FUSION ENERGY SCIENCES ADVISORY COMMITTEE
OFFICE OF SCIENCE

DoubleTree Bethesda Hotel and Executive Meeting Center
8120 Wisconsin Avenue
Bethesda, MD, 20814
7 March 2011 - 9:00 am to 5:15 pm

Agenda Monday, March 7, 2011

Time	Topic	Page	Speaker
9:00	Welcome, Meeting Agenda and Logistic	3	Dr. Martin Greenwald, FESAC Chair, Massachusetts Institute of Technology
9:05	DOE/SC Perspectives including the FY 2012 Congressional Budget Request	4	Dr. W.F. Brinkman, Director, Office of Science
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10:15	FES Perspectives including the FY 2012 Congressional Budget Request	9	Dr. Ed Synakowski, Associate Director for Fusion Energy Sciences
12:30	Lunch	16	
1:30	ITER Update: Accomplishments, Status, and Domestic Issues	16	Mr. Tom Vanek and Dr. John Glowienka, Fusion Energy Sciences
2:30	Fusion Energy Research and Development in the "ITER Era":A Korean Perspective	20	Dr. G. S. Lee, President, National Fusion Research Institute in Korea; Chair, Management Advisory Committee, ITER Council
3:30	Break	24	
3:45	Update on Fusion Nuclear Sciences Pathways Assessment Activities	24	Dr. Charles Kessel, Princeton Plasma Physics Laboratory
4:45	Public Comments	27	
5:15	Adjourn	30	

FUSION ENERGY SCIENCES ADVISORY COMMITTEE
2010-2011

Agenda Tuesday, March 8, 2011

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9:00	Briefing on the Results from the Workshop on Opportunities in Plasma Astrophysics	31	Hantao Ji, Co-Chair, Committee on Opportunities in Plasma Astrophysics; Princeton Plasma Physics Laboratory
9:45	Briefing on Portfolio Analysis and Management System (PAMS)	35	Linda Blevins, Office of Science, Office of the Deputy Director for Science Programs; Keith Tucker, Office of Science, Office of Business Policy and Operations
10:15	Break	37	
10:30	Briefing on the National Academy of Sciences Study On Inertial Fusion Energy for Energy (process-related items only)	37	Professor Ronald Davidson, Chair, NRC IFE Panel; Princeton Plasma Physics Laboratory
11:00	Discussion Of the New Charge: Policies and Practices for Disseminating Research Results	39	Dr. Ed Synakowski/FESAC Members
11:30	Committee Discussion	40	Dr. Martin Greenwald, FESAC Chair Massachusetts Institute of Technology
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FUSION ENERGY SCIENCES ADVISORY COMMITTEE
2010-2011

MONDAY, MARCH 7, 2011

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

WELCOME

Dr. Greenwald welcomed returning and new committee members and asked that members introduce themselves. He indicated there would be a special time allotted for public comment and those who wanted to speak should contact Mr. Albert Opdenaker to be placed on the list.

ROLL CALL

Committee Members Present:
Dr. Martin J. Greenwald, Chair
Dr. Richard W. Callis
Dr. Bruce Cohen
Professor Raymond J. Fonck
Dr. Amanda Hubbard
Dr. Hantao Ji
Dr. Christopher J. Keane
Dr. Ramon Leeper
Dr. Kathryn McCarthy
Dr. Dale M. Meade
Dr. Ellen Meeks
Professor Farrokh Najmabadi
Professor Edward Thomas, Jr.
Dr. Nermin Uckan
Dr. Steven Zinkle

Committee Members Absent:
Professor Riccardo Betti
Professor Robert Rosner

Ex Officio Members Present:
Professor Steven Allen
Mr. Lee C. Cadwallader

Ex Officio Members Absent:
Dr. John W. Steadman

Others Present:
Ms. Laura Biven
Dr. Linda Blevins
Dr. W.F. Brinkman
Dr. Ronald Davidson
Dr. Patricia Dehmer
Dr. Hui Li

Others Present:
Mr. Albert L. Opdenaker III
Dr. Stewart Prager
Dr. Ed Synakowski
Mr. Keith Tucker

AGENDA ITEM: DOE/SC PERSPECTIVES INCLUDING THE FY 2012 CONGRESSIONAL BUDGET REQUEST

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

- Expressed uncertainty about the current state of affairs regarding the federal budget and proposed cuts.
- Detailed the function of the Office of Science and their work on the frontiers of science.
    - Supported 100 Nobel Laureates – 22 in the last decade
    - Provided 45 percent of federal support for physical sciences and in that support there were key components of the nation's basic research in biology and computing
    - Supported 27,000 PhDs and graduate and undergraduate students
    - Provided access to 21st century tools accessed by 26,000 users per year
    - Reviewed major events and noted that the President had said that it was our generation's 'Sputnik' moment and that the budget would assist the Office of Science in meeting the goal of reaching a level of research and development not seen since the space race.
    - Acknowledged that the United States faced a different world with countries such as India, China, Europe, other Asian countries including Japan in intending to compete vigorously in science and technology, including in energy technology.
    - Stated that the President intended to push hard on clean energy technology and the Office of Science was well positioned to respond to that with an arsenal of basic science capabilities, major scientific user facilities, national laboratories, and university researchers. These resources were focused on critical national needs.
    - Noted the creation of bioenergy research centers and energy frontier research centers. A new energy innovation hub, the Joint Center for Artificial Photosynthesis has also been created.
    - The Office of Science has responded to the President's goals in the 2012 budget in a three-fold fashion:
        - Applying new material design to energy technology, including nanoscale structures. The growth of materials was formerly an empirical process but today that could be improved. The goal of clean energy had a starting point with materials.

  - Biosystems – developing new molecular toolkits and testbeds for improved biological components/biohybrid systems and processes. Indicated that the challenge was not decoding DNA but controlling and learning how to use enormous amounts of data in databases. An example was given of using synchrotrons to study the structure of proteins with a database of 40,000 proteins today. Discussed how they had been able to now itemize what made up biology. Acknowledged that the challenge was still to learn about how cells work and to be able to use biology more successfully.

  - Improving modeling and simulation to facilitate materials and chemistry design, enabling simulation of more complex things. Gave several examples of simulating multi-grain materials such as the crack propagation in multi-grain nickel. Described their interest in synthetic biology using DNA to structure things that previously they had not thought to do. Noted that they were using their super computers, located at Oak Ridge and Argon for this type of analytic analysis.

- Discussed the breakdown of the budget to recognize initiatives, noted that money was put into three areas; the basic energy sciences, the environmental sciences and advanced computing.

- Noted second that there was a decrease in fusion funding but this would be balanced out by funding promised by the Senate in 2011 when they would have more fusion energy than fusion research dollars than anticipated especially for ITER (International Thermonuclear Experimental Reactor).

- Discussed research hubs which the Office had always promoted and were now receiving positive publicity. Noted that hubs were being actively promoted and that they had one hub for research on artificial photosynthesis with the object being to find a catalytic way of producing fuels from sunlight and CO_2 presumably in water and in an efficient fashion.

- Confirmed that they were also promoting a hub on batteries. Described batteries as being a critical issue in energy technologies. Noted research was being done on improving lithium batteries with the dual issues of materials and due processes involved.

- Discussed six associate director organizations and their highlights.

  Scientific Computing:

  - Stated that the major machines of Scientific Computing should be nurtured to ensure that good science was done with them. Acknowledged that the real challenge was the exascale supercomputer and hoped that solutions could be found in the next six to eight years. Described this process and challenge in detail. Noted that a challenge was also the design of a computer that could handle storage needed for exascale both economically and in terms

of power consumption. Also described the difficulty of uncertainty quantification due to computing error. The budget would determine when the program would commence.

- Discussed the work done at Oak Ridge using the Jaguar supercomputer together with the work done at a company called BMI working on simulations of airflow around trucks travelling at highway speed. The research had shown that addition of shaped boxes on the bottom of the trailer could reduce drag by 12 percent. That translated into a 6.9 percent increase in fuel efficiency. Advised that there were 1.3 million of these Class 8 trucks on the highways today which would result in cost savings of a billion and half gallons of diesel fuel if applied to all the trucks.

Basic Energy Sciences:

- Noted that they deal with the battery hub and want to look at interfaces. Noted that there were many examples in the energy world of using them with high efficiency and related to the interfacial structure of various interfaces between solids. Used the example of First Solar, a company making solar cells from cadmium telluride and the challenges they faced in making the process more efficient with interfacial resistance issues.

- Commented that Basic Energy Sciences had strong interest in light sources and the free electron laser in the x-ray regime at the SAC (Scientific Advisory Committee). Described an experiment that illustrated how to obtain the structure of a protein and said it sometimes took 10 to 15 years to crystallize a protein into a large enough crystal that you could do structural determinations with a cyclotron. Described a process where they took nano-crystals and used an liquid jet to propel droplets through an x-ray beam to get the crystal to get a diffraction pattern.

- Remarked that Basic Energy Sciences had made progress in batteries which have been applied to cars. These inventions included a new cathode material, a lithium manganese material which had several beneficial features, including far lower weight.

Biological and Environmental Research:

- Summarized the work of BER (Biological and Environmental Research) including climate research. Stated that the next IPCC (intergovernmental panel on climate change) report would come out and expressed the importance of understanding what the issues were with respect to climate and global warming. A lot of simulation work has been done using machines at the repository at Lawrence Livermore Laboratory for all the models and for inter-comparison work of different models in climate. Noted that they have a set of facilities called arm facilities designed to measure the nature of clouds and aerosol effects which are the two issues that lead to the most uncertainty.

- Stated that BER has been working on biofuels and making progress. Biofuels are made up of what you extract from switchgrass or a corn stalk. The researchers have modified the DNA of switchgrass and reduced the amount of lignin resulting in 30 percent more sugar. This pushes it closer to being economically viable without government subsidies. Several other examples were given of research being done in this area.

Fusion Energy Sciences:

- Noted that the community was becoming closer due to ITER which was positive. Acknowledged that it was an enormous challenge ensuring that ITER was a reality. Advised that they needed to be concerned about high energy density materials and large numbers of displacements. Commented that the management at ITER was good and headed by Prof. Osamu Motojima. Felt that ITER was still an enormous challenge that faced huge technical and design problems, but significant progress had been made, and management had improved. A slide of the ITER site under construction was shown. Stated that funding demands regarding ITER would really increase in 2013.

- Highlighted recently verified research with the D-IIID fusion reactor which suppressed potentially damaging L-mode issues.

Nuclear Science:

- Noted that this was broken into three groups, those who do conventional nuclear physics, those who want to do detailed structures of the proton and the neutron and finally those who study quark-gluon plasmas. Stated that quark-gluon plasma research was being done at Brookhaven National Laboratory. Discussed the search for element 117 and commented that the community was hopeful regarding research for ion stability and hopeful that it would be found.

- Discussed laboratories and noted that two new facilities were being built, one being an upgrade of the Jefferson Laboratory and the other a building called FRIB (Facility for Rare Isotope Beams) at Michigan State University. Stated that these new constructions had strained the budget for nuclear physics so a decision was made to close the Holyfield Accelerator at Oak Ridge National Laboratory.

- Discussed the production sites of the isotope program in the United States and noted that it was well organized and was a complex endeavor, illustrating with a slide that showed the different contributors who supply isotopes of various types. Commented on the two issues in isotopes and discussed problems of availability in the world. Commented specifically on the shortage in Helium 3 and said that there are heavy water reactors like the CANDU (Canada Deuterium Uranium) reactors in Canada that have tritium which could be processed into Helium 3.

High Energy Physics:

- Noted High Energy Physics is going through a complex phase transition. Confirmed that they would turn off the Tevatron at the end of September, the last major accelerator in the United States for high energy physics. Noted that high energy was now completely at Cern and the United States had a large effort at Cern. Tevatron was closed based on an original intention to close it in 2011 due to decreasing efficiency.
- Noted achievements in particle physics. The Fermi satellite was built which is a large gamma ray detector and its investigations into pulsars and novas was discussed.
- Noted that in high energy physics they were trying to decide the direction in which experiments should take place in the U.S. Commented that one potential area for investigation was long baseline neutrino experiments.
- Briefly discussed accelerator technologies development and the impact that it has had on the world including in medical technology. Also noted the interest that their developed technology was having on countries like India and China.

- Confirmed that the Office of Science tried to do a lot for students. His slide showed their Science Bowl winners, high school students competing nationally in a science contest with First Lady Michelle Obama and Mr. Steven Chu giving out the awards and also the first class of 150 graduate fellowship recipients. Confirmed the importance of that program and hoped that the program could be started once more in 2012.
- Concluded with the point that it was important for the science community to help sell the importance of ITER in Washington and stated that it would be a major challenge to keep on track in terms of funding to make it work. Emphasized that it was important to have people in Congress who were enthusiastic.

COMMITTEE DISCUSSION

A question about the difference in numbers between the 2010 and 2012 budget was raised by Dr. Greenwald where the Office of Science received more funding but fusion science received less. A response was given by Dr. W.F. Brinkman who replied that some of the funds were taken up by ITER. He also noted that the White House had emphasized the importance of clean energy and they had to comply.

A member commented that Congress, in particular the House didn't appreciate the impact of the bio and physical sciences that the Office of Science supported. He was asked how the Office of Science was

addressing this. A response was given by Dr. Brinkman that he believed many were not aware of the impact at all and further that there was sometimes a prejudice against the Department of Education and the Department of Energy and it seemed to come up in 2011 again. This was acknowledged as a particular problem in Congress as was climate research.

The issue of ITER and the process to close on the baseline in FY12 was raised. What reviews would be held? Did he see any major changes to the scope? Dr. Brinkman confirmed that that was to be controlled by Professor Motojima but he thought that he would try to keep costs under control and would trim his management teams.

Dr. Hantao Ji remarked internal departments within the Department of Energy could work more closely together and this would save costs. Dr. Brinkman agreed and responded that there was ongoing collaboration going on with the department. Dr. Ed Synakowski confirmed that there had been discussion within offices in the Office of Science and also with nuclear energy on what a joint effort might be. It was also noted that a lot of collaboration was going on in computing as well.

The question was asked about why they couldn't make a stronger argument for funding on the basis of contributions to the economic wellbeing of the country, to the preservation of the environment and to national security. Dr. Brinkman responded that they had been focused on energy and that they had not focused on security. It was acknowledged that they do supply research regarding weapons, such as anthrax but that they could do a better job with this argument.

BREAK

The advisory committee stopped for a ten minute break.

FES PERSPECTIVES INCLUDING THE FY 2012 CONGRESSIONAL BUDGET REQUEST

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

- Stated that it was a pleasure to meet with everyone to talk about challenging times and work hard to develop budget proposals according to priorities that had been laid out.
- Welcomed the opportunity to discuss choices made in the FY12 budget proposal and to communicate the views of his office regarding those priorities.
- Noted that it would also give them an opportunity to talk to him and program managers about those choices. Commented also that he would also discuss office activities and how FESAC (Fusion Energy Sciences Advisory Committee) interacts with the national community.

- Welcomed new members and thanked them and continuing members for serving on the committee.
- Advised that he would present a perspective on the administration's standpoint on science and its place in the budget and fusion's place within it.
- Indicated that the talk would concentrate on the priorities and opportunities that they had and how they infused the FY12 budget proposal. Also noted that he would highlight the motivation for particular choices and how the priorities made would inform those choices.
- Discussed the FY12 budget rollout and points communicated by Secretary Chu.
    - A major theme noted was sacrifice and even with the administration's emphasis on science such as energy efficiency and renewable energy and funding for hydrogen technology, the Tevatron, fossil energy, credit deductions for oil, gas and coal activities would be eliminated or phased out. This included the closure of the Holyfield facility at Oak Ridge National Laboratory.
    - He either reduced or increased the FES (fusion energy sciences) budget depending on your position. Some changes occurred due to the ITER budget rollercoaster.
- Confirmed that the administration was committed to targeted science investments that had near-term payoffs with a period of approximately a decade or two.
- Stated that requests were up from FY10 and FY11 requests.
- Stated that it was to advance U.S. leadership in basic and applied science and to support targeted investments in basic investments relative to new, clean energy technologies.
- Advised that Fusion's request of $400 million represented a 6 percent decrease compared to FY10 and a 5.1 percent increase over FY11.
- Underscored that science did well when compared to other federal endeavors in the recent budget proposal, considering the financial context.
- Discussed priorities and opportunities in the context of the FY12 budget proposal.
    - Advised that when the program is discussed on Capitol Hill the point is made clear that fusion could make a difference this century with respect to the health of the planet and national security. Noted also that the U.S. is leading or among leaders in critical areas of the fusion energy sciences and distinguishes itself in terms of the nature and impact of its innovation.

  - Commented on the mission statement of the department and advised that they were aiming for understanding for fusion on earth and of the plasma universe. Described in detail in a more in-depth discussion of this, how it affected the drive for national and international research and that they should take advantage of existing overseas facilities.
  - Discussed the Greenwald Report regarding a long-range strategic plan for magnetic fusion energy. Confirmed that this was viewed as an urgent international need but also represented a U.S. leadership opportunity.
  - Stated that discovery science was common to all elements of FES and captured the need to reach beyond the challenges of particular targets.

- Discussed FES priorities:
  - Learning plasma science, the ITER project and the future research program.
  - The ITER future driving the demand for continued or growing major facility operation.
  - Attention to the emergent science of 3D physics.
  - Careful consideration with how we proceed with validated simulation.
  - Growth of the international research portfolio.
  - Plasma dynamics and control science and using existing tools and investments, again capturing international research development.
  - In material science and fusion nuclear science investment is required in both experiment and computation.
  - The Plasma 2010 Report calling for a federal home for plasma science which would help motivate a growth in the discovery science area.
  - HEDLP (High Energy Density Laboratory Plasmas) science to inform IFE (Inertial Fusion Energy) and for discovery, looking for a restructuring of that portfolio with emphasis on maximizing leverage with other agencies and laboratories and priority for near-term results.
- Discussed the budget and detailed the breakdown.
- Confirmed that the main share of the funds was going to operations on the major devices as well as theory and simulation.
- Stated that ITER was the keystone for establishing the scientific and technological feasibility of magnetic fusion energy and discussed the budget for FY10 and FY11 relating to ITER. Acknowledged that ITER was unique in that it touched all of the major elements. Reviewed the

construction and progress of the ITER site. Discussed the new management team. Asked that if members are asked about ITER on Capitol Hill to state that the project had already benefitted U.S. industry and that over the duration of the project 80 to 90 percent of funds allocated for hardware construction would be awarded competitively within the U.S.

- Stated that the U.S. facilities were a leading strength and they contributed to every major research area especially the plasma control science. Gave the opinion that they should be complemented with investment in international research.

- Noted that with respect to material science and technology there was a high quality of research in the U.S. and the effort could be deepened on major facilities.

- Discussed the point that major facilities should be partnered with university-scale efforts to answer critical questions.

- Advised that four out of the five winners of the nuclear fusion prize were U.S. researchers and two were from universities and all of the awards were for research conducted on their major facilities.

- Discussed international research and collaborations on overseas devices and noted he thought this needed to grow despite challenges to U.S. based major facility and university teams working in international situations.

- Advised that there was an increase in material science and enabling technologies proposed.

- Advised that the Fusion Nuclear Science Pathways Assessment (FNSPA) was ongoing and a high priority was identifying clarifying information that would assist in decisions. Elaborated further on this assessment.

- Noted that a challenge within the Office of Science and an opportunity in the Office of Science was building a scientific basis that established a scientific credibility for developing into a true energy development area, that the Office of Science should be an incubator for scientific ideas.

- Confirmed that there was an increase in funding with respect to SciDAC (Scientific Discovery through Advanced Computing) supporting a new computational materials project.

- Confirmed that the FSP (Fusion Simulation Project) planning activity would be completed this fiscal year and that due to ITER it might make it difficult to execute the FSP at the funding levels previously envisioned. This was elaborated on in more detail.

- Stated that with respect to high-energy density laboratory plasma physics there was an intention to adjust and realign that portfolio.

- Advised that in the budget proposal general plasma science was increased in the FY12 proposal. The increase would allow for the increase in new proposals. The emphasis on cross-agency and international partnerships was emphasized again. Noted there was an effective partnership with the NSF (National Science Foundation).

- Discussed the substantial depth and extent of university engagement in FES sponsored activities. Approximately 490 students participated in research across the portfolio. Confirmed that the challenges included creating opportunities for students in areas most relevant to fusion in plasma sciences future. Advised that they had a responsibility to find models that students and university leaderships find exciting.

- Made a point on IFE (Inertial Fusion Energy) stating that any new initiative in IFE technology would depend on the output of the NAS (National Academy Study). Stated that Dr. Ronald Davidson would discuss those processes further tomorrow. He mentioned ignition with regard to the NIF (National Ignition Facility) and the scientific output of the national ignition campaign and available budget authority.

- Related his personal and the Office's perspective regarding IFE and reiterated comments made in a public forum for the national academies.

- Discussed FES work, approaches and engagement with the community and noted that FES program managers were currently doing double or triple duty driven by retirements and departures. Elaborated on new hires and hiring processes currently going on and plans for the future regarding personnel.

- Described a new organizational structure which would make it a rewarding place for the program managers to work which would then lead to them seeking further rewards by helping the communities succeed. Commented that the operating principles were two divisions, research and facilities operations and projects and details regarding this were elaborated on and an in-depth description was given using the accompanying slide.

COMMITTEE DISCUSSION

Speaking as the voice for the theory community in FESAC, Dr. Bruce Cohen noted that there was concern over the pause in the FSP (Fusion Sciences Program). The concern was over the delay of implementing a robust FSP especially as there might be limited impact on ITER because of that delay. He expressed concern that theory and modeling would suffer a budgetary decrease, and they had previously suffered with a flat budget. He described this as a blow to the theoretical modeling community. Dr. Synakowski was asked if he could comment and asked what he envisioned the future would be after the pause.

Dr. Synakowski responded that the potential of validated simulation as a tool for discovery was recognized. It was not a value that was lost. The decision to make this pause was not taken lightly. He

noted the forces that led to it were budgetary constraints and that with the FSP in planning activity, but no formal start of activity yet, this was the best time to make the painful decision to pause, and make sure things got off on the right foot. He clarified that this was a purely internal decision.

Dr. Cohen remarked that the decision regarding the pause should have involved dialogue with the FSP planning team, and those in the executive committee. Dr. Synakowski said they take on this sort of dialogue "with extreme caution" when developing a budget.

The 'Sputnik' moment that Secretary Chu and President Obama had been proposing was brought up by Dr. Steven Zinkle. He asked if Dr. Synakowski could say a few word about OFES (Office of Fusion Energy Sciences), a capsule version of what their 'Sputnik' moment was for this. He asked if it was 'deliver on ITER' or the fusion pathways analysis, or was there more for accelerating development on fusion?

Dr. Synakowski responded that ITER was a critical element adding that ensuring there was a vibrant program to take advantage of it was also important. He said the things we should pay attention to were the development of the international facilities in tokamaks and accelerators, and depending on what they found, the U.S. could fall behind. Dr. Greenwald added his comment saying from what they had heard he didn't hear any sense of urgency befitting a 'Sputnik' moment. Dr. Synakowski reiterated that it would be more challenging still in 2013 due to budget issues, and that they needed to work internationally or they would have no vibrant research element on ITER. These were unprecedented challenges.

Dr. Edward Thomas Jr. questioned whether the restructuring of the ICC (Innovative Confinement Concepts) program was problematic to the emphasis rightly placed on the significance of university programs. Were ICC programs in universities moving away from high-risk, high-reward type activities to more validation and verification activities? Secondly, he asked for more crystallized plans about how the university programs would go forward and the role of the universities given the budget pressure.

Dr. Synakowski said for the ICCs the intent was to sharpen the portfolio towards validation and verification and experiments that could support answering fundamental questions. He stated that the university programs touched every element of the portfolio that FES sponsored. He also confirmed that there were many opportunities for university engagement which they currently did not pursue, for example, in material science and discovery science that was clearly discovery-driven.

Dr. Thomas again remarked that he didn't see a structure for making the universities part of larger international activities, and Dr. Synakowski conceded that this was a liability, and expressed how proposals on partnerships with international labs had met with unexpected back pressure, and that they were still pursuing models for attracting students to be involved in advanced facilities, and that their past model would likely not be sustainable in the future.

The question of collaboration was raised by Dr. Ji as a more effective use of a limited budget. He suggested for example model testing with both material scientists and fusion scientists to solve

problems simultaneously through collaboration. He gave two other examples for collaboration such as computing and astrophysics. Dr. Synakowski responded that there was a viable model in place for some areas of the program, for example the partnership with NSF. Relationship building was required, and this was slow to develop. Other examples of collaboration were also given.

Dr. Ji noted that the restructuring of the management team should lead to better internal collaboration, and that this related to Dr. Thomas' question on how the universities fit into the structure. Dr. Synakowski agreed and remarked that the change in management structure was designed to soften the barriers between facilities, labs, and universities to coherently address questions using a wide range of scales of facilities, and determining which is best suited, and this would provide an opportunity to engage the universities. Dr. Ji remarked that smaller projects were often not communicating with mainstream fusion research, and this was a missed opportunity to make things more coherent and share discoveries between different regimes and concepts.

Dr. Ji asked further about what the evaluation process was on the FSP, and why this was taking a year. Dr. Synakowski was not prepared to discuss the process at this time, that there wasn't yet one defined, and indicated the process was taking a year because there was no point launching the program half way and they only wanted to launch it when they could do it properly and meet the necessary scale size.

Dr. Ramon Leeper asked about what the appropriate home was for the IFE, or what the possibilities were for it. Dr. Synakowski responded that from a technical perspective they were perfectly capable of creating space for a working environment where they could deal with classified issues. He thought that there could be a separate office to manage IFE technology and a political concern was if you were managing them, what would the discussions look like on the Hill. He thought there would be constant review by staffers, for example asking questions such as, why did we have to have IFE and MFE (Magnetic Fusion Energy). Why did we have two offices? He noted that that might create problems. He believed a single home had the best prospects for success.

A member asked what would happen if the funding for FY11 was not received let alone the funding for FY12. How would that affect the balance of elements? She also said that as they were an advisory committee it would be good to know what advice would be helpful in dealing with the tough questions and issues around the budget. Dr. Synakowski noted that the priorities were clear. He said if the FES was affected adversely in the budget in FY 11 or FY12 he wasn't prepared to say what area might suffer but they would try to stay with priorities outlined.

It was noted that for FY13 that Dr. Synakowski had provided some information on the technological planning. He was asked if he would be able to expand on longer range plans to help chart a path forward. This longer range plan seemed to be lacking. It was also noted again that there did not seem to be a sense of urgency for development in fusion, given that fusion represents a transformative opportunity. Energy security also represented a good argument for the value of fusion that was not being made.

There was also a comment on the IFE and MFE meetings and National Academy reviews endorsing the importance of keeping those activities together because there was a common bond. Dr. Synakowski said that he agreed regarding the sense of urgency. He also agreed regarding arguments on energy security, however this ran aground on materials issues until they had more credibility. He noted that it might not be as fast as hoped but within the constraints of what is available in terms of budget authority the development of ITER alone was giving an extraordinary lift.

Another member commented that the synergy between IFE and MFE was asymmetric due to the different nature of their charges. Should there be an equivalent study on MFE which could evaluate the credibility of MFE as there is for IFE? Dr. Synakowski agreed that there was merit to this, and noted that the asymmetry had been noted. Dr. Greenwald asked whether recommendations to addressing this imbalance was something that FESAC could assist with, and Dr. Synakowski said this was worth talking about.

Dr. Synakowski was asked to comment on where he saw HEDLP going. He responded that the call was cancelled because the FY11 budget request had no reality and that they would have to assume a continuation of some reduction. The restructuring or reorientation of the program he envisioned taking place through the solicitation and the values would be expressed in the joint solicitation for FY12. If more promising results were seen, then solicitation would follow.

LUNCH

The Advisory Committee recessed for one hour for lunch.

ITER UPDATE: ACCOMPLISHMENTS, STATUS AND DOMESTIC ISSUES

Dr. John Glowienka, *Assistant U.S. ITER Program Manager, Fusion Energy Sciences*

- Advised that he would be providing a high level status report and Mr.Tom Vanek would provide an update on the program on an international level.
- Advised that considerable progress had been made and that it was a significant transition year for the United States as the project was moving from research, development and design to fabrication.
- Confirmed that ITER would continue to incorporate critical input from the industry to ensure that they were constructing the right thing and that it could be maintained. They wanted to avoid previous problems where the EU wanted to build a vacuum vessel and were told that the industry was not capable of building it.

- Advised that an assessment review of the project would take place in April at Oak Ridge hosted by the DOE (Department of Energy), Office of Science and they would review the plans, processes and progress made toward the goal of launching the project.

- Confirmed that the project team was on schedule to complete the preliminary design to enable them to move to Critical Decision 2 for a major project in the United States hopefully by June 2012.

- Described the procurement arrangement and noted that they have five procurement arrangements for 11 of their assigned commitments for ITER. The five were listed. Described what the procurement arrangement entailed and noted it was a clear delineation and agreement of the roles and responsibilities of all the parties involved for meeting a commitment of particular hardware. The agreement stated what would be done and the credit assigned by accountants for completing it. It was confirmed that the five procurement arrangements in place accounted for 60 percent of value of U.S. commitment.

- Advised that for 2011 they continued to work on the design only of the blanket and shield and noted that they hoped to get a procurement arrangement in place for the electric power supply. Confirmed that they did have CD (Critical Decision) 1 which allowed them to do long leap procurement and award the contract for 40 tons of Niobium-tin strand for their 8 percent commitment to supply Toroidal field coil strand for the EU.

- Advised that there were delays and the CD was supposed to have taken place last year but would not be completed by June 2012.

Mr. Tom Vanek, ***Senior Policy Advisor, Office of Fusion Energy Sciences***

- Stated that the ITER project was further complicated by the structure of the seven-member international agreement on the project. He would first discuss the domestic situation and then the international situation.

- Advised that the domestic situation regarding ITER would be discussed first. He noted the request for 2012 was $105 million.

- Advised that there was a strong political consensus to complete the project to a sufficient state to have 'a first plasma' at the end of 2019. The date had important significance as the project was sold to the member governments and the U.S. based on keeping to a cost and schedule. The ITER council revisited the question and had always concluded that the project must be ready for a first plasma date of November 2019.

- Related the difficulties of adhering to that deadline with seven members plus the Congress, and the Office of Management and Budget. In addition financial resources would be required. Noted

that at the time of the CD 1 a profile was published with an earlier deadline. Advised that the funding was shy of the levels that were called for in that profile and noted that this was a consequence of where the administration viewed the project as of March 2010. Stated that the funding level that was there would enable them to proceed with critical components in 2012 but would make the completion date of 2019 challenging.

- Noted that it was incumbent upon policymakers such as Dr. Brinkman and Dr. Synakowski and above to ensure that we could fund the project adequately and appropriately. Discussed the economic situation in the United States with significant budget cuts and an unstable international economic situation that could produce challenges.

- Advised that a strong case for ITER would have to be made. He noted that ITER could be considered the 'silver bullet' for long term energy needs and that ITER was extremely important and the point would have to be made effectively to have success with fusion.

- Confirmed that they needed to make sure that Congress and the administration understood the situation in that it represented the main hopes for humanity in terms of energy.

- Stated that there were six other members besides the U.S. in ITER. One member alone was comprised of 26 individual states. Each member had faced internal challenges. Advised that the ITER council decided on the need for a new management team. Confirmed that the U.S. took management, schedule and cost seriously. Believed that the new team could carry the project forward and hold to the schedule and costs better than the previous team and had noticed a marked improvement in the way things are being done at ITER. Noted the problems of having the project run by committee.

- Noted that the EU's commitment to the project had been raised. Stated that the EU was the biggest contributor and found it had the largest need for additional funds. Identified a shortfall of $1.3 million for the years 2012 and 2013 but this was not affecting their funding profile for 2011. Noted that to stay on schedule the EU would need to come up with additional €1.3 billion but as at the end of 2010 the EU had came up short.

- Confirmed that the U.S. relationship with the other members of ITER was very strong and although the U.S. was a 9 percent member there was significant leadership within the ITER council and in the organization. Acknowledged that although there were challenges the situation had improved over the last 18 months.

COMMITTEE DISCUSSION

Dr. Greenwald remarked on problems that were holding up progress; decentralization and the fragmented procurement model. The second was the lack of staff with domain-specific knowledge that

would be needed to guide the large team of engineers. He asked if they had any comment and how they might evolve over the next few years.

Dr. Glowienka indicated there had been leadership change. He said that Prof. Motojima was replacing non-performers at ITER at every layer of management with people with better skills. Regarding decentralization, he noted 80 percent of the value of the ITER device comes from the domestic agencies. He confirmed that while the ITER organization was the design authority, the source of the materials and the commitments come from the domestic agencies. It was acknowledged that some of the problems were caused by the nature of the project as an international experiment. Mr. Vanek elaborated in some detail on the procurement scheme, which was designed to distribute costs as well as business to the different domestic industries which garnered political support. While there had been some difficulty with procurement, it had increased political buy-in. Dr. Richard Callis commented on the fact that several members of ITER chose for political reasons to support their technology base by taking on tasks they did not have expertise in, and this allowed for political reasons.

Dr. Callis stated that at the previous two international conferences on fusion reactor materials, there had been an accompanying ITER business forum, one in Nice, France and one in Sapporo, Japan. Now that the conference is in the United States he had not heard any announcements of the U.S. sponsoring a similar industrial forum, which he thought most useful for industry to learn about ITER and get involved.

Mr. Vanek noted that the USIPO (United States ITER Project Office) which was acting as our domestic agency has done a number of vendor conferences but that he would ask if they had plans to do more of this. Dr. Callis said these vendor conferences had a narrow scope, but the business forums was broader and encouraged teaming of industries. Dr. Synakowski made comments about the enthusiasm of business leaders he had experienced in a conference at Monaco regarding fusion and long-term energy development.

A response was made to Dr. Callis' first comment regarding the risk of procurement to non performing members, Mr. Vanek confirmed that this was a known risk, and ITER would put out to worldwide tender any work that members did not complete as per their signed commitments, and the non performing members would be responsible for the equivalent value.

Dr. Cohen noted that some U.S. R&D centers had responded to an ITER call for R&D support. He acknowledged that this was small compared to procurements but not to the theory groups were interested in helping ITER. He noted there was a disconnect and misunderstanding of procedure about what the U.S. IPO understood as the ground rules for solicitations to ITER. He stated that the U.S. groups were frozen out due to overhead costs and that this was a result of unclear communication among parties concerning costs applied for in proposals, and indicated that the US ITER organization must do a better job communicating these ground rules. Another member clarified that this was a process problem, that other countries listed costs differently. Dr. Glowienka confirmed there would be other

calls for tasks and that they could be successful. Dr. Glowienka asked the members to let him or Mr. Vanek know if they were hitting a wall with the USIPO with future problems.

Dr. Christopher J. Keane asked them to consider if funding was in place what would be the things that they would consider the highest risk issues in terms of bringing the project home by 2019. Mr. Vanek said the schedule was already compressed with an early finish date. He noted there would always be technical risks. Dr. Glowienka confirmed that the biggest technical risk was the central solenoid conductor which would come from the Japanese. He noted as at November 2010 they did not have a qualified conductor. He noted intense efforts were underway between the USIPO, ITER and the Japanese to determine the path forward and recover.

A question was asked regarding CD2 and the cause of the delay in the U.S. Was this budgetary, technical, or schedule related? Dr. Glowienka confirmed it was not budgetary but they did not have the materials to certify that they had a design that they could work against. He explained that with procurement, there had to be a design that was completed and agreed upon between parties and in many cases that was delayed. A question was asked what sort of process there would be to assess any schedule slippage due to the failure of a non performing member. Dr. Vanek said there was an aggressive attitude toward assessing whether milestones were being met.

Dr. Greenwald noted that within the U.S. communication had been good through the U.S. BPO (Burning Plasma Organization). He felt that overall ITER communication was poor with no communication strategy and he urged the presenters to bring this deficiency up with the new ITER management. He saw that as very important with such a decentralized program. Areas noted were the slow filtering and dissemination of information, strategies, progress and tenders. Dr. Vanek stated rapid improvement had occurred due to new management , and believed further improvement would be seen.

FUSION ENERGY RESEARCH AND DEVELOPMENT IN THE "ITER ERA": A KOREAN PERSPECTIVE

Dr. Synakowski introduced Dr. G.S. Lee, thanked him for coming and indicated he had an interesting vantage point as a national leader within his country, holding a position on ITER, and having experience with success bringing fusion to the forefront of South Korean national energy policy.

Dr. G.S. Lee, President*, National Fusion Research Institute, Korea and Chair, Management Advisory Committee, ITER Council*

Past and Present: KSTAR

- In Korea KSTAR (Korea Superconducting Tokamak Advanced Research) was a purpose and goal driven energy development program.

- Noted that to be successful in the development of that science they had cultivated and encouraged both diversity and creativity.

- Advised that the yearly budget for fusion was slightly shy of $300 million a year and that that this was a big effort for Korea especially relative to larger countries.

- Advised that it is called basic science research in Korea and mostly universities are involved not the national laboratory.

- Commented that when fusion was started as noted by Dr. Synakowski, they were at the University of Texas, Austin together. Confirmed that he came to the United States in 1980 and spent 12 years and returned to Korea in 1991. At that time they proposed a 50-year program to achieve viable fusion.

- Described a slide with diagram showing the history of research with KSTAR in Korea. Noted that for him as a project planner KSTAR was done. Confirmed that now he was working hard to make ITER move forward.

- Detailed the technological goals and targets and achievements of KSTAR starting from 1996 when the Center opened. Described design issues and problems during period of economic downturn in Korea.

- Advised that KSTAR utilized 70 Korean industries, not small companies but companies like Hyundai and Samsung. These industries included IT (information technology), aerospace, nuclear and heavy industry. Noted that from the beginning there was an emphasis on quality in management. Pointed to this corporate involvement as a significant reason for their success.

- Reviewed the status of construction progress with KSTAR in 2010. Explained the science and technology while showing a slide of the site. Subsequent slides illustrated the different constituent systems. Showed the operation phase in 2012 and second-year start 2013.

Present and Future: ITER

- Advised that they also started the Center for Fusion Theory and Simulation and discussed the facility, what they do and how they collaborate with ITER.

- Illustrated a slide of the ITER Facility Design and Construction site. Explained that they had to cultivate good scientists to learn how to operate an machine like ITER, which really had few precedents. Reviewed the construction schedule.

- Advised that KSTAR spent $420 million during the ten-year construction period. Stated that many companies did not make money during the period. Advised that Samsung funded a test facility in the amount of $500 million and Hyundai funded large amounts of the work.

- Acknowledged that Korean industry had a very competitive edge and noted that Korea could compete aggressively with Europe and complete projects ahead of schedule, given their success and experience with KSTAR.

- Confirmed that Korea had 10 procurements and he reviewed their progress regarding those procurements. Advised that except for tritium storage and diagnostic all eight were completed. Confirmed that they have 100 industries that have experience from KSTAR construction.

- Advised that they promised their National Assembly to procure domestically, but believes that segmentation isn't necessarily a bad thing, they had brought in parts of KSTAR from a variety of different countries.

- Confirmed that they have always concentrated on quality first, then schedule, then cost. The least important point was the procurement. Success of the project must not be sacrificed due to a country not wanting to procure internationally to finish a component. The ITER community requires trust, and he believes the attitude is changing. All member states must deliver on their promises, and he urged the committee to stress this point with the U.S. government, it was essential for the success of modern fusion.

- Gave an overview of the various potential points of failure that are difficult, and require massive testing, documentation, and quality assurance. KSTAR documentation was offered to ITER to assist, and while KSTAR wasn't as ambitious as ITER, he sees no reason why the various member states involve can't enjoy similar success if they have the right approach.

- Gave an overview of studies at KSTAR over a long period of time intended to resolve many control issues for ITER, and the various other collaborative efforts intended to prepare for ITER.

- Stressed the value of remote operation capacity using information technology as a way of saving costs and promoting a culture where everyone was working together and felt shared ownership.

- Confirmed the close relationship with his American colleagues in that many of the Koreans working in Korea on the project worked at Oak Ridge. Offered to work jointly with any of the member states of ITER. Emphasized that Korea was very interested in working collaboratively.

- Confirmed that they were beginning the construction of a new $45 million ITER research facility in April 2011, this facility would prepare by emulate running ITER once it was running.

Future: K-DEMO Design and R&D

- Discussed the future in K-DEMO Design and R&D and noted that Korea had the first Fusion Energy Development Promotion Act, 2007. He noted that the National Assembly in Korea was on board with regard to the Act and ITER. There was almost 100 percent support behind them. Detailed the main ideas behind the 2007 Act including tax breaks for R&D. Described the five-year plans in process in Korea for K-DEMO construction.
- Korea is working with the assumption of success, and is working toward abilities to process tritium.
- Discussed the construction of a campus in 2012 or 2013 with a ten-year budget of about $500 million and elaborated in detail on the current planning study for this facility.
- They are already looking at possible sites for a K-DEMO plant.
- In the long term he wants to facilitate KO-US collaboration post-ITER which will align with DEMO R&D.

Epilogue:

- Showed a slide from 1959 of the groundbreaking at the first nuclear research reactor in Seoul. Contrasted this with this with a slide showing in 2009 the Korean Power Company celebrating winning a Nuclear Power Plant contract, this is a company that operates 21 nuclear plants. Noted the remarkable progress both on nuclear, and in general in terms of overall development. With these successes leading up to KSTAR, there is no reason to think fusion success isn't possible, but it requires collaboration.
- Confirmed that that Korea wanted to work and collaborate with people who were dedicated, diverse and creative to build a machine and work with ITER.

COMMITTEE DISCUSSION

Dr. Nermin Uckan thanked him for his inspirational talk and wished him good luck.

Dr. Amanda Hubbard asked how his government was convinced to make fusion such a high priority? Dr. Lee responded that communication was the key and that you had to believe what you professed. He said that for him that the success of the work was ultimately more important than the money for him. The importance of the lifework was the key.

A member of the committee advised some caution in that the United States passed an act in 1980 that put fusion on the map as a law but it lasted two, maybe three years and it was not sustained. He

confirmed that the challenge was to have the commitment to make it work and saluted the efforts made in Korea in putting fusion on the map.

Dr. Lee said that there was a plan at work in Korea, and it was crucial to make a step by step plan which involved meeting and then expanding targets. Lawmakers must be convinced to believe and trust, and this was encouraged by using a specific target line.

Dr. Synakowski thanked Dr. Lee for his presentation and advised that the character of the talk was very welcome at FESAC.

BREAK

The Advisory Committee recessed for a ten minute break.

UPDATE ON FUSION NUCLEAR SCIENCES PATHWAYS ASSESSMENT ACTIVITIES

Dr. Charles Kessel, *Princeton Plasma Physics Laboratory*

- Noted that the motivation was an increasing awareness of the missing half of the fusion research program in the U.S.
- Stated that fusion nuclear science development was necessary to take any step towards fusion energy.
- Stated that ITER had shown how important technology was when mixed with plasma physics. Noted additional steps were needed to fill substantial gaps between ITER and the vision of a DEMO (demonstration) power plant.
- Commented that material science and technology was found to permeate all the areas in fusion energy development and served as a critical first step in FNS (Fusion Nuclear Science).
- Suggested that a broad program in fusion energy science was needed that would begin in basic R&D and lead to fully integrated systems for fusion.
- Noted that the purpose of Fusion Nuclear Science Pathways Assessment activity was to provide the scientific information to FES to enable them to develop the program.
- Advised that FES gave guidance with an aim to continue a process to define the research and material science, nuclear and non-nuclear and infusion nuclear science required for DEMO. This guidance required building on the priorities gaps and opportunities report and the ReNeW (Research Needs Workshop) reports and identifying research to be done so FES could prepare proposals.

- Felt that the center of attention should be on research that's required before a new facility.
- Noted that material science questions are accepted in the Office of Science as the frontier that would join burning plasma physics in establishing fusion's credibility.
- Stated the importance of identifying cross-office and agency synergies and noted that IFE was critical and necessary.
- Noted that he would look into pathways to DEMO and what the gaps benefits risks would be and the implications.
- Advised that the basic parts of the activities fell into three categories, first a detailed DEMO description for rollback, roll forward R&D specifications to begin the next level of detail by describing R&D items to be done over the next five to ten years and examining missions along the pathway to DEMO.
- Advised the need to establish the metrics by which they could show progress toward DEMO and examine steps and understand requirements for steps.
- Detailed the goals of the FNS-PA (Fusion Nuclear Science Pathways Assessment) activity:
    - Identify R&D activities in a series of topical areas.
    - Motivate R&D by rolling back from DEMO.
    - Subject DEMO parameters to critical review.
    - Noted they would be rolling forward from scientific need studies and identify what could be started now.
    - Primary focus is on R&D in the next 10 years, though long term R&D should be evident and lead to DEMO efficiently.
    - Summarized that they were trying to establish what had to be done, why it had to be done, how it was going to get done, facilities in particular and when it needed to be done.
    - Identify synergies with non-fusion and also international and ITER.
- Noted that the FNSPA should supply FES with accurate and clear information on the R&D that would allow them to make good choices, generate initiatives and proposal calls.
- Discussed the detailed DEMO rollback and noted that the U.S. DEMO definition is a power plant and the fact that electricity could be generated reliably and profitably by utilities. Mentioned a

few areas where DEMO could step back from this goal initially, but establish the physics and technology.

- Advised that they would be using a series of ARIES studies looking at various blankets and plasma configurations to establish the rollback parameter set and this was further detailed.
- Described " DCLL (Dual Coolant Lead Lithium) Demo Reference Parameters" table they had established regarding these parameters and went over it in detail.
- Discussed the face to face meetings which were followed by the formation of topical groups made up of core and outside the core of members and this was further described. Reviewed a slide with a description of the topical areas. Noted that the design studies were intended to be an integrating tool. Discussed enabling technologies and elaborated on the list. Discussed safety and environment including cultural issues and R&D areas. Reviewed plasma duration and sustainment and elaborated further.
- Described one of the first topical areas in materials science and technology being run by Rick Kurtz and Brian Wirth and detailed the core and non-core members. Outlined the subtopics in that area and allocations of teams.
- Detailed rough guidance on identifying the R&D and discussed the list in detail. Discussed timeframes, and goal, stated research should reflect path beyond five to 15 years. Described many aspects of the R&D and the processes.
- Detailed a facility list with R&D specification including the parameters for the devices. Noted there was a column for ITER for a comparison.
- Detailed a list for R&D specification concerning inserts and described the technology in detail. Gave an example of a tungsten initiative with more detailed information.
- Discussed enabling technologies which included all critical technologies for a successful device. Gave several examples of areas in this list and researchers involved.
- Reviewed the process of how to establish the most efficient step(s) or pathway from ITER to DEMO or missions. Noted that it was a complicated problem which they were currently working through. Noted the philosophy was his and outlined a thought process and understood the tradeoffs. Discussed these issues in greater detail including a list of metrics for measuring steps.
- Detailed his schedule, topical areas and groups formed by mid March, group work done by early June. Reports would be done by early June. Final reports would be written in June and July.

COMMITTEE DISCUSSION

Dr. Kathryn McCarthy suggested to Dr. Kessel that when the project was in the review stage that they use someone who has been involved in similar work, for instance on fission, as it was noted that the group of core people was mostly comprised of advisory committee members.

Dr. Greenwald made a comment about them getting into the work with greater specificity, and Dr. Kessel was asked to describe the granularity at which he was addressing the issues and the plan. He responded that each of the topical areas would be broken into subtopics and within the topics similar things would be seen such as establishing properties of a material in an environment, so real R&D items, specified in lists and scheduled.

Dr. Uckan raised the point of the lack of transparency in that there was no access to ITER documents unless a researcher was directly involved in a specific group. He responded that this was the case. He also noted that the material on the public presentations was not available. Dr. Greenwald said that lack of access to meetings should be reconsidered.

The issue of priorities was raised, was some prioritization for specific areas from his exhaustive list. Dr. Kessel responded yes, first was that there was a time sequence which would impose prioritization, and that they would leave it to subgroups to prioritize. A member suggested that they should reconsider "punting" on balance of plant, as this had a big impact on attractiveness.

Dr. Ji asked for more specificity on international collaboration. He responded this was difficult. They would know the parameters of overseas facilities and would be aware of groups of researchers but other than that it might present some difficulties.

Dr. Synakowski underscored that the most essential thing was to have enough information to craft solicitations, and the range of needs was so varied that if any traction was found there wouldn't be any issue hitting targets. There's less need for strategy and more just technical clarification on needs.

The need for more transparency with meetings was echoed by Dr. Hubbard, who went on to ask about the "plasma duration sustainability" group. Would they be coming up with a list of needs for this group? Is this something tackled with the new management structure at the FES? Dr. Synakowski said that this is precisely what the one element of the new organizational structure was meant to address.

PUBLIC COMMENT

Dr. Greenwald noted that they would now move on to public comment. There were three, Mr. Glenn Warden, Mr. Mike Mull and Dr. Adil Hassam.

Mr. Glenn Warden

- Stated that he had an objection in regard to the HEDLP proposed changes for the FY12 budget and an objection to a sentence on Page 220 of the FY2012 budget submissions which described magnetized HEDLP being "significantly redirected and re-sized toward basic science".
- He believes the intention is to draw these funds and use them for warm dense matter research and develop user communities at ARRA-funded efforts (American Recovery and Reinvestment Act). He believes this would be a programmatic rather than scientific decision.
- He believes there has been no community input in this decision, and that it would go against FESAC recommendations. It would also require projects which are underway, particularly PLX at Los Alamos, to resubmit, even though they have already been peer reviewed. This action would dissuade research in areas that FESAC has considered a priority.
- All three approaches for creating access to extreme states of matter should be explored.

Dr. Synakowski responded as the comments were directed to him. He confirmed that the intention was not to eliminate the area of research but to re-direct it and resize it. He agreed that there should be a lot of caution when evaluating how guidance was put out, when it would have an impact on upcoming activities. That said, in their particular solicitation, it's reasonable and responsible for them to recast programs due to budget pressure, otherwise they can't move.

Mr. Warden said that they already had a broad program on warm dense matter, and if the activity needed to be broadened, the budget should draw from all sources, not from one.

Dr. Mike Mauel

- Prefaced that he was speaking from a personal perspective, not as a representative of any group. Stated he would discuss discovery research in magnetic fusion energy.
- Noted his interest was not in discovery science that allowed us to have understanding and validation of what was already being done. Stated that he was talking about research that made discoveries, changes or improvements to what we do that makes fusion better.
- Discovery research is vital to science, and cannot be managed like technological development, and had to be promoted with patience.
- Examples were given of many discoveries, each was a game changing idea, and many came from smaller studies. Looking forward to ITER, we need to maintain commitment to discovery research in discovery science.

- The recent decision by FES to focus on tokamaks and stellarators has had a negative impact reducing the number of university based plasma experiments, reducing intellectual vitality, and alienating researchers by shutting down productive experiments.

- Spoke from his experience at Columbia on the LDX (Levitated Dipole Experiment) in conjunction with MIT which was shut down. He pointed out the nature of this experiment, as well as the discoveries it had produced, which were mirrored and verified in Tokyo, where they had a record steady state confinement of magnetic fields.

- Argued that this LDX research would assist with ITER, and had expanded understanding of the science, but next step experiments was not supported, and he believes it was due to the refocusing on accelerators and tokamaks.

- These shut downs are a discouraging message to the community.

- Called for a reinvigoration of discovery research, and that the alternate confinement research program be focused on experiments that seek deep understanding of phenomena, and game changing discoveries, this would include tokamaks and stellarators, but not exclusively.

- Called for an open dialogue with the university to promote research and to widen participation across the spectrum of research.

Regarding this presentation a comment was made agreeing that there should be a way to engage smaller universities in ITER and other big machine-dominated research, to have greater participation in the whole scientific community. This was a difficult and unresolved issue. Dr. Mull said that experimental plasma research was an important high profile part of research that was crucial to universities to point at to stake their involvement in a fusion program.

Dr. Adil Hassam

- Stated that he would discuss his view that small intermediate-scale experiments at universities were needed elements in a vibrant fusion energy sciences program.

- Used the Maryland Centrifugal Experiment as an example with his talk.

- Described the experiment and gave a technological overview, and discussed how they had achieved their goals.

- Stated that the physics researched are cross-cutting into other areas.

- Graduate students are motivated by science which has a basis in fusion energy, they are excited about being part of a cause, and this focuses their efforts. This leads to new physics and applied physics.

- Small and intermediate experiments are cost-effective, and even though diagnostics may be basic, the fact that many small scale experiments are novel means they are still very productive.
- Local experiments contribute to the long-term sustainability of plasma physics as an academic discipline by increasing visibility, and passing on the knowledge base to younger scientists.

Dr. Greenwald confirmed that he agreed with many of these ideas particularly the ability of small experiments to contribute to theory and modeling. Dr. Dale M. Meade felt that universities were incubators of ideas of the next generation. He acknowledged special attention should be given and it was a good place to try to innovate. He agreed with the importance of experiments for the sake of students and gaining support at departmental level. He also said that large offsite research at a major facility was the next best thing if budget constraints meant research was cut at universities, as they do with high energy physics. Infrastructure issues are as important as the innovation side of things.

Dr. Hassam echoed Dr. Meade's thoughts on the importance of stability in attracting students, but said he didn't believe the high energy physics offsite model would work given that these are smaller experiments.

Dr. Synakowski reiterated the difficulty of shutting down these valuable experiments for tactical reasons, but did not want to comment on the specifics of the experiments that were raised. He called on people to remember the priorities that have been focused on in the past, and believes with these priorities in mind they are well structured for these small to medium scale university experiments. He believes that change was required, and as the change was instituted, many opportunities for research experiments have arisen with opportunities for growth.

Dr. Hubbard said she was struck by how results from these smaller university experiments applied to other areas, and wondered whether there was an opportunity to redirect this research. Dr. Hassam worried that some of these redirections might draw them into verification activities rather than discovery science.

A member stated that some of the ramifications of these cuts could be seen in prospective students asking about the viability of programs. If new programs were being planned which strengthened these partnerships, there should be urgency in the leadership in developing these programs. Dr. Synakowski again pointed to the reorganization efforts which were motivated in part by the need to involve universities in a systematic way, and ought to help, even though they were in a difficult transition period.

Dr. Ji again pointed to using a way to stretch funds by having collaborations and killing two birds with one stone. He believes funds could be used more efficiently.

ADJOURNMENT

The Fusion Energy Sciences Advisory Committee adjourned for the day at 5:15 p.m. The committee will reconvene tomorrow March 8, 2011 at 9:00 a.m.

TUESDAY, MARCH 8, 2011

BRIEFING ON THE RESULTS FROM THE WORKSHOP ON OPPORTUNITIES IN PLASMA ASTROPHYSICS

Dr. Stewart Prager, *PPPL Laboratory Director, Princeton University*

- Stated that he, Dr. Ji and Dr. Hui Li were presenting the results of a study and a report titled "Research Opportunities in Plasma Astrophysics".
- Noted that the results are from the workshop and the report was being given on behalf of the community of researchers that participated in the study.
- Advised that Dr. Ji was an experimental plasma physicist and Dr. Li from Los Alamos was a theoretical astrophysicist. Advised the presentation would be split between them.
    - He would give some background and motivation for the study and workshop.
    - Dr. Li and Dr. Ji would present and synopsize the substance of the report.
    - One area of the report was the identification of 10 major questions in plasma astrophysics and Dr. Li would describe those.
    - The bulk of the work was focused on 10 plasma topics or plasma processes that underlay astrophysical phenomena presented by Dr. Ji, the opportunities and a summary.
- Reviewed slides showing illustrations of plasma pervading the universe at all spatial scales from solar wind to plasma jets.
- Noted that plasma astrophysics is a diverse field in terms of practice, comprised of theory and computation and involves observations from both the magnetosphere observation to cosmological scales.
- Plasma astrophysics consists of laboratory experiments including magnetized basic plasma experiments, high energy density experiments, liquid metal experiments and aspects of fusion experiments

- Gave pictorial examples of the diversity of plasma astrophysics and noted different examples of experiments. Described numerical simulations.
- Defined plasma astrophysics as any plasma physics that is important beyond the earth's atmosphere.
- Described observations, several being the aurora in the earth's atmosphere to the solar flares, pulsar winds and extra-galactic jets.
- Noted that it was good time for plasma astrophysics, and it was enjoying growth, because of the maturity of the field thanks in large part to fusion. Stated there was enormous progress to be made thanks to applicable diagnostics and techniques from fusion. There is a surge in remote sensing data.
- Noted it was a diverse field in its practice and the full realization of the opportunities of plasma astrophysics would require a coordinated effort among all practitioners.
- Noted that sometimes the different communities working with various aspects of the field did not get together, were funded by divergent groups, and this did not reflect the unity of the field. Astrophysics was supported by NASA (National Aeronautics and Space Administration) due to relevance to missions, support from DOE because of fusion relevance, and some NSF support but had no clear funding home.
- A workshop was organized to identify the challenges and opportunities in the field by coordinating all the diverse experts.
    - Involved greater than 100 scientists in the preparation and participation.
    - This review was similar to what ReNeW was for fusion. Unlike ReNeW however, this was grassroots driven not funded by an agency.
    - It was a study of six to nine months with 10 topical working groups that brought forward the challenges and opportunities in 10 different topics. The workshop and study was organized according to basic plasma processes.
    - Provided a list of the topics covered and researchers. Presented information on the diverse membership within each working group.
    - Noted that plasma astrophysics had impact in three areas beyond solving direct astrophysical problems: fusion in terms of the people who practiced it and also topics including overlap with MFE and IFE, observational missions and basic plasma physics.
    - Noted that the workshop had the support and endorsement of all relevant funding agencies.

- Described the workshop outcome report. At the end of the workshop the working group leaders extracted 10 major questions in astrophysics that one would need plasma physics to answer.
- The workshop listed 32 opportunities on the questions raised.

Dr. Hui Le, *Princeton University*

- Noted that there were 10 problems listed. Planned to concentrate on six or seven. All were illustrated by slides and described in detail:
  - How magnetic explosions work, for instance in solar flares. How are particles accelerated during reconnection process?
  - How cosmic rays accelerate to ultrahigh energies, is this due to shock, reconnection, how do they propagate?
  - How are magnetic fields generated in stars, galaxies and clusters? What is the dynamic process where flow kinetic.thermal energy is converted to magnetic energy?
  - What powers the most luminous sources in the universe?
  - How are star and planet formation impacted by plasma dynamics? How do dusty plasmas behave in planet creation?
  - How are jets launched and collimated?
  - Do magnetic fields affect cosmological structure formation?

Dr. Ji, *Co-Chair, Committee on Opportunities in Plasma Astrophysics, Princeton Plasma Physics Laboratory*

- Noted that he would discuss the processes to answer all the previous questions. Decided to concentrate on six. For each he discussed what it was, why it was important, the challenge and the relevance to fusion.
  - Discussed magnetic reconnection, a fundamental process to rapidly release magnetic energy through topological rearrangements.
  - Discussed collisionless shocks and particle acceleration.
  - Talked about waves and turbulence.

  - Discussed dusty plasma.
  - Talked about radiative hydrodynamics.
  - Discussed relativistic pair-dominated strongly magnetized plasmas.

- Remarked on how studying plasma astrophysics can benefit fusion plasma physics, and common ground in techniques, experiments, and theory.
- Discussed the major opportunities born out of the workgroup project:
  - These included multi-island reconnection and particle acceleration, shock acceleration of cosmic rays, turbulence initiative, plasma physics under extreme conditions, and a jet initiative.
  - All of these opportunities were of a magnitude greater than single principal investigator projects.
  - Noted there were three or four within each group and 32 in total.
- Relayed the recommendations of the group, which was that the plasma astrophysics program be strengthened in structure and coordination across DOE, NSF and NASA.
  - This would aid the missions of these agencies.
  - This would provide motivation and justification for deeper consideration of the funding strategy.

Dr. Greenwald remarked how intriguing and important the workgroup was, and how necessary it was for fusion and plasma researchers to reach out to each other, and to reach out to other fields. Dr. Leeper noted that the research would attract top talent into all of the related fields and that the report was impressive.

Dr. Ji was asked if he planned to brief NNSA (National Nuclear Security Administration) in addition to FESAC and raised questions about the funding profiles, and diagnostic requirements. Dr. Ji responded that yes, NNSA and NSA . (National Science Administration) will be briefed. He confirmed that funding included everything, diagnostics and computation etc.

Dr. Leeper asked about multiplexing, having several astrophysics experiments working from the same source. He agreed, and said there was some overlap between the groups.

He was asked if they had considered the relevance and leverage in more industrial plasmas other applications such as low temperature plasmas or processing plasmas. It was noted there was no specific emphasis on this. Another member remarked that while there wasn't this emphasis, several experiments had industrial plasma application. Dr. Ji said this was a useful thing to look into.

Dr. Synakowski pointed out that they have heard of this workshop previously, and there was a lot of interest, and the workshop would help make the budget argument.

BRIEFING ON PORTFOLIO ANALYSIS AND MANAGEMENT SYSTEM (PAMS)

Dr. Synakowski pointed out that there had been recurrent issues with unification of approaches to file management and procurement, and the Office of Science was now addressing this with the PAM (Portfolio Analysis and Management System).

Linda Blevins, ***Office of Science, Office of the Deputy Director for Science Programs***

She thanked the FESAC committee for inviting her to speak.

- Explained that the motivation and the reason that she was speaking was provided by the advisory committees coming in every three years for programs and reviewing files. The most recent FESAC COV (Committee of Visitors) report just issued had a number of recommendations. It recommended a better internal data system and a requirement to collect certain types of data including demographic data. Noted that the PAMS (Portfolio Analysis and Management System) project had been going on for a while. She thanked the contributors to the project.

- Her role was as an integrator of information. Collected input from the six science programs on business practices and the Office of Workforce Development for teachers and scientists.

- Her role was to harmonize practices across the programs. Noted that she was joined by Mr. Keith Tucker, the project manager for the PAMS project.

- Explained the business process using a flow chart which tracked who was involved, different phases of the process from solicitation to proposal to awards, and how this was to change after the PAMS project.

- Noted with the increased proposals coming in that it was prohibitive to do proposals manually from emails. This would be done via PAMS and decisions issued by PAMS.

- Through PAMs all of the information concerning a proposal would be centralized and web accessible, from proposal to close out. Proposals and reviews would now all be communicated through the same system, and the intention was to capture the capabilities of PeerNet.

- Declinations will also now all be dealt with via PAMS to automate the process and reduce workload on staff.

- Technical negotiations on budget and scopes will also be dealt with via PAMS, awards will also be documented in PAMS.

- Noted that labs would have the information available to them for viewing in PAMS.
- PAMS will also allow them to compile better information about all the proposals that come in, some of which may be made available for use.

Mr. Keith Tucker, *Office of Science, Office of Business Policy and Operations*

- Discussed PAMS and noted that it was built on a government off-the-shelf existing system. It was developed for another federal agency originally. Noted it would be modified as required by the Office of Science. Listed the other offices using the program currently, including NASA, and the Department of Justice.
- Noted it supported the grants management process from beginning to end, unlike current systems, and consolidate and integrate with existing systems.
- Stated that it employed a service-oriented design and was already integrated with other systems like grants.gov. Some older systems would still be used such as STRIPES (Strategic Integrated Procurement Enterprise System) on grants. PAMS would interface with these other systems.
- Advised that older systems with outdated technology would be replaced, but they wouldn't duplicate functionality of well-functioning systems.
- Wanted to improve the data management, collect better demographics.
- Reviewed the project's iterative methodology. They conducted a gap analysis. They will test, train, and deploy as they migrate to the new system.
- Noted that data could be migrated for use in the new system.
- Reviewed the current status on the project and said they estimated it would take two to three years to get the full functionality deployed.

COMMITTEE DISCUSSION

A member asked whether the modification of the system was being contracted out, and it was confirmed it was, and was being sustained through the next few years. Ms. Blevins clarified that there wasn't a three year wait for any functionality but that as and when different iterations were ready they would proceed, some things would be available soon.

A member commented that they were happy to see flexibility as a project goal, as they had had bad experiences with off-the-shelf systems that were repurposed for other usage. Dr. Hubbard asked whether the system would have enough flexibility, to be able to not send out an automated letter in

smaller competitions for grants, or when funding ran out, due to the sensitivity of the matter. Ms. Blevins said that these would be fully editable on their discretion.

Dr. Hubbard asked whether they would be able to track performance, including publication and citation of early career researchers through and after the length of a project. Ms. Blevins said that all agencies would be moving to a common reporting format, and this could include this information, and they could track this during an award. After the award tracking would be considered to be out of scope.

BREAK

The Advisory Committee recessed for a ten minute break.

BRIEFING ON THE NATIONAL ACADEMY OF SCIENCES STUDY ON INERTIAL FUSION ENERGY FOR ENERGY (PROCESS-RELATED ITEMS ONLY)

Prof. Ronald Davidson, ***Chair, NRC IFE Panel; Princeton Plasma Physics Laboratory***

- Updated FESAC on the NRC (National Research Council) assessment of inertial fusion energy.
- Noted that their committee was new and in the process of collecting information so he would comment on process, but could not report on findings and recommendations.
- Reviewed concepts and technical challenges for inertial fusion energy including the choice of driver, ignition scenario, chamber technologies and implementation.
- Described the committee structure noting that there was a main committee and a target physics panel. Outlined the responsibilities of each group. Added that they had 22 technical experts from many of the critical science and sub fields on the committee.
- Envisioned a study that would range between 18 and 21 months.
- Provided parameters to the target physics panel. Described the target physics panel and their schedule.
- Noted that that they had acquired the right balance of technical expertise to cover the various areas of expertise for the main committee. Listed the names of the membership of the main committee and the target physics panel.
- Noted the committee's statement of task, which is to prepare a report that assesses the prospect for generating power using Inertial Confinement Fusion, identifies the scientific and

engineering challenges to develop a demonstration plant, and advises on the preparation of an R&D roadmap for the conceptual design of a demonstration plant.

- Noted that they were asked to prepare an interim report that would impact programs decisions for FY2013.
- The target Physics Panel main charge is to assess the current performance of various fusion target technologies, and describe R&D challenges to providing suitable targets on the basis of parameters established by the committee.
- Reviewed the NRC inertial fusion energy assessment. Started with the scope of activities of the main committee. This would include identifying what current facilities exist and what would need to be developed, as well as developing roadmaps for promising concepts, with success criteria. Detailed the processes to be used.
- Advised on the present status. Noted that two full meetings had been completed. Needed one or two more fact-finding meetings before preparing an interim report.
- Presented the timetable for the remainder of the study, culminating in the final report to the department of energy in June 2012.

COMMITTEE DISCUSSION

Dr. Cohen noted that the review was on science and technology issues associated with IFE but to pursue it in a serious manner require addressing the 'elephant in the room' was that the NSA controls a lot of the facilities but had no energy mission and conversly FES has an energy and a science mission but limited resources. He noted that it would be hard to imagine the NAS taking on both MFE and IFE on their budget.

Prof. Davidson noted that it was an area of interest to the community and it was clear that the DOE would have to deal with this if it was seen as a program worthy of an energy mission. He agreed with Dr. Cohen's characterization of the NSA/FES facilities dilemma, but this would be the DOE's issue to deal with.

Dr. Meade asked a question about the wording of the statement of task, and wondered whether it would be more accurate to specify they were looking for commercial power. He also asked about built in assumptions to the study, and how they viewed the NIF (National Ignition Facility) objectives and whether they will be achieved. Prof. Davidson said that they did not assume success at the NIF, however they were aware of the excitement in the community about high gain at the NIF.

Dr. Meade wanted attention paid to the nomenclature used for fusion energy such that it would translate to different nomenclature in IFE and MFE, and not muddy the waters. Dr. Meade also

wondered whether the MFE community had an equivalent sort of study, but this discussion was tabled until later.

Dr. Hubbard wondered what number of those in the committee were in the community and thus advocates, and how many were skeptics. Prof. Davidson wouldn't put a number on it, and said that he thought people on both sides of the issue would believe the committee biased in two different directions, and perhaps this spoke to its fairness, but his own opinion was they had the right people on the committee with a well balanced breadth of knowledge and background.

DISCUSSION OF THE NEW CHARGE: POLICIES AND PRACTICES FOR DISSEMINATING RESEARCH RESULTS

- Dr. Greenwald opened discussion on how one would balance the public's access to the research results that they pay for compared to issues of copyright, intellectual property and the scientific process. He confirmed that they were not being asked to make policy but to carry out an assessment in their own field of what is currently done and why.
- Noted this question was broad in its reach and included both written documentation and also digital data.
- Advised that Dr. Cohen had agreed to Chair the committee and he had agreed. Advised that they would like a balanced committee from different areas in the field and institutions.
- Noted that Dr. Synakowski would comment and then Dr. Cohen would say a few words.

Dr. Ed Synakowski/FESAC Members

Introduced Laura Bevin and asked her to provide some background on the charge and how the Office of Science viewed the activity. Noted she was in the headquarters of the Office of Science.

***Laura Biven, Office of Science, Office* of the Deputy Director for Science Programs**

- Noted that she would be reviewing the slides that Dr. Brinkman had intended to present on March 7.
- Noted that this discussion had been ongoing but the most recent impetus for the charge was the America COMPETES Reauthorization Act of 2010. (America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science)
- The Act called for the following:

  - The National Science and Technology Council to establish a working group on public access that would look at the dissemination and long-term stewardship of the results of federally-funded research.
  - The working group to provide them with input on discussions.

- Noted that with regard to the charge they were asking three things.
  - Describe what your current practices and policies are.
  - Identify what was working, which policies were sustainable for their field and worked well.
  - Identifying opportunities where they might increase public access.
  - Asked for a report to be finalized July 1

COMMITTEE DISCUSSION

A question about the preservation of digital data was raised. How important was the issue? Ms. Biven noted that it was important but for the purposes of the charge they wanted to know about the public access aspect. She noted that they could include the preservation component in their current practices. The Office would find that interesting.

Dr. Cohen asked about some implications to the COMPETES act which were not mentioned such as intellectual property issues, patent issues and the cost of access not mentioned but should be of concern. He also noted the potential for abuse by the public for access to data. He asked for comment on some of these issues.

Ms. Biven responded that the intention was not to interpret policy but rather just called for the establishment of the working group and they asked that they respond to those issues. With regard to legal issues they were interested insofar as they affect public access. Regarding issues with public access leading to spurious inference from data, she said they would want to know about situations where it was cost prohibitive to make data accessible and sensible.

Dr. Cohen asked about the process to constitute the members of the panel to do the report. Dr. Greenwald responded that the FESAC Chair and the panel chair work together to come up with a list, which is then run by OFES. The panel would have to be relatively small to finish the report in the allowed time.

***Dr. Martin Greenwald, FESAC Chair*, Massachusetts Institute of Technology**

- Noted several things he wanted to discuss. Talked on March 7 about a letter asking for a study on MFE prospects that would complement the IFE study. Drafted a short letter but asked about two issues. One is should they send a letter to Dr. Brinkman and if so, what would it say?

- Discussed the letter that would be sent to Dr. Brinkman and reviewed the main points, it praised the important and timely NRC study on prospects for inertial fusion energy, but noted the perceived asymmetry regarding challenges and opportunities relevant to magnetic fusion energy, and recommended initiation of a similar study on magnetic confinement fusion activities. Was this letter appropriate?

COMMITTEE DISCUSSION

Mr. Opdenaker expressed that it was not appropriate to send such a letter to Dr. Brinkman due to FACA (Federal Advisory Committee Act) rules. A response was given that they did on occasion send letters subsequent to committee discussion on specific topics.

A suggestion was made to remove "recommend" from the letter and use "like to see" or "it would be appropriate" something in that vein. Dr. Synakowski noted that there were various ways it could come forward not necessarily with a letter, and that they could just speak with Dr. Brinkman. Dr. Greenwald said a letter was the only way they could officially speak as a committee. Dr. Synakowski echoed Mr. Opdenaker's concerns and stated they should be mindful of precedent on unsolicited recommendations, but he wasn't sure if it was inappropriate or not.

Dr. Ji said that this would be a good time for a study, not just for symmetry, but that in an international context, many countries were looking at what they were going to do after ITER, so it made sense. Professor Raymond J. Fonck was agnostic on the mechanism for delivering the recommendation, but was in support of this sort of study. Dr. Meade echoed this support and wanted both sides to be investigated on a uniform basis.

Several committee members supported the main idea in principle and the ideas behind the letter. Other members of the committee were not comfortable with aspects of the letter in its current form. Dr. Synakowski didn't find it useful to frame MFE in opposition to IFE, as this reinforced a divide in the community which was not helpful. He believed they should elevate themselves above this, MFE should stand alone, it should not seem motivated by balance or opposition. Also he reminded the committee that the audience of the letter may well feel that they have done much to support MFE. Dr. Zinkle later supported this and wondered what the event was that was motivating this, and could they make this argument, so it didn't just appear as a "me too".

Dr. Greenwald agreed after other comments that they would review the wording carefully before the final form, but they wanted to focus on the value of the letter first, and whether they should send it, before the actual content.

Dr. Greenwald clarified that there had been a change in direction over the last decade, and the new administration was taking energy more seriously. Since then they haven't responded as a community to the opportunity, and they aren't at the table in the new energy discussions taking place, and this was a motivating force in terms of timing. Dr. Ji said that the primary reason for the argument should be focused on creating a roadmap for MFE, and the secondary argument should have softer language and indicate it is support and complement the IFE study.

Dr. Meade agreed that this was a opportune time, and he found it discomforting that there was no roadmap leading toward energy available for persuasive argument, especially when the administration had made comments that required refuting on magnetic fusion. In a way this was strange because ITER was a very concrete goal they were moving toward that imposed a roadblock, but they did not speak in those terms, and no independent group was evaluating the issues.

Dr. Syankowski expressed concern with the idea of asking the NRC to develop their strategic plan. There would be ways of framing questions more appropriately to their role, but an advisory body shouldn't construct such a plan. Dr. Greenwald isn't interested in who makes the study, they aren't encouraging that it be done by the NRC necessarily. Another member echoed the concern that they need to have a roadmap in place themselves before proceeding.

Dr. Hubbard asked Dr. Syankowski what the current OFES strategic plan was, given this was their purpose. This strategic plan is to develop a pathway in a way that ReNeW could not, but this had been delayed by other work.

Professor Fonck said that there was a tremendous value in having an independent body agree what issues need to be addressed to have a credible case for fusion. This wasn't a plan, it was the necessary precursor to making a plan to address these issues. He also believes that there is appropriate timing, as ITER has been described as the penultimate step to fusion, and this would define everything else that has to be done, and this would take time, so discussions ought to start now to properly motivate progress. Dr. Ji indicated that this sort of study would mitigate any potential budget issues with ITER.

Dr. Greenwald responded to Dr. Syankowski's practical procedural questions about what had to be done by when concerning the letter, and said they could agree on a resolution which Dr. Syankowski would communicate, or agree on the substance of the letter and subsequently finish the wordsmithing.

The idea was raised of creating a sub-committee of FESAC to draft a letter or statement that would then come to the public discussion at the next FESAC meeting, if they had the next meeting in a timely manner. That would provide time to take issues into account. Other members suggested that it was not possible to create a subcommittee, certainly not immediately, but it would be an agenda item on the next meeting, and the minutes would reflect that this was a topic of significance that was under discussion.

Discussion now turned to the subject of scheduling meetings. This had to do with the timing of the next meeting including the frequency of meetings and possible charges.

- They did not want to meet when it was not necessary however they had noted the decrease in the frequency of the meetings.
- Noted that the current meeting was the first meeting they had had in a year. Other advisory committees typically met three times a year. The last fusion-specific charge was three years ago in February 2008.
- Noted five areas that he thought needed more attention.
    - Charges and Meetings
    - Assessment of the role of university research
    - Evaluation of the fusion nuclear science planning activity
    - Assessment of the role of international collaboration
    - Opportunities and the priorities of the basic plasma sciences area

Dr. Syankowski stated that while he understood the sentiment, and was broadly supportive of a number of the issues raised, it would be inappropriate for the office to deploy charges at this time and they were not currently ready to ask some of these questions. The office will only engage the community when they are ready to receive the advice. He felt that fusion nuclear science planning activity seemed of high importance. He felt the basic plasma science question brought to mind the value of working engaging beyond FES with other agencies.

Dr. Ji asked for a timeframe for the next meeting. There is a charge due in July and this normally prompted a meeting before that. They were planning for at the least a single days meeting around that time.

ADJOURNMENT

The Fusion Energy Sciences Advisory Committee Meeting adjourned for the day at 12:00 p.m.

Respectfully Submitted

March 28, 2011

Reviewed by FESAC members, speakers, and the DFO
and certified as correct by Dr. Martin Greenwald, FESAC Chair - April 15, 2011

FUSION ENERGY SCIENCES ADVISORY COMMITTEE
2010-2011

Signed by Martin Greenwald, Chair of the Fusion Energy Sciences Advisory Committee on April 16, 2011

Martin Greenwald