FUSION ENERGY SCIENCES ADVISORY COMMITTEE
OFFICE OF SCIENCE

Fusion Energy Sciences Advisory Committee Meeting
April 9-10, 2014
Hilton Rockville Hotel and Executive Meeting Center
1750 Rockville Pike; Rockville MD 20852-1699 (301) 468-1100
(Plaza I&II Ballroom)
AGENDA

April 9		
Time	**Topic**	**Speaker**
9:00 a.m.	Welcome, Meeting Agenda and Logistics	Professor Mark Koepke, FESAC Chair West Virginia University
9:15 a.m.	DOE/SC Perspectives, including the FY 2015 Congressional Budget Request	Dr. Patricia Dehmer, Acting Director Office of Science
10:00 a.m.	**Break**	
10:15 a.m.	DOE/FES Perspectives, including the FY 2015 Congressional Budget Request	Dr. Ed Synakowski, Associate Director for Fusion Energy Sciences
12:00 noon	**Lunch**	
1:15 p.m.	ITER Project Status	Dr. Ned Sauthoff, US ITER Project Office
2:00 p.m.	Discussion of the Charge on a Ten-Year Strategic Plan for the FES Program	Dr. Ed Synakowski, Associate Director for Fusion Energy Sciences
3:30 p.m.	**Break**	
4:00 p.m.	Increasing Access to the Results of Federally-Funded Scientific Research	Dr. Laura Biven, Office of Science
4:30 p.m.	Public Comments	
5:00 p.m.	**Adjourn**	

Fusion Energy Sciences Advisory Committee Meeting
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April 10		
Time	**Topic**	**Speaker**
8:45 a.m.	Charge on the Committee of Visitors for the FES Program	Dr. James Van Dam, Director, Research Division, Office of Fusion Energy Sciences
9:30 a.m.	Perspectives from the Office of Advanced Scientific Computing Research	Dr. Steve Binkley, Associate Director for Office of Advance Scientific Computing Research
10:15 a.m.	**Break**	
10:30 a.m.	Charge on Workforce Development Needs for the FES Program	Dr. Hantao Ji, PPPL, Chair of the FESAC Subpanel of Workforce Development Needs
11:15 a.m.	Laboratory Plasma Astrophysics and Beyond	Dr. Hantao Ji, PPPL
11:45 a.m.	**Adjourn**	

ROLL CALL

Committee/Voting Members Present:

Professor Mark Koepke, **Chair**
West Virginia University

Dr. Steven Zinkle, **Vice Chair**
Oak Ridge National Laboratory

Professor Amitava Bhattacharjee
Princeton Plasma Physics Laboratory

Dr. Bruce Cohen
Lawrence Livermore National Laboratory

Professor Raymond J. Fonck
University of Wisconsin, Madison

Professor John E. Foster
University of Michigan in Ann Arbor

Dr. Charles M. Greenfield
General Atomics

Dr. Richard J. Groebner
General Atomics

Dr. Amanda Hubbard
Massachusetts Institute of Technology

Dr. Hantao Ji
Princeton University

Dr. Jin-Soo Kim
FAR-TECH, Inc.

Dr. George H. Neilson
Princeton Plasma Physics Laboratory

Dr. Juergen Rapp
Oak Ridge National Laboratory

Dr. Linda E. Sugiyama
Massachusetts Institute of Technology

Professor Ellen G. Zweibel
University of Wisconsin-Madison

Committee/Voting Members Absent:

Dr. Ramon Leeper
Los Alamos National Laboratory

Professor Robert Rosner
The University of Chicago

Dr. Christopher J. Keane
Washington State University

Liaisons/Ex officios Present:

Professor Fred Skiff
American Physical Society
Division of Plasma Physics
Professor of Physics
University of Iowa

Dr. Minami Yoda
American Nuclear Society
Fusion Energy Division
Professor of Engineering
Georgia Institute of Technology

Dr. John W. Steadman
Institute of Electrical and Electronics Engineers
Dean of Engineering
University of South Alabama

Liaisons/ex officios Absent: None

DOE/SC Attendees:

Dr. Dehmer
Dr. Laura Biven (first day only)
Dr. Binkley
Dr. Brown
Ms. Chao
Dr. Laviolette
Mr. Lehman

DOE/FES Attendees:

Dr. Synakowski
Mrs. Afzal
Dr. Barish
Dr. Bolton
Dr. Finnegan
Dr. Glowienka
Dr. Mandrekas
Mr. May
Mr. Nardella
Mr. Opdenaker
Dr. Podder
Mrs. Satsangi
Mr. Stevens
Dr. Thio
Dr. Van Dam
Mr. Vanek

Other Attendees:

Rich Hawryluk, PPPL
Phil Ferguson, ORNL
Robert Cauble, LLNL
Ned Sauthoff, ORNL
Mark Haynes, Concordia Power
Mickey Wade, GA
Mohamed Abdou, UCLA
Miklos Porkolab, MIT
Steve Dean, FPA
Louis Termmello, PNNL
Gerald Navratil, Columbia U
David Hill, LLNL
Tony Taylor, GA
Vyacheslav Lukin, NRL
John Gardenier, Independent
Erol Oktay, Independent
Stewart Prager, PPPL
Michael Zarnstorff, PPPL
Earl Marmar, MIT
Ray Fonck, U of Wisconsin
Dale Meade (first day only)
Chi-Chang Kao, SLAC (first day only)
Turkan Gardenier, Pragmatica Corp.

MINUTES OF FESAC MEETING

Wednesday, April 9, 2014

Dr. Mark Koepke, Chairman presiding.

WELCOME

Dr. Mark Koepke introduced the purpose of the meeting, reviewed safety procedure, and introduced Dr. Pat Dehmer, Acting Director of the Office of Science.

PRESENTATION ON DOE/SC PERSPECTIVES, INCLUDING THE FY 2015 CONGRESSIONAL BUDGET REQUEST

Dr. Patricia Dehmer, Acting Director of the Office of Science

Dr. Dehmer gave perspective from 12 years in BES and 7 years as the Deputy Director of the Office of Science (SC).

Dr. Dehmer discussed how, during the 12 years she was the Designated Federal Official for BESAC and more recently for the 7 years she interacted with all FACAs, she had encountered neither the level of perceived conflict of interest, the number of expressions of concerns received, nor the prevalence of parochial bias associated with the Rosner panel that was charged with prioritizing the non-ITER Magnetic Fusion Energy (MFE) activities. She described how other Advisory Committee panels operate in general and, specifically, that they are expected to adhere to the FACA rules of the advisory committee. Opinions from labs are obtained by a strategic planning panel from invited presentations followed by a question-and-answer session, rather than obtained from panel membership. She urged FESAC to take all measures necessary to avoid problems experienced with the Rosner panel process and report.

She elaborated upon the FES-related slides in her presentation and discussed how important having a good FES strategic plan is to realizing these FES opportunities. She outlined other SC-office examples of strategic-plan processes leading to beneficial budget authority.

Other SC program offices experienced FY15 budget increases: advanced computing (which is a high priority for SC this year, bolstered by dozens of reports from ASCAC and workshops); also, SEAB is looking at exascale. The BES increase results from interesting exercises that culminated last July in a BESAC report from a subcommittee chaired by the BESAC chair. This impactful FESAC report led to shockingly grand changes in the light-source community: it terminated one project, changed other existing light sources, and had a big impact on both the FY15 Presidential budget request and the FY14 enacted budget. The BER increase in areas of high-performance computing for climate change came from strategic workshops and input. The domestic HEP program is on hold while we wait for the HEPAP report due in May. No significant new investments are being considered until the P5 standing subcommittee and HEPAP set the direction for the high-energy program. In the meantime, HEP experienced a $50M decrease. Similarly, the FES budget experienced a significant decrease both to ITER and the domestic program. The increase for NP aligns with

their well-established plan; this increase goes for the FRIB construction project, funded at $90M/year; it resulted from a strategic plan that is well supported by the community and DOE. In further comparison with other SC offices, ASCR experienced a significant increase for upgrades, and for lifting a new generation of exascale computers to come on line in early 2020. For ASCR, increases in computing is the highest priority, based on the ASCAC report, the National Academies report, Exascale-Computing-specific workshops, in addition to the Secretary's advisory committee.

BES planning resulted in an exercise ending in July, from a BESAC subcommittee chaired by the BESAC chair and with significant participation by the BESAC members. With community input, BES made significant changes to the BES strategy on the light sources, including one $1B facility, and made changes to 2 other light sources. There were significant impacts on the FY15 presidential budget request and appropriations on the Hill. The increase to BES wouldn't have happened otherwise. BER has significant climate change computing resources, from advisory input. HEP got a $50M decrease and retained construction roll-off, while waiting for the HEPAP P5 report due in May. The DOE is not planning to make significant budget inputs, until the Particle Physics Project Prioritization Panel (P5) and HEPAP set directions for domestic program increases in Nuclear Physics, for FRIB, post-CD-2 at Michigan, funded at $90M/year with a near $100M peak, resulting from a strategic plan with community, SC, and administration buy-in.

She explained the FES and ITER slides:

FY12-FY15 budget chart showing FES, ITER, and C-Mod. The FES total, minus ITER and C-Mod, amounts to about $250M, which is similar to the analogous 2013 budget subtotal. It's a challenging year, similar to what is happening to HEP, waiting for reports to come out. If FES is supported by OMB, House, Senate, and the community, then budget increases can happen. FES is waiting for input, and can make or break the budget pattern. Focus not on FY15, but on what comes out of the committee that must not be tainted by parochialism. OMB, community, Hill support needed.

ITER: No surprise for management issues in Cadarache. Management assessors report came out; based on that, SC, DOE, & the Administration's optimum budget for this year (FY14), the acceptable budget number for ITER was $150M. The challenge is to put the rest of the FES effort into items identified in the strategic plan. Dr. Synakowski will focus on this in his talks, but the 3 bullets in the charge letter track exactly to what congress has requested.

Flat funding requires draconian choices, and is a very challenging budget to deal with. Historically 2.1% inflator gave the Office of Science modest head room in 10-15 year planning. Real scenarios are in bullet 2, which utilizes OMB inflators, including cost of living. 4-5% growth is not realistic, and most people discount that as a realistic scenario. Scenario #4 is the same but, starting from a lower level. The committee needs to focus on the lowest, most draconian scenarios. Don't say we can't consider a budget that doesn't allow us to meet all our commitments. Within the department and administration, the lower budget scenarios are the ones taken seriously, and should be the focus of the charge activity.

The increases in SC are high performance computing and delivering high performance codes that will be used by the community. The rest are nominally flat-funded. On facility operations, many user facilities are at capacity, such as light sources, leadership computing, National Energy Research Scientific Computing

Center (NERSC), nanoscience, etc. NSTX, DIII-D, and C-Mod operation is based on congressional direction with FY15, and FY16 having shorter run weeks, that do research for ITER, and take care of students. In NP, the Relativistic Heavy Ion Collider (RHIC) and ATLAS are operating at capacity.

In looking at the pie chart comparing 2007 and 2013 for distribution of the users between the 30 SC facilities, it's clear that the new leadership facilities are gathering the user community. Fusion is less in 2013 than 2007 due to NSTX being upgraded. Neutron scattering, light sources, and high performance computing are leaders.

HEP is continuing planning, but the HEPAP report is waiting until the Long Based Neutrino Experiment planning is completed.

It's important to take a holistic look across SC, and note that the well-defined affordable, strategic plans backed by the community will receive funding. It's incredibly important to respond to the charge well.

She covered the chart on the facilities terminated and new facilities, then transitioned to discuss the BESAC report on x-ray light sources:

John Hemminger chaired the subcommittee and pulled input from presentations from affected organizations, and didn't vary far from BESAC. The findings were that the US is in danger of losing leadership. International construction is aggressive. The direction needed to go in was not the direction being taken by the US. The direction was in free electron lasers, but not the ones planned. The $1.5B effort at Berkeley and SLAC was significantly modified, the storage ring upgrade was not competitive, and needed a major change in plans. This was briefed to the Department, OMB, and the Hill. Chart 14 showed the before and after. Got there better, faster, cheaper and this is reflected in the 2014 budget.

What you embark on in this charge letter is very important. How you do it, keeping a distance during discussions with the stakeholders, is critical, otherwise results will not be taken as being independent. The activity will be put into the content of all FACA committee reports over the last 12 months. How unbiased was the report and the committee, was it accepted by the community, and avoided the infighting and squabbling? Reports for 4 major SC programs, including scientific computing and BES, are also coming in. How does this stack up for credibility, impact, and saneness compared to the others? This report will not be in isolation. In the broader context, take the charge very seriously as it could be immediately impactful if uniformly supported. One of the most important jobs for this committee is how to budget for FES.

COMMITTEE DISCUSSION

Q: Dr. Cohen:
The budgets have produced significant cuts, resulting in the community screaming. Concerns are lack of unanimity on the budget, not agreeing on stewardship, losing leadership internationally and R&D to ITER, feeling undermined, less people doing the work, loss of student interest, the trend is not good for the future, wondering, what upper management at DOE is thinking, does this do the right thing for scientific stewardship.

A: Dr. Dehmer:
Substitute this question for any other office in SC, they have been flat or declining, HEP is now cannibalizing its research program. BES, despite its success, is in a dead fight for funding, as is BER, NP is the poster child for research budgets that are too small. The only increases are in high-performance computing or computation. After 20 years, I've learned it's easier to sell a facility than research. It's not a compelling argument for increasing your budget to say you are discouraged and losing interest. You have to say why it's impactful to have this research. All loss of research is unfortunate and I sympathize, but you have to make the case. I just formulate and defend the budgets. Others had to cannibalize, and didn't get their budget. NP reduced their budgets, so this is endemic across SC. The hardest thing to accomplish in my 12 years in BES, was increasing the funding in energy frontiers, and that was a 5 year campaign. Trust me, getting an increase is hard, especially for a new initiative. For the US, think about the world-class facilities, how to support the research. The case should be made as to why we need these facilities, not about losing students; what areas are critical, why are they needed, how do they support the long range plan?

Q: Dr. Zweibel:
Workforce development and Strategic Laboratory Infrastructure (SLI) took a hit. What are the thoughts on planning for these?

A: Dr. Dehmer:
SLI got no new starts in FY13. The focus is finishing off everything in SLI. The next new starts will be much smaller. There will be 4 new starts this year and each can ramp up next year to $120M. I'm pleased with the 4 new starts. One of the new starts is a $25M project at Princeton Plasma Physics Laboratory (PPPL) to get infrastructure upgrades, which is a high priority.
Workforce Development for Teachers and Scientists (WDTS) is a high priority, but got a 20% decrease. This was a result of consolidating workforce development, which was supported by OSTP and OMB and detailed in a 2013 report from the Committee on STEM Education of the National Science and Technology Council. The effect was to combine the WDTS budgets of the Department of Education, NSF, the Smithsonian, and other Federal agencies such as DOE (SC). This consolidation resulted in 226 programs being reduced to 110 programs. 78 programs were eliminated and de-funded. Many mission agencies were very vocal and the hill was also unhappy. The Hill in 2014 inserted an additional $10M to bring back funds. The FY15 budget couldn't ask for the $10M again. The difference is only a $7M decrease, not the $10M. You need to be aware of the puts and takes. There is funding for 3 new starts and new programs in SLI.

Q: Dr. Hubbard:
Back to Dr. Cohen's question. I understand the why of what is happening. The non-ITER budget was $305M in FY14, which was similar to what was requested, then $266M, a few weeks later in the request. Why request $40M less?

A: Dr. Dehmer:
We don't have the budget authority in SC and OMB to support the WDTS. The Hill will frequently plus-up important areas, but then can't sustain it. There was only 0.9% increase or, $45M for SC, available to still go forward with highest priority. SC, in its totality, focuses on significant priorities from DOE, but we couldn't sustain that level, with this increase.

Q: Dr. Hubbard:
This community has been penalized for not having a strategic plan. Since 2009 and the ReNeW report we were told that we don't want to do strategic planning, that we should stay out of it. Now we don't have one, and it seems like the message is changing. The charge indicates that the community will evaluate the building blocks, and FES will make the plan.

A: Dr. Dehmer
I have never taken advice from an advisory committee and only slapped on a cover page and sent it to the Hill. Without community input, we don't have anything to create a strategic plan. BESAC didn't say how to implement, but only provided the advice. Afterward, SC and BES worked with labs and came up with plan based on BESAC advice, which became the strategic plan. The last time you did this, you had controversy. The budget scenarios were not fully addressed, so what we want is the best advice from the community, on the 4 scenarios listed. Dr. Synakowski will work with SC, and the Director, to come up with a plan, that will be submitted.

Dr. Hubbard: Glad to hear that.

Q: Dr. Neilson:
Back to comments on the Rosner panel, I appreciate your candor on that subject; this is appreciated, and helpful to us. Can you go further? You mentioned that the panel had some issues. I don't want us to go in the wrong direction. Was the panel packed with those who had parochial interests?

A: Dr. Dehmer:
Based on anecdotal input.

Q: Dr. Neilson:
There are always parochial interests. Was it the behavior that you perceived was the problem? Did you get e-mails? Were people unwilling to set aside what is best for the community to push their own interests, based on parochial and institutional interests?

Q: Dr. Neilson:
Everyone is from an institution, so we just have to watch ourselves, consider how it will be read, and its credibility. Having all parts of the program engaged in dialog.
Are we special because we are a small community? The light sources had 3 facilities greatly affected. Did they have to be extremely careful that they were independent of those voices in the report?

Q: Dr. Neilson:
Were there staff from those labs/facilities that were affected on the panel?

A: Dr. Dehmer:
I'm pretty sure that there were not members affected by the proposed changes that were writing the subcommittee report. I was stunned about what was not done in the written report by the (Rosner) panel.

Q: Dr. Ji:
Back to Amanda's question on strategic planning. Since 2008, then 2009, we were ready to assist in the strategic plan, but we never got the chance. What high level strategy is going on between the SC 6 big offices? What processes are going on there, in other words, at DOE, do we have a strategic plan at that level, that plans for increases and decreases in the budget?

A: Dr. Dehmer:
It's not what area we want to decrease, it's what things rise to such importance that you can't not support.

Q: Dr. Ji:
Do you have community support at your level?

A: Dr. Dehmer:
No, they take the six FACA panels, the academy reports and go to the Associate Directors, who do planning on their own. They know where they want to go, so they will come in for very formal budget exercises. In there, they need to hit high, medium and low marks, and brief the Director of SC, who is the final arbitrator, who then goes to the Under Secretary. The Directors sit before the Secretary, and the CFO. The Secretary then decides what he likes and what recommendations he will make.
Then it goes to OMB, which gets priorities from the White House, which will skew decisions one way or another. Trust me. The Director of SC knows what all the reports are, and what the ADs want. I know every single budget line of all the programs. It goes, up, or down, based on OMB, what is coming from the White House.

Q: Dr. Ji:
As far as the ten year strategy goes, do we have a long term picture for what SC is planning?

A: Dr. Dehmer:
Yes, as a budget planning exercise, every AD racks the construction and operations budgets for the next 10 years, including the notional impacts going out 10 years using OMB inflators.

Q: Dr. Ji:
How does the FESAC committee know the 10 year impacts?

A: Dr. Dehmer:
That's what the ADs or the Secretary does. For example, what's the impact of starting a new facility,

construction, operations, etc., such as climate modeling and how many years will you need that increase, 5 years or in perpetuity?
Every line is carried out for 10 years. Research can be bundled for 10 years.

Q: Dr. Bhattacharjee:
You have made wise remarks about strategic planning to this committee which represents the community. Why are we meeting in April after 9 months, and this is the first time we are talking about FES?

A: Dr. Dehmer:
Dr. Synakowski handles that.

A: Dr. Synakowski:
I will cover that.

Q: Dr. Zinkle:
Thanks for the overview, guidance, and the information on the process, on the strategic plan. The strategic plan will be due in October, to meet congress's January 1st deadline, so that is approximately 5.5 months to complete the work. How does that compare to other advisory committees?

A: Dr. Dehmer:
Some are much longer, HEPAP dragged it out, and didn't make it in time to hit the budget season. The light source got a charge in January, and had the report in July, so 6 months.
I think you can do this in the time given. You don't have to create new reports; synthesize existing reports for budget scenarios.
It's the logic on existing documents that is needed. BESAC was easier.

BREAK

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

PRESENTATION ON DOE/FES PERSPECTIVES, INCLUDING THE FY 2015 CONGRESSIONAL BUDGET REQUEST

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

Dr. Synakowski thanked Pat Dehmer, Mark Koepke and the new and continuing members of FESAC and indicated that there are many dimensions to talk about.
He stated that:

- This first slide has been shown many times. The premise is that the status quo is not a plan, in terms of a constant level of research effort, and thinking of where we need to be in the next 10 years for the strategic plan.
- Pat Dehmer alluded to ITER having immense challenges, but that class of science is where the

fusion program needs to go. Namely, the ability to demonstrate credibility rests in demonstrating a burning plasma. How as a community, do we fix the program, convey the technical material and policy to your FESAC members. Ned will talk about the project, and Pat gave you sound advice about the strategic plan.

- The relation to FY14 is complex, but we've been given rules of engagement, compared to the generous FY14 budget. Ned will talk about ITER, and following him, we will hear from Dr. Laura Biven. We have a couple of changes to the agenda.
- I was pleasantly surprised to be asked to talk to BERAC, another advisory committee; it was a breath of fresh air. Dr. Sharlene Weatherwax (the AD of BER) has a practice of bringing in a panel member to present their research. We will try that in this meeting, where Dr. Hantao Ji and Steve Binkley, the new AD for ASCR, will talk to us about their work. Clearly that office perspective and engagement, looking forward, is beneficial.

He took the opportunity to go on a different axis to:

- Convey his appreciation for Al Opdenaker, whom he characterized as a very thoughtful and interesting fellow, with ideas about what ought and ought not to happen, all in the name of federal service.
- Recognize Al for his two dozen years of service as FESAC program manager, and that it was a hard thing to ask him to step aside from FESAC this year as he took on more technical program management responsibilities.
- Express his appreciation to and recognition for John Sauter, who is now retired, for his dedicated management of the grants in FES.

In relation to slide 6 of his presentation, he stated that:

- This has been a most complex time with the charge, and strategic planning taking place at the same time. We have received a timid administration budget, then a generous congressional budget, looking at a three year time frame.
- FY13 had a $398M congressional request for FES, with ITER funding at $150M, so $248M for the domestic program presented a shock to the community.
- Then, Congress wrestled with a CR, sequestration, and negotiations with the Hill, at extremely high bandwidth, and enacted a budget of $378M after the effect of sequestration, and what we know about what is taking place at ITER
- The brunt was felt in ITER, which after reprogramming and negations, we made some changes.
- There was generous funding in FY14, with the request of $458M, and enacted budget of $505M, with the ITER portion of the total of $200M, and the non-ITER budget at $305M.

In discussing slide 7 of his presentation, Dr. Synakowski related that:

- Congress created an ITER funding cap at $225M, which addressed the concern of domestic program impact. The $225M may be in question, based on the current international ITER status.
- The domestic program needs to perform well and create high impact science.
- The ITER funding profile is not being optimized to the level that would complete the project in the shortest time at the lowest cost, which would be higher than $225M/year.
- During the last 3 years, there have been serious problems in the international ITER effort. The Administration will not issue a blank check. At a high level, $150M is appropriate due to a lack of a credible international ITER schedule.
- The decrease in ITER didn't translate in a 1:1 increase in the domestic program. It's a false calculus, and risky calculus, to assume that.

- There is a desire for a realistic assessment of needs. Something beyond our $225M/year in the FY13/FY14 two-year plan; something more rigorous, with a resource loaded baseline, along with a US fusion strategic baseline.
- You couldn't have picked less favorable headlines, although well deserved, in the ITER challenges, and NIF.

Dr. Synakowski elaborated slide 8 of the presentation by stating:

- When Dr. Dehmer was talking, I could relate to her, because I learned much over the last five years from FESAC and appreciate the ReNeW activity, the Greenwald panel and earlier efforts, especially in our efforts in FY12 to seek input from the community, and the committee on priorities.
- I presented a strategic vision to the Rosner panel, to be linked to the ReNeW thrusts and with roots in the Greenwald panel report with the intention of following through with a strategic plan.
- Why are we only doing this now? The Rosner panel was the logical step in this, but two years ago we ran into challenges, roadblocks, and COI issues. That was not a basis to construct a plan that could be construed to have community buy–in and was not useful as advice.
- I want to discuss Amitava's question as to why nine months have passed without a meeting since you came on FESAC. The most weighty issue to address is the strategic plan.
- We were not in a position to meet again on this topic and not able to meet the date, given the state of play of the Congress with the House and Senate having two very different marks for ITER, what was happening with C-Mod, and two budgets being worked simultaneously. What congress says certainly matters. There was no sensible strategic planning exercise given the chaotic nature of last year, as we were making heroic efforts that took enormous bandwidth within the office to focus our attention on these off-normal episodes as we were managing our way through sequestration and a full-year continuing resolution.

Dr. Synakowski conveyed to the committee the new budget on slide 9 by stating:

- Pat described the boundary conditions and you can blame me for being ineffective in changing the boundary conditions. They don't look like what congress enacted last year. I have to ask for advice on a plan with the administration's budget outlook of C-Mod in mind. We must build upon domestic capabilities furthered by international partnerships. Here I am talking about taking advantage of leverage within SC such as ASCR, with international partners, and with other agencies, following the lead of big science and not at the exclusion of the domestic program.
- Fusion is our centerpiece, but our program aspires to be broad; broader than MFE. The science has to change the nature of how we understand risk, and development steps. ITER will not be a reactor or even the last step to a reactor unless other steps are taken in parallel to have validated computing.
- In your bones, you have to have an understanding that fundamental change is needed. There are gaps that the world is addressing which provide US opportunities through leverage. This is underscored with both tough and generous budgets. We are not looking for a plan that is world leading across the board. Rather we are looking for world-leading endeavors in several targeted endeavors.

In discussing slide 12 on the congressional directive, he talked about:

- Wanting to point out that the FY14 request is the comparison and that it is complicated by the congressional directive.
- The absence of additional resources constrains our ability to give awards; a considerable part of the generous FY14 budget was used to mitigate challenges of fully funding grants.

- Recently developing a new budget structure that was talked about in the Budget Roll-out Meeting and at APS, in a way to organize the way we talk about the budget. This has been socialized and has been received well. In briefings this logic has helped to talk along these lines, which are foundations, long pulse, high power, and discovery science.
- Foundations: This lays the foundations and give the basis for ITER attaining a Q=10, and also a basis for FNSF or CTF. This is not orthogonal relative to long pulse, but the facility is not the emphasis like it used to be on DIII-D, etc.
- If we get the green light to get the budget aligned this way, we want to bring in university programs, such as Columbia and MIT with LDX, and Wisconsin with Pegasus, etc.

Dr. Synakowski discussed:

- On D-IIID, I want to convey in a nutshell the importance of the experiments in informing burning plasma science, anticipated to be carried out on ITER. It is highly impactful as one of 3-4 in the world, for magnetic fusion research, so maintaining its capabilities through upgrades will be important in the future. See slides 15 and 16 for the details about DIII-D and the request of nearly $70M, for 15 run weeks. NSTX and DIII-D should be 25 run weeks for optimal operation; I make this point whenever possible.
- The fundamental experiments to be carried out on DIII-D and NSTX, which are listed on page twenty, such as toroidicity and advanced scenarios, for addressing the fundamental science, operating space, and technical risks, will be covered well by the two facilities. This resonates with the Administration and, I would say to the panel, we have the opportunity in the next few years, to use these facilities to identify the mission space and associated risks for developing a Component Test Facility (CTF) and/or FNSF with the correct aspect ratio.
- The NSTX upgrade is progressing well ahead of the CD-4 dates and will increase by nearly a factor of two the device's engineering parameters. The level of effort going into FY15, moves from construction to operations. There is a necessity to be more efficient, effective and attractive to university students. Workforce development is good, but there is unfulfilled potential.

Dr. Synakowski elaborated on the FY15 budget (slide 21) by telling the committee that:

- C-Mod plans to have five run weeks, and potentially perform upgrades; if additional resources become available, we may see additional run time or update the machine with more mature diagnostics and systems to get results. My own bias, if additional resources were to become available for C-Mod, would be to use them for additional run time. C-Mod is directed to make FY16 the close-out year.

In discussing the theory program (slide 22) Dr. Synakowski compared the budget and made the following comments:

- Enactment by congress was prescriptive to the dollars in program areas. Some funds have been set aside in a reserve account, that don't show up. Anticipate funds going to the field, in the general area of computation, and advanced measurements that support integrated computing and modeling. We are discussing how to best spend those funds.

In connection with slide 25, Dr. Synakowski explained that:

- Long pulse, including tokamaks and stellarators, create opportunities for US leadership. Enabling technology in materials and nuclear science address research needs to close the gaps. This enables the long pulse to exist in the first place.

Dr. Synakowski explained on slide 28:

- The opportunity exists for a tremendous bang for relatively few dollars by collaborating with BES, especially with a strap on SNS that could provide a nearly 14MeV neutron source.

Dr. Synakowski elaborated on the slide showing ITER contributions (29-35).

- Imagine bringing components together in an extremely complex system. Managing this is a challenging effort. The effort is slowing but still meeting the needs as discussed on slide 31 regarding the schedule slip. There are three items at risk of being the long pole in the tent, where the near-critical path is at risk of becoming the critical path.
- The ITER Organization is working to update the schedule with full transparency from all the ITER members, but they won't be meeting the US resource-loaded schedule. The Administration response to commitment is on the management side, to offer the best in project management.
- On slide 32 Dr. Synakowski explained that the Administration has expressed its great unease about ITER management, and conveyed this at a splinter meeting, using words like cross roads.
- At stake is the credibility of the endeavor.
- To be committed means taking ownership and not just supplying cash and in kind hardware. The ITER Management Assessor (MA) report and the OPA Lehman review informed the opinion in addition to on-the-ground reports. Discussions have taken place at high levels, such as Dan Poneman, but Secretary Moniz has recused himself.
- The reforms taking place are small but essential steps. The ITER Council adopted the recommendations of the Management Advisory Committee, which is a significant step forward.
- The last IC was chaired by Bob Iotti, who is very impressive in project management at the mega scale, including projects involving nuclear waste and nuclear power. He has been broadly impactful and is a breath of fresh air, working to take the ITER Council from a UN-style diplomatic organization to an organization that engages at the working level that demands action.
- The MAC demanded a corrective action plan, and Bob Iotti is engaged with Director General Motojima. 8 of 11 of the recommendations could be taken by the ITER Office. Bob Iotti worked to put a corrective action plan in place, and get it approved.
- Chart 33 discusses the detailed actions being taken, and Ned Sauthoff will talk hardware. There is a great technology story about the science and technology staff involvement.

Dr. Synakowski enhanced the text on slide 38 by stating that:

- The funding for HEDLP was cut, restored, and we are considering cuts again.
- We are excited about the Matter-in-Extreme-Conditions Instrument, which is turning out to be an exceptional instrument on the research station for the LCLS which has taken high level partnering with BES. It's a magnificent 200 terawatt operating tool, with the potential to be upgraded to the petawatt level.
- When forced with budget pressures and when operating in an envelope that needs to respond to boundary conditions, we have considered the reduction to the joint SC/NNSA HEDLP program. It is our judgment that at least this class of science will have NNSA stewardship in the broader sense, even if the SC financial contribution is reduced, whereas there are other areas of our portfolio where FES is the primary or even sole steward.

Dr. Synakowski elaborated on the budget and policy slides (41-50) by stating that:

- There was a wide range of program elements in the past budget. We propose grouping elements in the 4 new categories to provide programmatic coherence in addressing plasma physics issues (slides 41-43).

- If it wasn't fun enough already, we have also been the subject of a GAO audit requested by the House and Senate. They have license to go where their nose leads them and they have license to broaden their investigation. I am pleased by how FES engaged in this and that GAO conducted their work very professionally (slide 48).

Dr. Synakowski took questions on the FY 2015 Budget request:

Q: Dr. Cohen:
Congress wants our thoughts on an FSP plan. Are you going to get any assistance from the research community in preparing this?

A: Dr. Synakowski:
We have to be careful how we ask for advice. We will not ask FESAC. We can ask the labs; they are at our service in that area.

Q: Dr. Cohen:
HEDLP contraction is an outstanding example of how contraction impacts the program and has a huge impact, if we disregard congressional action in FY14; it amounts to abduction. The curtailment of the joint NNSA program is part of that. HEDLP is a long-running area, where it was not clear which activities belonged to which program and it was not fully healed or sorted out. The Joint Program dealt with that more carefully and systematically, but now it is gone.

We have number a of NNSA facilities that had been exploited with FES funding and university participation that are gone from the research portfolio and HIF is a casualty. SC in my mind gets a black eye for stewardship in this area. You have to make tough budget decisions, but this doesn't sit well.

A: Dr. Synakowski:
If I had made the cut elsewhere in the program, someone else would be equally upset and asking the same question. You know my experience at LLNL. In terms of the black eye, I credit the FES program managers for being very smart in how they managed this area, in anticipating the budget challenge. They took on the full funding mandate early, which enabled many of their PIs to survive and to fight another day. I will defend management and the hard choice that was made. Scientific enterprises in HEDLP will not go away. It came down to whether other support will be there from NNSA.

Q: Dr. Groebner:
I heard you and Dr. Dehmer want our advice, but I haven't heard from you. You don't want specific advice about specific institutions, but are you looking for broad advice?

A: Dr. Synakowski:
Details will be discussed with my afternoon talk.

Q: Dr. Groebner:
Does it need to be couched in terms of what happens with existing facilities?

A: Dr. Synakowski:
I will tell you this afternoon and give advice along the broader themes and initiatives. Its recognized advice

is requested on facilities, and closures. I would have to go deeper to make specific recommendations.

Q: Dr. Groebner:
What is bad advice?

A: Dr. Synakowski:
Rejecting this charge is bad. That has happened. Good advice would be to establish critical scientific areas, where the US can assume a leadership role here compared to world resources, how the US can fill these gaps, referring back to the page of new categories. I don't expect you to carry out detailed budgeting. You have to assume puts and takes, and it has to meet current budget conditions, keeping the budget categories in mind.

Keep in mind that inflation erodes level of effort. For example, how many years of inflation are equal to how many run weeks. You need to identify the leading science questions, examine what are the opportunities, and how they map onto US devices, activities and initiatives. New initiatives equal reductions in other areas, under flat budgets. Identify where can we exhibit excellence in each area, even if not across the board. The Department is interested in broad stewardship. Bad is ticking off budget elements.

Q: Dr. Foster:
On the Workforce, does DOE have an estimate of what the workforce needs will be over the next ten years? Are the existing facilities such as DIII-D and National Spherical Tokamak Experiment (NSTX) sufficient to train that work force?

A: Dr. Synakowski:
We do not have a quantitative workforce assessment to know what is out there to receive the workforce. Frankly no. I think our major facilities could do more for workforce training. The Administration has a widely held belief that national labs can and should do more with university workforce development. Driven by many of the scientific questions that are the most compelling, universities require a larger infrastructure and gaining access to those plasma conditions. The sociological challenge is how to make these facilities and this arrangement attractive? That could be an interesting charge for FESAC.

Q: Dr. Foster:
How does international collaboration work? Can students go to EAST under the international collaborations?

A: Dr. Synakowski:
We have received from W7-X their views on university engagement and how they might partner. We are considering these views on how to layer in their engagement into the structure. The intention is to move in the direction of international teams, led by labs that bring in university engagement. The hosts of the present international collaboration teams are quite receptive to this. I leave to you, what is attractive to the deans and students. Access to science, increasingly, will be addressed by the lab type facilities.

Q: Dr. Greenfield:
Budgets for ITER are going up and down unpredictably. How do we fulfil our obligations and not get on the critical path and how is the US received by international partners and not be seen as unreliable?

A: Dr. Synakowski:

We don't have a high-fidelity state-of-play understanding regarding the ITER project, which makes it hard to be competitive in the SC environment and argue for $225M. Also, policy issues are quite important and led to the $150M budget. Answers to questions about our level of commitment are not easy and are determined by discussions with other ITER Members, but the new approach is more complicated.

It was far from ideal when we put forward the $225M budget request, with SC rules for contingency. We assumed first plasma in 2023 and that with $150M we can meet our commitment on long pole items such as the TCWS, but other items have to get paused. But there is no IO schedule against which to measure. If additional budget authority over $225M were to be made available, the US could recover its pace. If we continue to get reduced funding, we are at risk of becoming the long pole in the tent.

Q: Dr. Zweibel:
On slide 43 if we compared the three budget categories, what are the trends of BPS vs. non-BPS discovery science, relative to existing categories?

A: Dr. Synakowski:
That is tough math. What we are trying to do in advanced tokamaks, is arguing for increasing the # run weeks, and investing in upgrades, in advanced and spherical tokamaks, but we are also proposing to close out C-Mod, which will decrease the advanced tokamak research. Long pulse research over 3 years is going down and we are missing an opportunity there. Discovery Science (HEDLP) has also gone down.

Added investment in DIII-D and NSTX, shows determination to increase beyond 11 run weeks and is a reflection of their value and of the fact that they have been woefully underutilized. Increased run time will increase access to university students, and reflects the need for well-diagnosed studies in collisionless plasmas.

There are tremendous leverage opportunities in materials science, particularly with irradiation experiments in SNS at ORNL and for high heat flux experiments at ORNL, to be able to irradiate them and study combined effects. The challenge in Discovery Plasma Science (DPS) is that relevant regimes require hotter plasmas and higher levels of magnetic reconnection. During the next 10 years we will look at how DPS funding is distributed, and look for opportunities in DPS.

Q: Dr. Ji:
What is your vision regarding budget categories? Will they be changing to accommodate the new structure? Will the organization of FES solicitations also change?

A: Dr. Synakowski:
There is no effect in the B&R structure in going from left to right as you map from the old to the new. The exceptions are enabling technology which goes into 2 categories and EPR which gets split up into 3 categories. We have to consider how this affects how we do business in FES.
Columbia with HBT moves to advanced tokamaks. Wisconsin, with Pegasus, moves to spherical tokamaks, and HSX moves to long pulse.

Q: Dr. Ji:
Different budget categories have close ties between large and small experiments and some have closer ties to theory, but there are other complications. Why not put theory in Discovery Science for more freedom?

A: Dr. Synakowski:
They are not orthogonal axes.
One advantage is in briefings, we can motivate the program much better with this new budget structure. The primary emphasis is different in foundations, long pulse and high power, where you are looking at specific issues such as high gain to driven systems, equilibrium sustainment, and the 3D approach of stellarators. There is "discovery" in all of the budget categories, but in so-called Discovery Science the emphasis is truly exploration and on expanding the science. The focus is less on confinement physics, and more on turning the knobs on science leading to a validated understanding.

A: Dr. Cohen:
Theory and Simulation has a crosscutting component.

Q: Dr. Ji:
Ten years from now, how will you integrate small universities into the categories that contain the large facilities? These categories may help you answer that.

A: Dr. Synakowski:
That is the intent. With the new structure, we can talk about the science questions we need to confront and it's not about the facilities per se. This is in the right focal plane for the Office of Science.

Q: Dr. Hubbard:
Materials and nuclear science, including Plasma Material Interface (PMI), is a high priority in listing gaps in past studies. In your early talks as AD to FESAC, you talked about it, but the budgets are declining and are small compared to international collaboration efforts. What is included for the next few years? Will it meet the needs for US leadership if we are realistic? The German effort in materials is several times larger, as I learned by serving recently on a German review panel.

A: Dr. Synakowski:
In tough budgets, we still can and do have opportunities. With SNS this could give access to neutron material science that no one else in the world is doing, at a level of about a $1.5B class facility. We have credible plans. We are waiting for buy-in from BES. If budgets continue to be tight, we may need to shift resources, but I suggest it is an opportunity and argue to the panel, that we need to take it seriously. Even when the level of funding for research is flat or dropped, it's still an important point to maintain excellence and grow in each of the four areas. These are tough choices, so I value the subcommittee's advice and want to hear the external presentations from the community on how to do this. The status quo will not get us where we want to be 10 years from now. How do we actually fill gaps while looking for leadership opportunities?

Q: Dr. Zinkle:
You explained the motivation for restructuring. Seems reasonable. But, the Greenwald and ReNeW reports have gaps and opportunities that may be a better way to align the budget categories. What was the thought process to arrive at this particular budget structure? Particularly, why use Foundations to describe AT and ST? To an outsider, does this mean entitlement, because stewardship comes with forefront science, not stewardship as a birthright; we need to address the forefront of science.

A: Dr. Synakowski:
I will not defend any proposal completely. There are other reasonable proposals that could have been advanced. I hadn't thought of foundations as an entitlement. It is establishing the foundations of science

to give confidence to move forward in burning plasma science in ITER and scientific facilities. This captures leading edge work. I want to avoid outsider misconception, but I wonder if that is the perception.
It's foundational in relation to long pulse and high power; Foundations is at the core. Everything else builds on it except discovery. If you have Foundations, you can perform long pulse experiments at KSTAR and EAST that we have the potential to support. Long pulse resides in that. Burning plasma science and High Power rests on all of these foundations. It starts with Foundations, then Long Pulse, then High Power as a nested hierarchy. It's more than foundational, it's world leading. These are not stacked completely; there is orthogonality.

A: Dr. Zinkle:
You have nicely described the complementarity of AT and ST research. That is forefront science in its own right, and also world-leading.

A: Dr. Bhattacharjee:
I echo your sentiments about the program managers in GPS. It's a highly leveraged program, but FES doesn't take the credit for good work in cooperative facilities. NSF is claiming the importance of DOE's role as primary custodian. NASA and NSF recognize us as the primary custodian. These new categories could have a chilling effect on broadening theory, simulation, and burning plasma science in general. When Dr. Dehmer showed us a pie chart about the SC user base, we might undermine that if we forget the role of universities.

A: Dr. Synakowski:
Thanks

Q: Dr. Greenfield:
A number of people have mentioned the desirability of having more students work on large facilities. This is a good idea. But it will take significant resources—run time, supervision, infrastructure, etc. For students to be successful, this needs to be taken into account in the planning.

A: Dr. Synakowski:
Thanks

BREAK

The Fusion Energy Sciences Advisory Committee recessed for a 1:15 minute break for lunch.

PRESENTATION ON THE ITER PROJECT STATUS

Dr. Ned Sauthoff, US ITER Project Manager, ORNL

Dr. Sauthoff presented his slides on the ITER project status and further explained that:

The potential 30 month delay to the ITER construction is affecting the schedule of the components that follow in the assembly sequence. Other systems are also delayed, and are being monitored for delays for deliveries that were due in FY14 and FY15.

This speaks to the lack of absolute control of the US schedule due to the integrated nature of the site construction and integration.

Technically there are no show-stoppers.

COMMITTEE DISCUSSION

Q: Dr. Neilson:
To fusion this is the best supported project in the last 20 years. Considering the scale, political overlays, and challenges that exist, we are to provide input to the strategic plan out 10 years, and focus on the domestic program. I got confused on the 1st plasma dates. What should the domestic program do that it is not now doing, from now to 2024, as far as organizing programs that are prepared to exploit ITER.

A: Dr. Sauthoff:
It's beyond my scope. That's FES, in my personal opinion. The U.S. is good at ITER design; no issues with U.S. scope. How do we position ourselves for the research activities? Discussions go back to 2003 on research organization. Dr. Greenfield has worked out some ideas. The US position is that run time should be divided by merit, and conducted by international teams. The US gets involved by merit, so we need to be on the winning teams that will get machine time by expert representatives in burning plasma areas, operating instruments, and planning experiments, that need integrated computational models and simulations that demonstrate readiness. The US is well positioned for these activities.

Q: Dr. Greenfield:
What are the FES management processes for line-item construction projects, for example ITER?

A: Dr. Synakowski:
FES engages the US ITER Project Office. Additionally, the USIPO is reviewed by the Office of Project Assessment (OPA).

Q: Dr. Hubbard
Thanks for the funding profiles. This helps to understand the tradeoffs. Management is a big issue of concern, if one reads the New Yorker and ITER Council minutes. Recommendations are being adopted, but I haven't heard the details. Do you have a sense of changes that are about to be made?

Dr. Sauthoff:
I am the chair of the ITER Organization (IO) project management task force. The council has 3 working groups: the Succession Planning Working Group, the Overall Management Performance Assessment Working Group (led by Jeff Hoy), and the IO-Domestic Agency (DA) Interaction Working Group. The ITER Office/Domestic Agency integration working group is trying to address the more difficult issues that the IO is under. The IO is responsible for construction, but they don't control the DAs, who have other motivations. For example, a cost reduction by one DA may increase risk to another DA. This cost increase should go into the decision process. We are trying to find mechanisms to change decision making processes for the IO and DAs. The working group should propose principles of decisions driven by project interest, and delegated authority. Configuration Management (CM) is needed for control of the design and managing changes, with an excellent scheduling system for planning and monitoring. The task force is

addressing these issues, and providing initial assessments and plans to the ITER council and Management Advisory Committee meeting. Action plans have been agreed to and are being taking into account.

Q: Dr. Rapp:
Acknowledge technical challenges. Question about design maturity for ITER overall?

Dr. Sauthoff:
All of the US scope is either in final design, or progressing well toward final design and moving toward manufacturing, and getting input from industry. Industry is involved at the front and continues through the final design, to help with manufacturability, unlike the vacuum vessel, which was not done in the US and could have benefited from up front prototyping and consultation.

Q: Dr. Rapp:
Any significant design issues from other partners that affect us or the whole project?

A: Dr. Sauthoff:
I don't see any real US issues with the cost profiles. We are relatively invulnerable to those issues, but there are risks to other parties who haven't done up-front planning. We are not as mature on the post-first-plasma issues, which carry greater contingency on those project items, due to being less mature, and also the farther time horizon.

Q: Dr. Cohen:
There was a high-up inquiry in SC, on Russian scientists, and potential fall-out from Ukraine. Can this possibly affect our participation in ITER?

A: Dr. Sauthoff:
Ask Ed.

A: Dr. Synakowski:
Answers are being developed in real-time, including the location being considered for the next ITER council meeting. It is a sensitive issue, and discussions are on-going.

Q: Dr. Cohen:
Maybe a look at NASA's Space Station would help.

A: Dr. Synakowski:
We want to find a way to have a successful IC, which is the leading challenge. Meetings in or hosted by the Russian Federation is the issue.

Q: Dr. Ji:
On the charge on workforce needs; we have to guess ITER first plasma needs. Are we half the way there? The budget profile is a guess. Are we over the hill or still in the climbing phase for unknowns?

A: Dr. Sauthoff:
The design is at the 50% level, in trying to complete the design of all components with the team in place, having the right interfaces, and safety critical inputs are needed. Fabrication is not over the hill; it's just starting. We are planning that, in the long term, there will be a change over in staff, which will cause

approximately a 15% cost increase factored into contingency due to inefficiency. We are working to identify successors to key people. Having a stable budget helps to attract the staff, and hold onto the core team. We are in a much better position with regards to a stable, predictable budget.

Q: Dr. Zweibel:
When you look at the pipeline of young people being trained and look at the long horizon, will we have the people?

A: Dr. Sauthoff:
Looking out 20 years, you will not have the same people. We must recognize the need to inventory skill sets. We don't need PhDs in plasma physics, but rather engineers, and managers. There are a variety of skills needed for various phases of the endeavor. The community hasn't built this scale of experimental facilities, other than ITER. Physicists don't have skills needed for fielding experimental facilities. Engineers, (structural, electrical, systems, etc.) operations, are the disciplines needed. We need to move away from looking exclusively at plasma physics, particularly for the construction phase. We don't know how many will be needed in industry, but they hopefully are working on that. The operations phase will need skills in burning plasmas, with state of the art research developed prior to ITER. Workforce development in physics and technology coming from existing facilities will help. In the 1950s we didn't have the luxury of having all the skills in place. For example, SRNL had tritium experience, but it didn't come from fusion.

Q: Dr. Fonck:
Looking at the funding profile history, and a 2023 1st plasma, I question whether that is reasonable. A funding drop to $150M takes you to 2024. What would it take to pull it back to 2023?

A: Dr. Sauthoff:
$150M is a $75M drop. Earlier, there was a change in cash contributions, which is $115M. To make it up in FY15 or FY16, you need that much, or more, to recover.

Q: Dr. Fonck:
I need to know what it will take to pull the schedule back.

A: Dr. Sauthoff:
Pay no cash contribution and emphasize hardware. Under Dr. Brinkman, that changed to $150M, but it also included the cash contribution, which leaves $110M.

PRESENTATION AND DISCUSSION OF THE CHARGE ON A TEN-YEAR STRATEGIC PLAN FOR THE FES PROGRAM.

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

Dr. Synakowski prefaced his talk by briefly discussing the international and Ukraine situation. He characterized this as an issue that supersedes anything that we are talking about here. That this is driven by the administration, and that we are following their lead, and we are playing by the book.

In discussing slide 5, he pointed out:

The emphasis on advice on excellence in leadership in each of the 3 key areas, as opposed to being able to lead in all activities in all areas.
Instead of axes, think about hierarchies, that will support FNSF, CTF, etc., that all build on these foundations. The wording is chosen to focus on not only the ITER high gain, but develop the basis for a driven, lower Q CTF.

Long pulse; we want you to engage in a leadership level, beyond the current relaxation time in the collisionless regime. We want to understand the opportunities and priorities in this class of plasma for equilibrium sustainment, current drive, boot strap, and also science and technology of the materials, heat flux, and neutron science related fields.
Discovery Plasma Science (DPS): this is a disparate group of enterprises, and in some cases the most challenging.

On slide 6 the emphasis was:
On prioritizing between the program elements. It is more than prioritizing just the 3 areas, and includes ranking elements within the 3. You would have layered priorities, so these elements are not in isolation.

On slide 7 the committee was told that:
You already know my biases in this regard, and Pat gave her insights on the multi-scale computing. If fusion doesn't reduce development risks, it could be viewed as being not viable, particularly for multi-billion dollar endeavors. I'm ready to give additional thoughts on the ORNL Spallation Neutron Source (SNS) strap (FMITS) and the High Heat Flux (HHF) test stand (MPEX). W7-X, EAST, KSTAR, etc.

On slide 8 the emphasis was:
There is a sense in SC and the Hill that the fusion community is reluctant to let go of the present direction. That is risky to stay with the status quo at our current configuration that will not fill gaps and assert leadership in as many areas as possible and the community does so at its peril. One thing ASCR has going for it is crosscutting disciplines.

On slide 9 additional discussions included that:
We will not ask you to comment on GPP and SBIR/STTR. The Administration priorities include excellence on a broad front, exercise of leverage opportunities, and partnerships, and that in this presentation. I show university-scale ATs and STs as included in Foundations.

Also, theory and simulation is not just MFE, but crosscutting as well. Look at other scientific disciplines that have extended their reach beyond US shores.

The explanation of slide 10 detailed:
In making the mapping from left to right, think of nested shells, with the foundations the center shell, then long pulse then high Q and materials, then high power. Ensuring excellence on a broad portfolio that leverages existing capabilities is important to the administration.

Emphasis on slide 11 included that:
Foundations is not just about MFE, but is cross-cutting. As an aside, in understanding the Administration forces, and to enable increasing the plasma science, we need access to resources that require a more complex infrastructure. Labs will need a better 10 year plan for integrating research with all the community such that the labs and universities are working together.

In discussing slide 14 and concluding the talk discussion was about:
Small-scale EPR in discovery science mostly means devices that depend on self-organization. V&V and progress in computing must be more than getting time on a super-computing platform.
It's conceivable that FESAC might say the nature of our science is changing, and that we need a massive shift to parallel computing, and create test stands to verify and validate this modeling.
Another possibility might be that the US needs to assert itself to retool and look predominately in the fusion science materials area. It would be a challenge for plasma physicists to come to this conclusion.
This is more along the lines of prompting thoughts of the range of possibilities to be considered. These ideas should be considered and included or ruled out only with serious consideration.

For slide 15 the additional comments were:
That Dr. Pat Dehmer strongly endorsed having Dr. Koepke chair this panel due to his proven engagement on the Rosner panel, his IPA work at FES, and the precedent set by BESAC.

COMMITTEE DISCUSSION

Dr. Fonck:
Thanks, formidable charge. Clarification is needed on the idea of moving towards FNSF in the future. What is your tactical approach to doing this and the best path moving forward? Planning is assumed to be the next step. How should the panel deal with this while not being sure what is the best path? The charge doesn't assume this.

A: Dr. Synakowski:
That question is too good!
Why would we have a credible research enterprise based on a narrow focus?
NSTX, DIII-D facilities can inform questions about technology risks and the mission space of FNSF; consider novel aspects. Look at the deepness of the field. Understanding the mission space and options is valid even if it's not the correct path forward. Whether FNSF is a stellarator or a tokamak, it still needs advice. We have the tools to address part of the problem, while not committing to locking down the configuration.

Q: Dr. Fonck:
What about the development path that calls for an FNSF?
Do you envision a strategic plan that addresses that?

A: Dr. Synakowski:
There should be that facility in the US. Develop a strategy that assumes there will be an FNSF.

Q: Dr. Fonck:
Again, formidable charge. Something of this magnitude calls for an interim progress report from the subcommittee back to FESAC. We need this to socialize the results with the community on the process and describe what kind of input has been received and where the subcommittee thinks it is going.

A: Dr. Synakowski:
Worthy considerations.

Q: Dr. Neilson:
I endorse having an interim report. FESAC needs to stay on top of this formidable activity. The risk is there

to not complete it. These budget categories seem to be moving away from an FNSF. All the categories are about plasma, plasma and plasma. In the 3 pillars, one is materials, but it seems to be buried as a sub-element in the discussion. Development is needed in the breeders and coolants that will be used, not just the displacements per atom (dpa). We are not preparing foundations for that type of work with these new budget categories. Measurement and other systems are needed that are not in the condensed budget categories.

A: Dr. Synakowski:
You may have a conscious bias of what is consciously represented here because I see this as an area of high impact. Areas within DOE such as the SNS strap (FMITS) are areas ripe for high impact leverage in Long Pulse, along with computational materials science, and the partnership with ASCR. The panel will assert leadership in evaluating what the rest of the world is doing, and this area could catapult us into a leadership area and comes before areas you talk about.

Q: Dr. Bhattacharjee:
On Page 7, multi-state computing and simulation, and also on page 49 in your morning presentation, you say that the plan should provide for the FSP and it should be consistent with the 10 year strategic plan. This report is due in 6 months, but needs to be consistent with the strategic plan. This is important, but then it must be done much earlier.

A: Dr. Synakowski:
It is not a perfect world. I think we can construct a reasonable plan that will not preclude what the ten-year plan will include. It will not be a comprehensive plan.

Q: Dr. Bhattacharjee:
Do you intend to pass the FSP plan back through FESAC?

A: Dr. Synakowski:
We need an outlet for multiscale computing, but the report to congress will not be comprehensive. With 180 days we are not planning to route this to FESAC. We already have much input and will use it.

Q: Dr. Zweibel:
What resources for strategic planning will be made available, what is Mark's budget?

A: Dr. Synakowski:
We haven't talked about resources beyond activities on FESAC. You will have past reports and stakeholders will come in and make their case. If we need to do more we can talk.

Q: Dr. Groebner:
Using resources outside our immediate sphere, what did you have in mind?

A: Dr. Synakowski:
SNS, Light sources, computing capabilities through ASCR, NAS, international, experimental devices.

Q: Dr. Groebner:
Fusion machines I'm familiar with, but not the light sources.

A: Dr. Synakowski:

Dr. Steve Binkley, the ASCR AD, will give you information on computing activities. It will have an educational component. You can learn about the MEC end station, hopefully from others on the panel.

Q: Dr. Hubbard:
Dr. Dehmer suggested that this process is the most important fusion exercise. I endorse that an interim report come out, to help greater buy in. I also suggest in-person workshops for the community to present and discuss, especially with the FESAC chair being the same as the subcommittee chair.

Q: Dr. Ji:
Is the plan for a science program or an energy program? This is an old question. Are we ready to break out into an energy program?

A: Dr. Synakowski:
There is a value judgment in the way you phrase the question. Stay with the science. There is a wealth of science to be done for where we want to go and it's deeper than plasma physics; it requires a shift in what computing can do. SC is where the scientific basis for moving forward is investigated. There is ten years' worth of work here. It will be a deeply scientific activity.

Q: Dr. Ji: We had Snowmass, do you envision something like that or a workshop format? What process do you plan to take?

A: Dr. Synakowski:
I don't see the resources to do a Snowmass kind of effort. There will be energy, but not that kind of format. It must be more focused.

Q: Dr. Greenfield:
Science vs. energy priorities can change depending on the energy goal, but that balance still needs addressing.

A: Dr. Synakowski:
True, we want to remain open to the possibilities, but discouraging getting diverted from the primary effort.

Q: Dr. Zinkle:
Within FES, there is a broad landscape from BPS, to fusion engineering science. How sporting should we be in moving towards fusion energy in 2050? This would help in the prioritization, for example, should we just do science without the march towards energy?

A: Dr. Synakowski:
The preponderance has to be the science leading to the energy goal. Keep in mind Pasteur's quadrant such as blackbody quantum mechanics for example as the pure science, which was driven by the lighting industry. This pure practical application has driven the greatest intellectual achievement in the 19th century. There's no problem to claim a strong science program to inform an energy mission. The panel should assume that it has to be directed towards the energy goal.

Q: Dr. Kim:
Where do we find the Science advisory committee report?

A: Dr. Synakowski:
It's on the SC web site.

Q: Dr. Cohen:
I'm glad to see FSP type activities which reinforce the strategic plan. FSP would be a project if done correctly, on the scale larger than the $1M ASCR SciDAC. This could kick start theory and modeling experiment partnerships, but with stagnant and theory budgets, you can't mount an endeavor. To make an FSP, within the theory budget, is a money problem. FSP makes an additional problem, even though science and politics would support it. Don't replace part of the theory program with the FSP.

A: Dr. Synakowski:
The puts and takes for integrated simulation need not just be within theory and simulation. I challenge you to answer bigger questions. Will fusion efforts take place with less facilities? Do we require a change in culture in fusion research to where the focus is in data acquisition, interpreting the data and complex measurements, similar to the astronomy field where the ethos surrounds the data, and not the facility? Similarly, the real need for fusion, hypothetically, might not reside in the construction and demonstrations of facility capabilities, but real progress comes in demonstrated predictive capability. This might require a fundamental shift between theory and computation. Look beyond a zero-sum game. Look at the entire portfolio for the trade, because the fundamental nature of the field may need to change in 10 years.

Q: Dr. Cohen:
When priorities were decided at FES, run weeks were more important than the theory budget.

A: Dr. Synakowski:
It was more than that. The future may include removing limitations on partnerships, and the plan for example with ASCR may change. You may not be interpreting our biases correctly. There is more than just my bias in play. The results don't mean that I don't see a profound shift in emphasis for the role of computation as an important opportunity. We never had the chance to work on this in the past.

BREAK

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

PRESENTATION ON INCREASING ACCESS TO THE RESULTS OF FEDERALLY-FUNDED SCIENTIFIC RESEARCH

Dr. Laura Biven, Senior Science and Technology Advisor, Office of the Deputy Director for Science Programs

Dr. Laura Biven gave a presentation on increasing access to federally funded research.

COMMITTEE DISCUSSION

Q: Dr. Fonck:
Are the 7 publishers available, so that we can find out?

A: Dr. Biven:
It's no secret; I can get you the information.

Q: Dr. Fonck:
If the publishers make these available after the period of exclusion, will they make them available on their own web site?

A: Dr. Biven:
The idea of the pages will focus on DOE funded research. If the publisher doesn't make public access you can still get the data.

Q: Dr. Cohen:
I remember your last presentation and how we present data in the community. There is confusion in the minds of the PMs (program managers) and the PIs (principal investigators). It's been in draft form, but all new proposals are required to conform to this standard. We are hoping for explicit instructions for what is a minimally acceptable data management plan (DMP), especially with an unfunded mandate, to dot the "i"s and cross the "t"s.

A: Dr. Biven:
I have no comment on the time line. The level of detail guidance about what to include in the DMP and template will have a middle ground, with suggested elements of a DMP, which should describe what SC is hoping to see. Going forward, we will revise on an annual basis.

Q: Dr. Cohen:
The word minimal is emphasized because of all the people I know, no one has had a request for their data, so there is not a lot of enthusiasm to go beyond the minimal requirement. We do archive our data for ourselves, but putting it in a public place, especially at the labs which want to carefully review all that goes out.

A: Dr. Biven:
The requirement is to write the plan for sharing and validation of results. You decide what extent you make it available based on peer input and your PM. The PM and PI will negotiate the time for data preservations.

Q: Dr. Zinkle:
In the transition to the process there will be a lot of bumps in the road going from where we are now to the ideal state. Will it be at institution or PM level that will be providing guidance or is it up to the PI?

A: Dr. Biven:
This is not a step function change; the PM, PI and institution will all be going up the learning curve. The hope is to articulate expectations in the policy, and then we will have to have an assessment, to identify quantitative metrics on the success of the plan. COVs or advisory committees can review this.

Q: Dr. Koepke:
APS/DPP had a session on this topic. Hopefully other societies will have similar sessions.

Q: Dr. Foster:
A tutorial on data management plans would be helpful. NSF has a tutorial.

A: Dr. Biven:
We are not the same, but not dissimilar, with checks and balances on the facilities. There are 2 new items. You have 12 months to work on this.

PUBLIC COMMENT

Earl Marmar, MIT
I want to share thoughts as the community works through the 10 year strategic plan. I am glad to see the charge. Assume ITER participation. When considering this as part of the plan, 1st DT operations are more than 10 years away, probably 20 based on Ned's presentation and the way things are going. 1st plasma is an incapable ITER device, with several years to complete the machine, then several years for tritium operation. Keep this in mind in the 10 year plan, with such a long time horizon.
Parallel activities need to be in mind.
International collaborations to bridge gaps and to do the scope that we can't afford domestically. While important, it's not sufficient to maintain U.S. leadership. Li said "EAST is your" tokamak, however, we can learn much, but EAST is his tokamak, and not ours. We should keep this in mind.
There are 3 areas for dramatic domestic progress:

(1) solve divertor erosion problem, in relevant regimes
(2) reactor compatible steady state with control tools, which could be bundled in a new facility at a reasonable cost. This is a welcome idea to be fleshed out in the sub committee
(3) Technology needs to be focused down, with highest leverage, game changer, and superconducting magnets for MFE, because doubling the plasma beta gives a factor of four in energy output, but doubling the magnet field strength gets you a 16 factor of improvement. Fusion based applications with a modest, focused effort result in a high yield.

COMMITTEE DISCUSSION

No questions

PUBLIC COMMENT

Tony Taylor, GA
1. About process: Dr Dehmer stressed that we provide well defined affordable broad community support of the plan. Comment is to get community support, the process must provide for input and discussion. Importance of discussion and dialog in the community, meaning all the stakeholders. Several venues, meetings where opportunities between plasma and panel for q/a, panel and stakeholders
2. Context of entering charge. Consider what the program will be doing in the next decade. In this decade, we should prepare for an existing next decade
3. ITER: begin operations in next decade - a unique opportunity for frontier science and burning plasmas. Aim for ITER success, position U.S. for leading scientific role, should be the priority this decade.
4. FNS program: Ed has a vision for an FNS program to address the remaining challenges, such as materials,

components, and producing fusion fuel (tritium). This includes FNSF in the next decade. Research this decade now to prepare.

COMMITTEE DISCUSSION

Q: Dr. Cohen:
Dialog and consensus building is important. How to we control the entropy and human factors?

A: Tony Taylor, GA
Diversity is good at the beginning, should be encouraged. White papers only will get sanitized.
Q: Dr. Cohen
I wasn't being sarcastic.

A: Tony Taylor, GA
The chair will have to come up with good ideas.

PUBLIC COMMENT

Dave Hill, LLNL
Tony and I didn't coordinate, but will be parallel. On the process, the Deputy Director of the DIII-D program chaired toroidal alternate, chaired ReNeW. This forms my opinions for the panel plans. The charge is broad in scope and technical content, COI, and will require information and advice, since no one has all the expertise. Need useful rapid input. Whitepapers are insufficient. Need conversation from technical experts. Recommend which applies to workforce also:

1. develop process to meet and hear experts
    a. Define significant unknowns.
    b. Describe research requirements and research plan, how to make progress on these topics, resources, facilities.
    c. Lofty ambitions
2. Iterative and interactive process, like developing a talk.
3. Workforce development, encourage larger facilities to input their perspective. DOE should give answers, and quiz after the input to clarify, to understand how research would take place.
4. Look for interim report

COMMITTEE DISCUSSION

Q: Dr. Ji
How do you get the best dialog? Through teleVideo?

A: Dave Hill, LLNL
With televideo conferences, you miss the opportunity for side conversations, but good for information flow, and for handling q/a could be efficient.

Q: Dr. Greenfield:
I suggest both questions and also the white papers. Not all can travel, so having a mechanism for multiple input methodologies is helpful.

PUBLIC COMMENT

Stewart Prager, PPPL:
Comment on the process of this charge, I agree with Tony, Dave. Opportunity for the field, per Pat, DOE and congress will benefit. Look at not only plasma and discovery science. Each is a year-long effort. My suggestion is to appoint the committee, only get members who agree in advance, that this is their top priority. Mark will need to make this a full time job, especially with other FESAC job.
Pat was critical, maybe because people on the committee didn't meet enough, and not all were fully committed for this kind of task. Need face time to get over bias, prejudice, to get over barriers. Like a jury selection for 5 months. University professors will need free summers, plus semesters; labs will need relief from other duties.

PUBLIC COMMENT

Slava Lukin, NRL:
2 comments:
workforce development, relates to strategic plan. Take broader look at WD, the charge talks about workforce needs, graduate students, and post-docs. US in STEM education, preparation and funding is struggling and dropping. One of the important reasons people come to the US is Science & Technology (S&T) investment. If you prepare someone with specialization, they can be moved and bought, especially if they did not originate here.
2. high performance computing, multiscale modeling, FSP
work with NASA and DOD. Space weather (as mentioned by Amitava) is similar to the FSP. Many overlaps.

COMMITTEE DISCUSSION

Q: Dr. Ji:
You suggest input from broader, what about input from younger people?

A: Slava Lukin, NRL:
I am doing it. I think it's important, because people just came through the pipeline. Burning plasma many not be seen even for young people.

Q: Dr. Sugiyama:
Comment on the process. We emphasize face to face, but the problem is it favors people who have money to go to these meetings, but the universities and some in the simulation group don't have the funds. Please consider this when looking for broad input.

Q: Dr. Kim:
Are comments off-limits to other people? Is it private?
Are proceedings public information?

A: Yes, (Dr. Koepke),

A: Dr. Synakowski:
This is the publicly sanctioned forum. 28 people are on ready talk.

Q: Dr. Neilson:
When will the slides be posted?

A: Dr. Synakowski:
In days.

Q: Dr. Greenfield:
The committee got all the talks except Pats. Will we get hers?

A: Dr. Synakowski:
I will ask.
Also, I talked about forward funding. The sign is wrong in my presentation. Grants of less than $1M are constrained by the fully funded directive.

ADJOURNMENT

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

Thursday, April 10, 2014

Dr. Mark Koepke, Chairman, was presiding.

WELCOME

Ed Synakowski thanked Dr. Sam Barish and Shahida Afzal for organizing and running the meeting.

PRESENTATION ON THE CHARGE ON THE COMMITTEE OF VISITORS FOR THE FES PROGRAM

Dr. Jim Van Dam, Director, Research Division, Office Fusion Energy Sciences

In his presentation about the COV, Dr. Jim Van Dam, planned to cover the who, what, why, where, when and how.
He made some additional comments beyond the presentation on the difficulty getting meaningful data to quantify international standing.

COMMITTEE DISCUSSION

Q: Dr. Neilson:
You skipped over the deadline for the different charges. What is it and does it have to synchronize with the fiscal year?

A: Dr. Synakowski:
The deadline is January 15, 2014 for the COV. It does not have to synchronize with the fiscal year.

A: Dr. Van Dam:
FESAC has 3 charges. Workforce development (on a short fuse), strategic plan, and COV

Q: Dr. Neilson:
Does it have to sync with budget cycle?

A: Dr. Van Dam:
Not that I know. We are past the 3 year cycle. Dr. Dehmer signed the charge letter. For several years, we have been understaffed and overcommitted.

PRESENTATION ON THE PERSPECTIVES FROM THE OFFICE OF ADVANCED SCIENTIFIC COMPUTING RESEARCH

Dr. Steve Binkley, Associate Director, Office of Advanced Scientific Computing Research

Dr. Binkley began his presentation by explaining that in an interest to learn more about other SC organizations, Dr. Ed Synakowski requested that he, as the new ASCR AD, give a presentation in this forum. He also thanked Dr. Randall Laviolette, who has been the primary interface with Dr. John Mandrekas in FES.

In introducing the material, he discussed the history of scientific computing, the role of the department back to the Manhattan project, and the applied math and scientific modeling required for the success of that project.

COMMITTEE DISCUSSION

Q: Dr. Cohen:
Very interesting. As a computational physicist, for over 40 years I've watched the growth of computing resources in DOE and the community and it's heartening to see the progress and impact on science. I'm interested in the hard challenges in resource allocations that impact ASCR, the scientist using allocations, selling to DOE, congress, etc. For example, at the 3 big computing centers, National Energy Research Scientific Computing (NERSC), there are 4000 users, and are very selective in choosing how to use resources. How do you pick winners in advance to get real break throughs? DOE is spending lots of money on those researchers. What can get sold to congress? Is it big users, or small users, in a parameter study or convergence study? What is the thought process? You have a research arm, but you didn't talk about it. Brute force has made an impact, but we need innovation and smart algorithms, to solve challenges. Has the philosophy changed?

A: Dr. Binkley:
I agree. From my experience in computational chemistry, there has been a dramatic increase in calculation

ability over the last decade, and the rest of the advance has come from the algorithms; it's finding better algorithms to solve the fundamental equations. The ASCR research program does a lot of work on the applied math side, to solve Schrödinger equations, or the applied math that goes into that. 40% into applied math, so there is a strong focus.
For allocation of machine time, we take stock in our resources and receive input from the advisory committee. The allocation process is not rigorously tied to the computer. For a long time, the NERSC program was designed to provide access to the bulk of SC programs. NP now has its own computing resources. We are always re-evaluating, so please provide input.

Q: Dr. Cohen:
No criticism, but there is tension between a hero run hoping to get on the cover of the Nature magazine, vs. basic science that studies dimensionless parameters and conversions to prove a theory. The latter may be harder to sell. When ASCR got an increase was it hardware, or research based?

A: Dr. Binkley:
A significant piece goes into applied math from the plus-up. There are 4 parts:

1. Data (computer science, math)
2. Exascale (computer science, math, industry partnerships)
3. Power upgrades (to the next round of large machines, Argonne, ORNL, 100 petaflop machines in next few years at about $10M to each site for that)
4. The FY15 request has a big push into CS and applied math.

Q: Dr. Kim:
What is the review process of submitted proposals for doing fusion scientific research?

A: Dr. Binkley:
SCIDAC is the only venue for fusion.

A: Dr. Randall Laviolette:
The Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program, is run by the 2 facilities. For ASCR Leadership Computing Challenge (ALCC), 90% goes to that, 10% is discretionary.
If the question is for research funds, SciDAC is on a 5 year schedule where we have large competitions. The last one was in 2011-12. This solicitation is a follow-up to the initial solicitation. After 5 years, there is little new funding, until 2016-17, when new topics will be announced to each program office, who will have information about the needs. The solicitation goes under a peer review competitive process.

Q: Dr. Kim:
So, the next solicitation is down the road in 2016. What if you have new ideas before then?

A: Dr. Binkley:
Some SC offices have open solicitations, including FES.

Q: Dr. Rapp:
Coming back to big data, leadership class computing could be used for ITER data mining. Are any solicitations coming in this area, where data may be different data than HEP?

A: Dr. Binkley:
It will be a few years until needing to get the data off of ITER. The need and pressure now, today are in 2 key areas:
1. HEP planning on LHC upgrades with more data collection coming. LHC's first version. There is a hierarchical storage system.
2. Tier 1,2,3 data centers. DOE operates 2 tier 2 data centers. HEP approached us after the initial implementation for help. After LHC was operational, things changed. We entered into discussions for synergy to exploit between the 2 offices. This has 2 dimensions: we are in the process of exploring our ESnet to go offshore with the 100gb network. Presently it is just in the US and serves not just SC but also non-SC parts of the office. We are looking to connect to the EU with drivers for connecting to work together for the next LHC further down the road, past 2020. Depending on how ITER and other experiments will go, we will need to get a connection to Europe. We are exploring requirements at this point, but offshore connections are difficult.

Q: Dr. Rapp:
So, no certifications for fusion data?

A: Dr. Binkley:
We could add that to our list of topics if there is a broad interest in this area.

Q: Dr. Foster:
You talked about advanced computers with marketable tech. How does industry and DOE merge their needs?

A: Dr. Binkley:
We have single points of contact in all the vendors, so we know what all their plans are. We started off to look at the size and magnitude of the electronics industry, which spends $5B per year on R&D, so the size of our budget in all of SC is not going to drive industry. Rather we can identify technologies that are coming from companies like Intel, NVidia, and recognize the benefit of partnering and understanding needs to help with their marketing strategy.
Other times, it's affordable for them to develop certain machines for scientific users, which is a non-recurring engineering cost to develop computers that we need. For example we may have very unique, specific, specialized needs for a storage system. We want to make sure we get our data system requirements into the next generation machine.

Q: Dr. Bhattacharjee:
I have a question about how this impacts the "all in" approach, with lots of money spent. Computing is

getting very expensive and is a substantial investment, with large power requirements. There is a gap in the intermediate size computing facilities, with about 1,000 processors. How do you close this gap, with you and NSF being oversubscribed? Vendors want to help with this need. Have you thought about a facility where an intermediate-size cluster could be used to try out codes, algorithms, etc.?

A: Dr. Binkley:
We are aware of the mid-range gaps especially at labs and universities. Labs undertake this within their institutional resources to solve the need. At the SC level, we are focused on the large size facilities. In HEP, they do that within their own program resources. We don't have this in mind now.

Q: Dr. Bhattacharjee:
Any plans with NSF?
A: Dr. Binkley:
We would need to work with NSF, which is less focused on large data, and the question if universities could follow the lab model.

Q: Dr. Groebner:
Please clarify the SciDAC proposals. My theory and simulation colleagues have a proposal related to that as a source of funding. They don't say that you are looking for something that requires utilization of the large computing capabilities.

A: Dr. Laviolette:
In the announcement the proposal should require taking advantage of the capacity and capability.

Q: Dr. Groebner:
If the project doesn't fit supercomputing, how do researchers get help?

A: Dr. Binkley:
There are a large number of FOAs, so I encourage interested parties to look at the selections of FOAs that are out.

Q: Dr. Ji:
Can you talk about an example of funding research in the field of x-ray diffraction? Was that funded by your program alone or jointly?

A: Dr. Binkley:
We are just at the beginning of exploring that type of approach. An LBNL project in computer applications and connectivity was funded by ASCR, and the biological scientists are funded by BES, which is paying for the beam line. This is a new model, being used on LCLS at SLAC, ALS at LBNL ,and somewhat on APS at Argonne. The labs can do LDRD, to allocate for these kinds of activities.

Q: Dr. Ji:

Please talk about assisting theory and simulation experiments working in a coupled manner, while utilizing SciDAC funds for research.

A: Dr. Binkley:
We are just exploring options and in discussions for this modality to take hold. It's not just in the light-source example; we need to figure out what model to use.

Q: Dr. Ji:
Using the example of space physics research, Dr. Jim Chang was successfully able to investigate challenging problems in both simulation and theory to determine the best models. I recommend this successful model.

A: Dr. Binkley:
I will look into this for next year.

A: Dr. Koepke:
We should be made more aware of those examples in ASCR, and make contacts.

BREAK

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

PRESENTATION ON THE CHARGE ON WORKFORCE DEVELOPMENT NEEDS FOR THE FES PROGRAM

Dr. Hantao Ji, PPPL

Dr. Ji gave a presentation on the workforce development needs for the program. The presentation followed the published slides closely.

COMMITTEE DISCUSSION

Q: Dr. Koepke:
I have a question about the scope in the charge letter; there is only 1 place where workforce is on the page (in the subject line of the charge). I call this a STEM program charge. I don't think it's about developing the workforce, rather identifying the needs of the workforce. I'm going to exaggerate, and say you can do this in a week. You don't need to figure out ITER, DEMO, the statistics on men and women in the field and get their input.
You need to look at curricula and look at what courses are being taken and what needs to be taken. Look at engineering and physics departments. Look at fusion technology. What SC wants, and where are we lacking in theory, modeling, fusion engineering, etc…? This is going to all the other SC offices for scientist and teacher workforce development with the goal of including your words in our solicitation.

I don't think it's a prediction of the fusion workforce, but instead what is missing in the curriculum. The 2nd paragraph talks about disciplines where there is workforce training needed to address gaps in the SC workforce mission needs, for example in fusion technology areas. This also speaks to the university and lab integration and the university involvement. For example would a post-doc or international internship be better than the domestic internship? Are the Science Undergraduate Laboratory Internship (SULI) and the visiting faculty program (VFP) serving our needs? With these items, what are we missing? We can de-scope the effort to get answers to these questions.

Q: Dr. Neilson:
I had the same reaction to this charge and your talk. Mark was on the right track.

Q: Dr. Yoda:
Have you talked about the American Nuclear Society (ANS) scholarships and fellowships such as the National Academy for Nuclear Training (NANT)? Many engineering programs have no fusion program at all. How would you get a short course or other fusion materials or technology classes taught?

Q: Dr. Sugiyama:
Comment on how you measure the breakdown of needed disciplines such as in theory and simulation; for example, young people are getting hired, but they are all in computation, while the senior staff is in theory, who know the science. To prepare, you are looking out 10 years and beyond.

A: Dr. Koepke:
If you think this would help you to manage the charge, I encourage you to de-scope and then start small and go big, instead of start big and go small. This is similar to the facility charge, which needed prioritization, and it was a list of urgent medium, long term. A lot of work and assessment took place and then SC merged our input with the other Office's input.

Q: Dr. Ji:
The reason we worry is that we don't know what workforce is needed in the future, so we don't know what the curriculum needs are. For example, if we don't need fusion nuclear engineering for 10 years, then that is an area that we don't need to emphasize now.

A: Dr. Koepke:
Focus on the present. Are there recruiting and retention needs? SC would be happier with a much coarser list of curriculum needs in physics, engineering, etc., instead of a workforce development charge, that would feed into workforce development activities.

A: Dr. Ji:
I think they need the numbers.

Q: Minami:
I'm an engineer. You could make a list of areas that could use a short course in areas important to the

field, or looking at what is done domestically and internationally, for example in computational and experimental areas.

A: Dr. Ji:
Is this a numbers question? I think so.

A: Dr. Koepke:
They don't need the magnitude, just the category.

A: Dr. Synakowski:
I struggled with learning what was needed and I concluded that Mark has the right idea. I have determined that SC is looking for recommending where the machinery could be oiled and ways of doing business to help you in the future, so we can facilitate the research. It's not in getting the right numbers, but making sure we have the right programs and what we should be soliciting.

A: Dr. Koepke:
I think it's more of a data call, instead of a more subjective call. For example, we need more professors, but what discipline do we need them in? Confinement, transport, etc.

Q: Dr. Ji:
If it's yes/no that's easy. Should we find the number? Because training 1 and training 100 is different. For 100 we need a large continuous effort; for 1 you need a short course.

A: Dr. Koepke:
I'm seeing a survey going to the labs, about what is missing and what is in high demand. Give them a survey of what they are looking for in the charge. Someone will say, for example, we have this short course, or this curriculum. USBPO holding the ITER summer school is an example of what could be passed on in the report.

Q: Dr. Foster:
So is this only looking at plasma physics?

A: Dr. Synakowski:
No, this covers all the needs, including theory, computations, enabling technology, astrophysics, engineering, high power, long pulse, etc.

Q: Dr. Hubbard:
There are some areas we need to know, but we are assuming what we have will work. Fusion technology is one area which is needed, but it's shrinking. So for now it's not a problem, but if it gets worse you won't

even have the educators. We need to know the distinction between what is needed in fusion plasma science and the other disciplines needed in FES.

A: Dr. Koepke:
The 10 year strategic plan will go into student and workforce development, which is needed, but it's too late for your input.

A: Dr. Synakowski:
I have been trying to walk lightly in this meeting with respect to the strategic outlook, so that FESAC will be unencumbered by our views. Pithily put, assume that you are developing a workforce for ITER. How does that work? The workforce will have to be conversant in living in a world that is imbedded in massive amounts of data. The future world will be this way both domestic and internationally. There is an aspiration to grow fusion material science, but I'm not sure how that translates to this. Many plasma science questions will require more sophisticated infrastructural support that will require us to find a way for the labs to make experiments attractive to universities. For involvement offsite from campus, how does that work? In GPS or Discovery Science, we want to maintain excellence, but that comes out of the planning process. What problems are happening now? What students are missing? Is that the same as 10 years from now? That's the best I can do for now.

A: Dr. Neilson:
I think between Dr. Synakowski's talks yesterday and from his UFA talks and from Jim, you have a lot of information from FES and how they see the future. You had one of their FES graphics in your presentation, and from discussion in this meeting, and good people in the panel, you get a good idea of the vision from where the program goes, and what opportunities there are for a future vision. Make assumptions of program directions and state those assumptions in your report. Here are the data you need.

A: Dr. Koepke:
APS-DPP just approved a new student fellowship with a generous donation from Bill Stacy, in MFE engineering and physics that is just for graduate students. The leadership of the APS came to me, we liked it and approved it, but said that we want you to know that we want you to pick only the physics applicants. I'm not going to do that because we are a community of engineers and physicists. Is the selection committee going in that direction? If you look at scholarships in astronomy you might get some plasma physicists which might get the award. The point is plasma physics PhDs are not the only discipline that we rely on. They want lists so they can make workforce development decisions.

After the conclusion of the committee discussion, Dr. Mark Koepke stated that he would like to thank Dr. Hantao Ji for chairing this subcommittee, and Ed Thomas for serving as vice chair.

PRESENTATION ON LABORATORY PLASMA ASTROPHYSICS AND BEYOND

Dr. Hantao Ji, PPPL

Dr. Ji's presentation followed closely the slides in his presentation. The general message of the talk was the importance and cross cutting nature of plasma astrophysics. For example, there were 10 major plasma

processes from the 2010 Workshop on Opportunities in Plasma Astrophysics (WOPA) that he discussed.

COMMITTEE DISCUSSION

Q: Dr. Koepke:
When you are evaluating accretion in laboratory experiments what are the boundary conditions, for example is angular momentum in the radial and axial directions? Do you attempt to minimize the vertical or only radial components? Does the plasma heat up?

A: Dr. Ji:
Accretion conserves angular momentum, but converts it to heat. Fusion converts 0.7% while accretion converts up to 25%. It is highly efficient. Accretions are also very bright.

CONCLUDING COMMENTS ON THE STRATEGIC PLAN CHARGE

Dr. Mark Koepke, Committee Chair

Dr. Koepke retained the committee for some final remarks and discussion after the final agenda item. The discussion follows:

Dr. Koepke:
I want to stress that the format and form of the NSAC report should be used as a model for our work. It speaks to their field, but we need ours to be like this where it is accessible to deans, staffers, students, and everyone who could be an audience for the document. This goes way beyond the needs of SC to increase support for a plus-up in the budget. There will be a full court press for input from the community. Think about how the report and data will look in the end. Eventually I hope it will look like the NSAC report.

My intention is to finish assembly of the subcommittee on the strategic plan in a week or two. I needed the charge first. Now that it's out, I will send an e-mail to FESAC with the philosophy and strategy sent with the names of the subcommittee to help them understand my approach to respond to the charge. I will explain about the makeup of the subcommittee and the importance of seeking input to this crucial charge. I want FESAC to see this before we have our first meeting to help organize our thoughts.

COMMITTEE DISCUSSION

Q: Dr. Greenfield:
Do you anticipate a full FESAC meeting prior to the interim report?

A: Dr. Koepke:
No. I will explain in my e-mail. I hope to make the process continuous so that there will be transparency and an interim report is not required.

Q: Dr. Greenfield:
For the Rosner report, the full FESAC committee had concerns about the content, and was looking for data.

A: Dr. Koepke:
Transparency is key in how we will work.

A: Dr. Synakowski:
The #1 lesson learned is that it's important that people are independent, and the integrity of the process is critically dependent on this. What makes me nervous about an interim report is the need to maintain independence.

A: Dr. Koepke:
Having the interpretation of the charge clearly stated should help and be sufficient, so that people don't feel blindsided in the process.

Q: Dr. Neilson:
Dr. Ji made a point that the next FESAC meeting will be held at the end of June. How will that be handled?

A: Dr. Koepke:
There will be a teleconference meeting to go through the workforce development report and to approve the report.

Q: Dr. Hubbard:
Wouldn't the video conference be a good chance to update FESAC, so we can avoid disagreement, and then the panel is sent back to changes?

A: Dr. Synakowski:
There is a concern about us being in FACA space. This should be as absent as possible of conflicts of interest, because the committee has the potential to have conflicts.

A: Dr. Koepke:
I will manage this and I will not be looking to minimize disagreement.

Q: Dr. Cohen:
What about the assembly of the COV panel?

A: Dr. Koepke:
It's in the process. I need a week or two for other activities, then the COV will follow.

A: Dr. Synakowski:
The workforce development and STEM report will be rolled out as a public meeting.

A: Dr. Barish:
We have the opportunity to have a video conference as an official FESAC meeting since it's a public meeting. We plan on using Ready Talk, with the full committee to approve the workforce development report.

A: Dr. Koepke:
We will have FESAC comments, but it will be without FES AD comments; it's a business meeting.

Q: Dr. Neilson:
I favor an interim report. You have a plan to keep FESAC in the loop and the time scale is short. Instead of spending time polishing the report, spend time getting input from the community.

A: Dr. Koepke:
It is essential that we get input from the community, which will be the highest priority, including utilizing other venues (face-to-face, white papers, videoconferences, etc.).

Q: Dr. Ji:
Travel will be a financial burden to some. Videoconferencing will help those who can't travel and miss duties at work.

A: Dr. Koepke:
The USPBPO has, in principle, approved the forum for video and will be coordinating how to incorporate videoconferences into the communications plan.

DOE FES Acronym List:

AD: Associate Director, Office of Science

ALCC: ASCR Leadership Computing Challenge

ALS: Advanced Light Source, at LBNL

ANL: Argonne National Laboratory

ANS: American Nuclear Society

APS: Advanced Photon Source, at ANL

APS: American Physical Society

APS-DPP: American Physical Society-Division of Plasma Physics

AT: Advanced Tokamak

ASCAC: Advanced Scientific Computing Advisory Committee

ASCR: Advanced Scientific Computing Research

ATLAS: A Toroidal LHC Apparatus (an experiment at the CERN laboratory)

B&R: Budget and Reporting

BES: Basic Energy Sciences

BERAC: Biological and Environmental Research Advisory Committee

BESAC: Basic Energy Sciences Advisory Committee

BPS: Burning Plasma Science

CD: Critical Decision

CFO: Chief Financial Officer

CM: Configuration Management

COI: Conflict of Interest

COV: Committee of Visitors

CR: Continuing Resolution

CS: Computer Science

CTF: Component Test Facility

DA: Domestic Agency, participating in ITER

DIII-D: Doublet III-D (an experimental fusion device)

DG: Director General, of the IO

DOE: Department of Energy

dpa: displacements per atom (normally all lower case)

DPS: Discovery Plasma Science

DS: Discovery Science

EAST: Experimental Advanced Superconducting Tokamak, in Hefei China

EPR: Experimental Plasma Research

ESnet: Energy Sciences Network, DOE

EU: European Union

FACA: Federal Advisory Committee Act

FES: Fusion Energy Sciences, DOE

FESAC: Fusion Energy Sciences Advisory Committee

FMITS: Fusion Materials Irradiation Test Station, at ORNL

FNS: Fusion Nuclear Science

FNSF: Fusion Nuclear Science Facility

FOA: Funding Opportunity Announcement

FSP: Fusion Simulation Program

FY14: Fiscal Year 2014

FRIB: Facility for Rare Isotope Beams, (at Michigan)

GA: General Atomics, in San Diego, CA

GAO: Government Accountability Office

GPP: General Plant Projects

GPS: General Plasma Science

HEDLP: High Energy Density Laboratory Plasmas

HEP: High Energy Physics

HEPAP: High Energy Physics Advisory Panel

HHF: High Heat Flux

HSX: Helically Symmetric Experiment

IC: ITER Council

INCITE: Innovative and Novel Computational Impact on Theory and Experiment

IO: ITER Organization

IPA: Intergovernmental Personnel Act

ITER: Latin for “the way”, the title for an international fusion facility

KSTAR: Korean Superconducting Tokamak Reactor, in Daejeon, South Korea

LBNL: Lawrence Berkeley National Laboratory, in Berkeley, CA

LCLS: Linac Coherent Light Source, at SLAC

LDRD: Laboratory Directed Research and Development

LDX: Levitated Dipole Experiment, at MIT

LHC: Large Hadron Collider, near Geneva Switzerland

LLNL: Lawrence Livermore National Laboratory

MAC: Management Advisory Committee

MFE: Magnetic Fusion Energy

MPEX: Material Plasma Exposure eXperiment, at ORNL

NAS: National Academy of Sciences

NASA: National Aeronautics and Space Administration

NERSC: National Energy Research Scientific Computing Center

NIF: National Ignition Facility, at LLNL

NNSA: National Nuclear Security Administration, DOE

NP: Nuclear Physics

NRL: Naval Research Laboratory, in Washington, DC

NSAC: Nuclear Science Advisory Committee

NSF: National Science Foundation

NSTC: National Science and Technology Council

NSTX: National Spherical Torus eXperiment (at PPPL)

OMB: Office of Management and Budget

OPA: Office of Project Assessment, DOE

ORNL: Oak Ridge National Laboratory

OSTP: Office of Science & Technology Policy

P5: Particle Physics Project Prioritization Panel

PI: Principal Investigator

PM: Program Manager, DOE

PMI: Plasma Material Interface

PPPL: Princeton Plasma Physics Laboratory

Q: The ratio of power produced/the power to maintain a steady state plasma

R&D: Research & Development

RHIC: Relativistic Heavy Ion Collider

ReNeW: Research Needs Workshop

SBIR: Small Business Innovation Research

SC: Office of Science, DOE

SciDAC: Scientific Discovery through Advanced Computing

SEAB: Secretary of Energy Advisory Board, DOE

SLAC: Stanford Linear Accelerator Center

SLI: Strategic Laboratory Infrastructure, DOE SC

SNS: Spallation Neutron Source, ORNL

ST: Spherical Tokamak

STAC: Science and Technology Advisory Committee

STEM: Science, Technology, Engineering and Mathematics

STTR: Small Business Technology Transfer

SULI: Science Undergraduate Laboratory Internship

TCWS: Tokamak Cooling Water System, on ITER

USBPO: U.S. Burning Plasma Organization

USIPO: US ITER Project Office, at ORNL

V&V: Verification & Validation

VFP: Visiting Faculty Program

W7-X: Wendelstein 7-X, in Greifswald, Germany

WD: Workforce Development

WDTS: Workforce Development for Teachers and Scientists

These meeting minutes were created by Mr. Edward Stevens, DOE
Taken from his notes and those of Dr. Jim Van Dam, DOE

The meeting minutes were reviewed by the FESAC Chair and the Designated Federal Officer's (DFO's) representative.

Certified as correct by:

06 August 2014

Dr. Mark Koepke, Chair Date