing facility and why it was missing as per the charge.

Dr. Rosner suggested that the subcommittee could just state that what they considered as existing facilities were officially DOE-designated existing facilities so in effect be clear about what was done. He said the proposal to shut down Alcator was put into the FY 2013 president's budget and was submitted to Congress. It was proposed as they were under a CR (Continuing Resolution). He said one of the tenets of those was, do no harm, so if you're a Congressional staffer and the report was in your hand the logical thing would be to put it in the table and say it had been proposed to be shut down, but right now it had not been shut down. He said they were under a, do no harm, in the CR.

Dr. Rosner referred to the paragraph immediately after the table and changed two sentences. He stated it would say "as requested by the charge letter from Dr. Brinkman the subcommittee also categorized two of the existing facilities". That would be change one. He continued for the next paragraph the first sentence says the future of the Alcator C is presently uncertain. He suggested saying add to that so say "the future of the third existing facility Alcator C-Mod is presently uncertain." Dr. Sarff responded he was in agreement with that change. He said FESAC could decide to do that. He said it did not require an assessment and did not have a two-pager but there was a white paper.

Dr. Sarff said he would commit the committee to write a two-pager if FESAC would show C-Mod as an existing facility with its categorization. He said that if the subcommittee was asked to treat it as an

existing facility and go back and deliberate it they would have trouble finishing and he would not be able to guarantee that it would be an (a).

Dr. Rosner said the amended suggestion as amended by Dr. Betti was to change the first sentence in the next to last paragraph to say "as requested by the charge letter from Dr. Brinkman the subcommittee also categorized two of the three existing facilities". He continued and then the first sentence in the last paragraph would say: "The future of Alcator C-Mod facility, the third existing facility is presently uncertain".

Dr. Ji thought that Alcator C-Mod if it was not on the list would not be given serious consideration. Dr. Betti said that it was discussed and a decision was reached that it should not be listed. He said the issue was whether they wanted to overrule the subcommittee decision. Dr. Zinkle suggested having an asterisk and say it was not rated because of its special status but it would get the two-pager.

Dr. Betti asked Dr. Sarff about having Alcator C-Mod in the table with no rating but having an asterisk pointing to that specific paragraph. He asked if the subcommittee would consider that suggestion. Dr. Rosner said including a facility in the table but refusing to rate it did not reflect well on the field or FESAC. He considered it a bad idea.

Dr. Betti summarized the option that Dr. Rosner stated which was to include Alcator in the table but then instead of having the ranking under the science like the other two facilities there would be a reference to a footnote or reference to a paragraph explaining that the subcommittee did not rank Alcator because of the uncertain status of the facility. He said the third option was to treat it as one of the three and just the same treatment as the other two.

Dr. Betti called for a vote on solution one, the changes to the two paragraphs under table one. Members voted 7 on solution one. Dr. Betti called for a vote on solution two, adding to the table without ranking with reference to a footnote. Members voted 1 for solution two. Dr. Betti called for a vote on solution three, a full treatment of Alcator C-Mod. Members voted 1 for solution three.

Dr. Betti moved to accept solution one, the changes to the two paragraphs under table one. The votes for the motion were 7. The motion passed.

Dr. Greenwald said they had a disposition of the four major changes. He asked people who had minor changes to get them to the committee as soon as possible. He said he would send the instructions on the first three and Dr. Betti would send them on the fourth. Dr. Greenwald said FESAC also had to vote on the report itself.

Dr. Greenwald moved that subject to the agreed substantive changes that members had agreed to forward the report to the Office of Science. The votes for the motion were 7. The motion passed.

PREPARATION OF A LETTER TO TRANSMIT THE FESAC REPORT ON PRIORITIZATION OF SCIENTIFIC USER FACILITIES TO DOE

Dr. Dr. Brinkman,
With this letter the Fusion Energy Sciences Advisory Committee transmits its report addressing your charge of January 24, 2013 on the assessment of proposed facilities for our program. We want to thank Professor Sarff and members of the panel formed to answer the charge. We want to extend our thanks in taking on this formidable charge and completing their work in an extraordinarily short period of time.

As requested the report provides an assessment of several major facilities that should be considered as the Office of Science formulates its ten-year plan. Throughout the process the urgent need for new and upgraded facilities was clear. It was also clear that smaller facilities below the cost scale specified in the charge will be crucial. This study generated wide-ranging and lively discussion at the FESAC meeting after which the full committee voted to endorse the report.

Yours sincerely,

Dr. Greenwald noted that there appeared to be a feeling on the committee that the lack of a strategic plan or roadmap was really a problem. He said separate from the report he would like to make a motion that they make a statement on this and pass it along. He said the statement would say something like efforts on the current facilities charge and recent work on program priorities had once again brought into focus the lack of a clear, well-articulated and widely-accepted strategic plan or roadmap for fusion energy sciences. The FESAC urged the program office to develop such a plan utilizing the advisory committee process and with broad community input.

Dr. Greenwald moved that FESAC should send a letter to Dr. Brinkman to the effect that efforts on the current facilities charge and recent work on program priorities had once again brought into focus the lack of a clear well-articulated and widely-accepted strategic plan or roadmap for fusion energy sciences. The FESAC urged the program office to develop such a plan utilizing the advisory committee process and with broad community input. The votes for the motion were 7. The motion passed.

ADJOURNMENT

The Fusion Energy Sciences Advisory Committee Meeting was adjourned for the day at 5:18 p.m.

Minutes created by Granicus, Inc.

Reviewed by FESAC members, speakers, and the DFO

Certified as correct by:

_____ ___4/10/2013___

Dr. Martin Greenwald, FESAC Chair Date