American Nuclear Society
Fusion Energy Division
June 2013 Newsletter

Letter from the Chair, Minami Yoda, Georgia Institute of Technology, Atlanta, GA.

On behalf of the Division, it is my pleasure to welcome the newly elected members of the FED Executive Committee: Jean-Paul Allain (Purdue University), Kevin Kramer (Lawrence Livermore National Laboratory), and Kelsey Tresemer (Princeton Plasma Physics Laboratory). Many thanks to our outgoing Executive Committee members Paul Humrickhouse (Idaho National Laboratory), Keith Rule (PPPL), and Mark Tillack (University of California San Diego) for their service over the last three years. There are about 950 members of the Division as of April 2013, or about 8% of the total membership of ANS. These levels are comparable to last year. The three largest groups are student members (40%), members from the national labs (12%), and members from educational institutions (11%).

On an encouraging note, President Obama's FY14 budget proposes to increase the funding for fusion energy science by $50 million to a total of $458 million, including $225M to support ITER and ~5% increase for the D-IIID and NSTX experimental facilities. Unfortunately, the budget also proposes to reduce the domestic fusion research program by ~20%, or ~$60M, from FY13, including shutting down Alcator C-Mod, despite numerous efforts to avert this outcome. This is of course the President's budget proposal, and given the current budgetary struggles in Washington, it is unclear whether this funding level will be approved by Congress. Nevertheless, the request illustrates the importance of fusion energy for our future energy needs and the American commitment to ITER.

The Fusion Energy Sciences Advisory Committee (FESAC) submitted a report within a remarkably short time that assesses and prioritizes major domestic fusion research facilities (NSTX-U, D-IIID and its upgrades, the Fusion Material Irradiation Facility, the Fusion Nuclear Sciences Facility, the Multi-Petawatt Science Facility, and the Quasi-Symmetric Stellarator Experiment, but specifically excluding ITER) over the next decade (see Greenwald's article below). FESAC has also sent a letter urging the DOE Office of Science to develop a strategic plan as soon as possible for the American fusion research program. Having a strategic plan would be valuable in view of the budgetary challenges in balancing resources between ITER and the domestic fusion program, and the recent changes in the DOE and Office of Science leadership.

On the magnetic fusion front, ITER continues to make progress, with €300 million in contracts awarded recently for the construction of the tokamak complex, which contains the tokamak, diagnostic and tritium buildings. On the inertial fusion side, recent reports by both the National Academies and the National Nuclear Security Administration support the central role of the National Ignition Facility (NIF) in assessing the feasibility of inertial fusion energy over the next three years (see Kulcinski's article below).

Finally, some updates on fusion conferences: the FED is sponsoring several international meetings this year, including ICENES-2013 in Madrid, Spain, IFSA-2013 in Nara, Japan, and TRITIUM-2013 in Nice, France. Regarding the 21st Topical Meeting on the Technology of Fusion Energy (TOFE), the major meeting of our ANS Fusion Energy

Division, Brian Wirth (University of Tennessee/ORNL) has graciously agreed to serve as the General Chair, supported by Vincent Chan (General Atomics) and Rajesh Maingi (PPPL) as the Technical Program Chairs, and Jacob Leachman (Washington State University) and Lee Cadwallader (INL) as the Publication Committee Chairs. TOFE-21 will be embedded in the American Nuclear Society Winter Meeting on November 9-13, 2014 in Anaheim, California. Please mark your calendars!

New ANS "Fusion" Fellows – June 2013, Nermin A. Uckan, FS&T Editor, Oak Ridge National Laboratory, Oak Ridge, TN.

The election to the rank of Fellow within the ANS recognizes the contributions that individuals have made to the advancement of nuclear science and technology through the years. Selection comes as a result of nomination by peers, careful review by the Honors and Awards Committee, and election by the Society's Board of Directors. The list of current fellows, nomination steps, guidelines, and nomination forms can be found at http://www.ans.org/honors/va-fellow.

It is a pleasure to report that we have a new ANS "Fusion" Fellow added to the honors rank: Dr. Mark Tillack (University of California-San Diego). Congratulations, indeed for a well-deserved honor.

Mark Tillack, ANS member for 12 years, will be recognized as a Fellow of the American Nuclear Society during the ANS Annual Meeting, held in Atlanta, GA, June 16-20, 2013. Mark Tillack is Research Scientist and Lecturer at the University of California-San Diego (UCSD). In addition to research and teaching in the fields of high heat flux systems, power plant engineering, liquid metal MHD, and laser plasma interactions, Dr. Tillack also serves as the Associate Director of UCSD Center for Energy Research. He is currently pursuing research on laser-matter interactions and applications of high energy pulsed lasers as well as magnetic and inertial fusion energy technology.

Mark Tillack earned the highest grade of ANS membership "for his pioneering contributions in the field of fusion nuclear technology, including his research contributions and leadership activities in fusion nuclear technology R&D in both magnetic and inertial fusion energy."

Dr. Tillack is also a Fellow of IEEE (2012) and the recipient of the ANS-FED Technical Accomplishment Award (2008).

FED has two dozen or so Fellows and the FED Officers/Executive Committee have been encouraging all FED members to actively engage in nominating deserving colleagues to the fellowship grade. During the past couple of years, FED members have been working diligently to add one-to-two well-deserving colleagues a year to the FED Fellows roster. We need to continue this positive trend and keep nominating our colleagues. Please remember that one cannot get recognized and elevated to Fellow status, unless nominated. The FED "red-team" Fellows will be happy to provide guidance and help review nomination packages. Feel free to contact uckanna@ornl.gov for questions.

List of Officers and Executive Committee Members, Lee Cadwallader, Idaho National Laboratory, Idaho Falls, ID.

We are pleased to welcome the new FED Executive Committee Officers and members. In June 2012, Minami Yoda (GIT) began her 2-year term as Chair, Susana Reyes (LLNL) began her 2-year term as the Vice-Chair/Chair-Elect, and Stephen Combs (ORNL) began his 2-year term as Secretary/Treasurer. The newly elected Executive Committee members are Jean-Paul Allain (Purdue), Kevin Kramer (LLNL), and Kelsey Tresemer (PPPL).

We would like to thank the Executive Committee members whose terms have ended at the end of the Annual Meeting on June 20, 2013: Paul Humrickhouse (INL), Keith Rule (PPPL) and Mark Tillack (UCSD). The Officers and Executive Committee members for 2013-2014 are:

FED Officers:

Minami Yoda (GIT)	(12-14)	minami@gatech.edu	Chair
Susana Reyes (LLNL)	(12-14)	reyes20@llnl.gov	Vice-Chair
Stephen Combs (ORNL)	(12-14)	combssk@ornl.gov	Sec./Treas.

FED Executive Committee Members:

Yutai Katoh (ORNL)	(11-14)	katohy@ornl.gov
Arnie Lumsdaine (ORNL)	(11-14)	lumsdainea@ornl.gov
Rene Raffray (ITER)	(11-14)	rene.raffray@iter.org
Satoshi Konishi (U.Kyoto)	(12-15)	s-konishi@iae.kyoto-u.ac.jp
Jacob Leachman (WSU)	(12-15)	jacob.leachman@wsu.edu
Juergen Rapp (ORNL)	(12-15)	rappj@ornl.gov
Jean-Paul Allain (Purdue)	(13-16)	allain@purdue.edu
Kevin Kramer (LLNL)	(13-16)	kramer@llnl.gov
Kelsey Tresemer (PPPL)	(13-16)	ktreseme@pppl.gov

FED Past Chair:

Lee Cadwallader (INL)	(12-14)	lee.cadwallader@inl.gov

FED Standing Committee Chairs:

Nominating: Lee Cadwallader (INL)
Honors and Awards: Farrokh Najmabadi (UCSD)
Program Committee: Susana Reyes (LLNL)

FED Representatives on National Committees:

ANS Public Policy: Lee Cadwallader (INL)
ANS Publications: Nermin Uckan (ORNL)
ANS Program Committee: Lance Snead (ORNL) / Lee Cadwallader (INL)

Editors:

Newsletter: Laila El-Guebaly (UW)

Fusion Science and Technology Journal: Nermin Uckan (ORNL)

Liaisons to other organizations and ANS divisions:

ANS Board: Andrew Klein (OSU)
MS&T: Lance Snead (ORNL)
IEEE: Mark Tillack (UCSD)
RPS: Paul Wilson (UW)
YMG: Ahmad Ibrahim (ORNL)

FED Webmasters:

Mark Tillack (UCSD): FED Website
Dennis Bruggink (UW): UW Website

Treasurer's Report, Stephen Combs, Oak Ridge National Laboratory, Oak Ridge, TN.

As of April 30, 2013, our division had a balance of $48,414. Our initial balance at the beginning of 2013 was $48,092. Our income for the first four months of 2013 was $622 in member allocation; this is one-third (or 4/12) of the total allocation for the year (the monthly allocation is $155.50 based on 933 members at the beginning of 2013 ($2 per member). The expected total income for 2013 includes the total member allocation of $1,866 and ~$9,000 estimated from the proceeds of the TOFE 2012, resulting in a total of ~$10,866. The expenses for the first three months of 2013 were $300 to assist student travel to the two national ANS meetings (June in Atlanta and November in DC). Additional planned expenses for 2013 include $500 for the ANS NEED scholarship fund, $600 for conference phone lines during the two executive committee meetings (June in Atlanta and November in DC – costs could be less), and $500 for miscellaneous expenses (which is rarely used in full). The $500 that FED provides annually for support of ANS student conferences was paid out in 2012 for the 2013 meeting in Boston (hosted by MIT student section), and thus not an expense in 2013. No other expenses are anticipated for the rest of the year.

Fusion Award Recipients, Laila El-Guebaly, Fusion Technology Institute, University of Wisconsin-Madison, Madison, WI.

Fusion awards have been established to formally recognize outstanding contributions to fusion development made by members of the fusion community. The following awards (listed in alphabetical order) were available to the newsletter editor at the time of publishing this newsletter. We encourage all members of the fusion community to submit information on future honorees to the editor (elguebaly@engr.wisc.edu) to be included in future issues. The ANS-FED officers and executive committee members congratulate the honored recipients of the 2012/2013 fusion awards on this well-deserved recognition and our kudos to all of them.

IEEE NPSS Awards

Two awards were presented by the Fusion Technology Steering Committee of the IEEE Nuclear and Plasma Sciences Society (NPSS):

- Dr. **Abbas Nikroo** of General Atomics received the 2012 IEEE NPSS award for his many exemplary technical contributions and leadership initiatives in the field of IFE target fabrication techniques, including those to LLNL's NIF, University of Rochester's OMEGA, and Z at Sandia.
- Dr. **Phil Heitzenroeder** of PPPL received the 2013 IEEE NPSS award for his contribution to the design and construction of many of the world's major magnetic fusion facilities during a 40-year career at PPPL that includes > 20 years as head of the Mechanical Engineering Division. Increasing responsibilities, particularly in the magnet design and manufacturing area, for every experimental fusion device that PPPL has been associated with, has marked this career.

PPPL Awards

PPPL presented its 2013 outstanding research awards to two physicists:

- Dr. **S. Sabbagh** received the Kaul Foundation Prize for Excellence in Plasma Physics Research and Technology Development for his work on advancing the understanding and enhancing the stability of high-performance plasmas in tokamaks.
- Dr. **G. Hammett** was named the winner of the Distinguished Research Fellow Award for his work on deepening the theoretical understanding of turbulence in fusion plasmas.

News from Fusion Science and Technology (FS&T) Journal,

Nermin A. Uckan, FS&T Editor, Oak Ridge National Laboratory, Oak Ridge, TN.

During the past 12 months (from May 1, 2012 to April 30, 2013), FS&T received a total of 262 manuscripts for FS&T regular issues.

Of the 262 regular manuscripts, 112 were from North America, 56 from Europe (including Russia), 88 from Asia, and 6 from Others, with the following breakdown: 172 have been accepted, 46 are under review/revision, and 44 have been rejected/withdrawn. There was no FS&T Transactions published in this period.

The following dedicated issues were published during the period 5/1/12 to 4/30/13:

- Selected papers from 15th ICFRM 2011 – FS&T Jul./Aug. 2012
- Selected papers from 7th Fusion Data Validation– FS&T Nov. 2012 & Jan. 2013
- Selected papers from 20th IFE Target Fabrication 2012 – FS&T Mar./Apr. 2013.

The following issues are scheduled/planned for remainder of 2013 and 2014:

- IAEA Data Evaluation for Atomic, Molecular and Plasma-Material Interaction in Fusion – FS&T May 2013
- Open Magnetic Systems & Plasma Materials Interactions 2012 – FS&T *Transactions* (May 2013)

- Selected papers from 20th TOFE 2012 – FS&T regular issues (Aug. & Sept. 2013)
- IAEA-NFRI Data Evaluation for Atomic, Molecular and Plasma-Material Interaction in Fusion – FS&T regular issue (early 2014)
- Selected papers from 2nd IAEA-ITER Materials Technology 2012 – FS&T regular issue (early 2014)
- Lectures from 6th International ITER School – FS&T regular issue (early 2014)
- Selected papers from 16th ICFRM 2013 – FS&T regular issue (mid/late 2014)
- Selected papers from Tritium 2013 – FS&T regular issue (late 2014).

Electronic access to FS&T is available from 1997-to-current. ANS has completed scans of pre-1997 back issues and will soon start adding these issues as soon as they determine subscription protocols related to back issues. As always, tables of contents and abstracts of papers can be accessed at http://www.ans.org/pubs/journals/fst/. Individual and library subscribers can access the full text articles at http://epubs.ans.org/.

Please send your comments on FS&T contents and coverage as well as suggestions for potential future topical areas that are timely and of interest to fst@ans.org.

ONGOING FUSION RESEARCH

Assessment of the Prospects for Inertial Fusion Energy, Gerald L. Kulcinski, University of Wisconsin-Madison and Ronald C. Davidson, Princeton University.

The United States Department of Energy (USDOE) requested the National Research Council (NRC), in late 2010, to prepare an unclassified report that accomplishes the following:

- Assesses the prospect for generating power using Inertial Confinement Fusion Energy (IFE);
- Identifies the scientific and engineering challenges, cost targets, and R&D objectives associated with developing an IFE demonstration plant; and
- Advises the USDOE on the preparation of an R&D roadmap aimed at developing the conceptual design of an IFE demonstration plant.

In addition, the NRC committee was to be supported by a Target Physics Panel that has access to classified target physics information so that the panel can inform the main NRC committee on the relevant target physics issues. The charge to this panel was to:

- Assess the current performance of various fusion target technologies; and
- Describe the R&D challenges to providing suitable targets on the basis of parameters established and provided by the Committee.

The main committee consisted of 21 members and one consultant:

Ronald C. Davidson, *Co-Chair*, Princeton University
Gerald L. Kulcinski, Co-*Chair*, University of Wisconsin-Madison

Charles Baker, University of California, San Diego [Retired]
Roger Bangerter, E. O. Lawrence Berkeley National Laboratory [Retired]
Riccardo Betti, University of Rochester
Jan Beyea, Consulting in the Public Interest
Robert L. Byer, Stanford University
Franklin Chang-Diaz, Ad Astra Rocket Company
Steven C. Cowley, United Kingdom Atomic Energy Authority
Richard L. Garwin, IBM Thomas J. Watson Research Center
David Hammer, Cornell University
Joseph S. Hezir, EOP Group, Inc.
Kathyrn McCarthy, Idaho National Laboratory
Lawrence T. Papay, PQR, LLC
Ken Schultz, General Atomics [Retired]
Andrew M. Sessler, E. O. Lawrence Berkeley National Laboratory
John Sheffield, The University of Tennessee, Knoxville
Thomas A. Tombrello, Jr., California Institute of Technology
Dennis G. Whyte, Massachusetts Institute of Technology
Jonathan S. Wurtele, University of California, Berkeley
Rosa Yang, Electric Power Research Institute
Malcolm McGeoch, *Consultant*, PLEX, LLC.

The committee members were chosen from a wide spectrum of disciplines listed below:

Plasma Physics
Fusion (inertial and magnetic)
Materials Science & Engineering
Mechanical Engineering
Beam Systems
Central Station Power Plants
Electric Utility Industry
Energy Policy
Construction of Large-Scale Energy Systems
Fusion Physics & Engineering
Radiation Physics
Nuclear Engineering
Laser Systems
Heat Transfer
Non-Proliferation
Economics
Safety & Environment

The Target Panel consisted of 7 members:

John Ahearne, *Chair,* Sigma Xi
Robert Dynes, University of California, San Diego
Douglas Eardley, University of California, Santa Barbara
David Harding, University of Rochester
Thomas Melhorne, Naval Research Laboratory
Merri Wood-Schultz, Los Alamos, NM
George Zimmerman, Lafayette, CA.

There were 6 meetings of the main committee held between December 2010 and February 2012. An Interim Report was issued in March 2012, and a draft of the 234 page final report was completed by June 2012. After classification review and NRC review, the final report was released in February 2013. The classified report was completed in January 2013.

There are 56 conclusions and 26 recommendations made in the final report of the NRC committee.

Conclusions and Recommendations

Of the 82 conclusions and recommendations only a few can be presented in this short article. Therefore, 4 conclusions and 6 recommendations have been extracted from the final report for presentation here, and the reader is encouraged to access the draft report at http://www.nap.edu/catalog.php?record_id=18289. The final edited version of the committee report is expected to be issued by the NRC by the middle of July 2013.

Major Conclusions

The scientific and technological progress in inertial confinement fusion has been substantial during the past decade, particularly in areas pertaining to the achievement and understanding of high-energy-density conditions in the compressed fuel, and in exploring several of the critical technologies required for inertial fusion energy applications (e.g., high-repetition-rate lasers and heavy-ion-beam systems, pulsed-power systems, and cryogenic target fabrication techniques). (Conclusion 1 from the Interim Report; Chapters 2 and 3 of the final report)

It would be premature to choose a particular driver approach as the preferred option for an inertial fusion energy demonstration plant at the present time. (Conclusion 2 from the Interim Report)

The appropriate time for the establishment of a national, coordinated, broad-based inertial fusion energy program within DOE is when ignition is achieved. (Conclusion 4-13)
At the present time, there is no single administrative home within the Department of Energy that has been invested with the responsibility for administering a National Inertial Fusion Energy R&D program. (Conclusion 4-16)

Major Recommendations

In the event that ignition is achieved on the National Ignition Facility or another facility, and assuming that there is a federal commitment to establish a national inertial fusion energy R&D program, the Department of Energy should develop plans to administer such a national program (including both science and technology research) through a single program office. (Recommendation 4-11)

The achievement of ignition with laser-indirect drive at the National Ignition Facility should not preclude experiments to test the feasibility of laser-direct drive. Direct drive experiments should also be carried out because of the potential of achieving higher gain and/or other technological advantages. (Recommendation 4-7)

The Department of Energy should use a milestone-based roadmap approach, based on Technology Readiness Levels (TRLs), to assist in planning the recommended national IFE program leading to a DEMO plant. The plans should be updated on a regular basis to reassess each potential approach and set priorities based on the level of progress. Suitable

milestones for each driver-target pair considered might include, at a minimum, the following technical goals:

1. Ignition
2. Reproducible modest gain
3. Reactor-scale gain
4. Reactor-scale with a cost-effective target
5. Reactor-scale with the required repetition rate. (Recommendation 4-4)

Technical issues associated with the viability of recyclable transmission lines and 0.1 Hz, 10-GJ-yield chambers should be addressed with engineering feasibility studies in the next five years to assess the technical feasibility of Magnetized Liner Inertial Fusion (MagLIF) as an inertial fusion energy system option. (Recommendation 2-3)

Economic analyses of inertial fusion energy power systems should be an integral part of a national program planning effort; particularly as more cost data become available. (Recommendation 3-10)

The national inertial fusion energy technology effort should leverage magnetic fusion energy materials and technology development in the United States and abroad. Examples include: the ITER test blanket module R&D program, materials development, plasma-facing components, tritium fuel cycle, remote handling, and fusion safety analysis tools. (Recommendation 3-2)

Concluding Comments

While ignition has not been achieved at the time of this publication, there appears to be some confidence in the technical community that it is only a matter of time before ignition will be demonstrated in one of the DOE sponsored driver programs at the National Laboratories. If and when this happens, the NRC committee report lays out a roadmap to commercial electric power plants. It is not possible to attach a likely date for the achievement of ignition, but the benefits from a long lasting, safe, and economic energy source for the latter half of the 21st century are so great that it certainly justifies the effort that has been, and will need to be put into the Inertial Fusion Energy program.

FESAC Activities, Martin Greenwald, FESAC Chair, Massachusetts Institute of Technology, Cambridge, MA.

Following discussion at meetings of the Fusion Energy Sciences Advisory Committee (FESAC) on January 31, 2013 and March 15, 2013, the committee has approved and forwarded two reports to the Department of Energy's Office of Science (SC) answering two charges from Undersecretary Brinkman that concerned, respectively, research priorities and new investments in major facilities. These reports were drafted by two panels formed to study the issues and report back to the main committee. Below is a brief summary of those reports. All reports along with presentations and minutes of the FESAC meetings are available on http://science.energy.gov/fes/fesac/reports/.

Priorities Charge and Report

In April 2012, FESAC was charged to identify research priorities for magnetic fusion energy at three different budget levels corresponding to:

1. The FY13 presidential request;
2. The FY12 Congressional appropriations and
3. A gradual increase to 1.5 times FY13 presidential level with an increased emphasis on materials and fusion technologies.

Funding and priorities for ITER construction was not to be considered, neither were General Plasma Science or High Energy-Density Plasma research. Note that the FY13 presidential level represents a $32M cut from FY12 appropriated level for research in the portfolios covered by the charge. The 23 member panel, chaired by Robert Rosner (University of Chicago), completed its draft report on January 22.

The report organizes its priorities around the 18 "thrust" areas defined by the 2009 Research Needs Workshop, a community-wide effort aimed at identifying critical research areas (http://burningplasma.org/web/ReNeW/ReNeW.report.press1.pdf). Based on programmatic importance and timeliness, the thrusts were sorted into three priority tiers. Priorities within the tiers were not assigned. The top tier consisted of:

ReNeW Thrust #	Description
2	Control Transient Events in Burning Plasmas
6	Develop Predictive Models for Fusion Plasmas, Supported by Theory and Challenged with Experimental Measurement
9	Unfold the Physics of Boundary Layer Plasmas
10	Decode and Advance the Science and Technology of Plasma-Surface Interactions
17	Optimize Steady-State, Disruption-Free Toroidal Confinement using 3-D Magnetic Shaping, and Emphasizing Quasi-Symmetry Principles

With these priorities as background, the report found that "the FY2013 FES Budget level is inadequate to address even the highest priorities in a timely way." Specific findings with respect to this budget were highlighted:

1. It is out of balance in its budget allocation to facilities operations (10%) and research (45%). It therefore fails to take advantage of major past capital investments.

2. It jeopardizes ITER success because U.S. facilities are some of the best in the world to address urgent research needs.

3. It jeopardizes the U.S. ability to take advantage of ITER in the future, because it undermines our ability to attract top minds to the field.

4. It significantly weakens the preeminent capability of the U.S. program in innovative research and critical discovery science.

Thus, with respect to first part of the charge, the report makes the recommendation:

If this budget level persists, a thorough remapping between the high priority thrusts and the elements of the whole U.S. FES program must be undertaken.

While the report does not carry out this remapping, it notes:

One proposal, suggested in the FY2013 FES budget request, is an "... overall reduction in domestic research ..." while making "... a modest increase in funding for scientific collaborations on major international facilities." We disagree, however, with this ordering of priorities. While we expect ITER will become a dominant experimental focus of the U.S. program at the end of its construction phase, the research facilities available today in the U.S. are in some areas uniquely equipped to tackle pressing challenges facing ITER design and operation.

In this spirit, we emphasize the importance of maintaining strong experimental and theoretical elements in which graduate students in first-rate programs are directly involved in all phases of plasma science.

With respect to the second part of the charge, that is with funding restored to the FY12 appropriation level, the report made the following recommendations:

1. $12M should be deployed for a three to five year period of operation of C-Mod to resolve high-priority topics on ITER-relevant boundary and divertor physics, and might include upgrades as required to accomplish these goals.
2. $10M be allocated to increased utilization of DIII-D, covering operations and research focused on achieving faster progress on the urgent, high-priority research that DIII-D is carrying out for ITER preparations.
3. $10M be allocated to a highly targeted support of theory and simulation. This support needs to be focused on the high-priority research thrusts discussed earlier.

The report also recommends planning for new MFE facilities.

For the third part of the charge, defining priorities for a gradual increase in funding levels to 50% above the 2013 budget, the report recommends emphasis on "science-rich feasibility issues," particularly in areas that would prepare the way for a Fusion Nuclear Science Facility (FSNF). The report highlights expanded efforts in two broad areas (i) fusion nuclear materials effects, and (ii) plasma surface interactions. These would need to be supported by basic research and development and new facilities. Program elements and possible facilities in these areas are discussed in the report.

The report also noted the current uncertainty over the optimal magnetic confinement configuration for a FNSF. It recommends, essentially, a "watching brief", with funding priorities tied to an ongoing assessment of the reliability and feasibility of the various options.

Facilities Charge and Report

On December 20, 2012, FESAC was charged to provide input into an Office of Science effort to define priorities for new investments in major facilities over the next 10 years. For this exercise, "major" was defined as new facilities or upgrades to existing facilities costing at least $100M, though the committees were advised to take that number as guidance rather than a hard limit. To begin the process, each of the Advisory Committees was given a provisional list of facilities by their respective SC Associate Director to which they could add or subtract as they felt appropriate. The expectation was that the final list from FESAC would be short, with perhaps 4-6 facilities listed. The facilities were not to be rank ordered. When the advisory committee process is complete, SC will take all the input and generate a composite list that reflects their view of national priorities and opportunities. Input from the Advisory Committee was required by March 22. The composite list is expected to be announced in the fall of 2013.

A panel was formed, chaired by John Sarff (University of Wisconsin) with Don Rej (LANL) serving as Vice Chair. The panel assessed facility options based on their potential to contribute to "world-leading science" and their readiness for construction. Scientific potential was to be assigned one of four categories: (a) absolutely central, (b) important, (c) lower priority, or (d) don't know enough yet. Readiness for each proposed new facility or upgrade was to be assigned by placing each facility in one of three categories: (a) ready to initiate construction, (b) significant scientific/engineering challenges to resolve before initiating construction, and (c) mission and technical requirements not yet fully defined. (It became clear during the panel's work, that with these readiness definitions most proposals would score a (b) on readiness). The panel was also asked to categorize the scientific impact of existing facilities. The charge requested no other relative ranking or priorities among the facilities selected. The panel completed their work and submitted their draft report to FESAC on March 13, 2013.

The facility list provided by the Associate Director of FES to FESAC included four suggested new and upgraded facilities:

1. Fusion Materials Initiative;
2. Quasi-axisymmetric Research Experiment (QUASAR);
3. Fusion Nuclear Science Facility (FNSF);
4. Upgrade of the DIII-D National Fusion Facility.

To gain a broader perspective on potential facility opportunities, the panel issued a call for white papers from the scientific community and received 40 contributions, including those for existing facilities. The white papers are available to the public at http://burningplasma.org/web/fsff.html.

After deliberation the panel recommendations and assessments for new and upgraded facilities were:

Facility	Science	Readiness
Fusion Materials Irradiation Facility	a	a
Fusion Nuclear Science Facility (FNSF)	a	b
Multi-Petawatt Science Facility	b	b
Quasi-Symmetric Stellarator Experiment	a	b
Upgrade to the DIII-D National Fusion Facility	b	a

That is, the report adds one facility to the list provided by OFES. The full report provides a 2-page summary of each of these facilities. In addition the panel assessment of existing facilities was:

Facility	Science	Readiness
DIII-D National Fusion Facility	a	(existing)
Upgraded National Spherical Torus Experiment (NSTX-U)	a	(existing)

Because of the OFES plans for closing the Alcator C-Mod facility, it was not included in this assessment. The report notes and endorses the recommendations of the Priorities Panel with respect to C-Mod.

During the discussion of the report by FESAC, the lack of a major new facility dedicated to plasma-materials issues (PMI) was contrasted with the priority this area was given by the Priorities Panel. The rationale for this decision was included in an appendix of the report.

INTERNATIONAL ACTIVITIES

US ITER Report, Ned Sauthoff, US ITER Project Office, Oak Ridge National Laboratory, Oak Ridge, TN.

The ITER Council met in June in Tokyo to note the project's progress as it transitions to full construction, including the work of both the ITER Organization and the seven Domestic Agencies, to act upon a series of proposals from the Director General, and to provide direction to the ITER team.

Previously, at the site in Saint-Paul-lez-Durance, France, the bottom floor and outer walls had been completed and nearly 500 seismic isolation supports had been installed in preparation for the pouring of the Tokamak Complex itself, which will be supported on the seismic isolators to reduce the accelerations from earthquakes. The Council heard of major contracts recently placed by the European Domestic Agency that will construct the main Tokamak Building and the Assembly Building.

The Council also heard of the significant progress in the fabrication of components in the Domestic Agencies. Most of the Toroidal Field Coil superconducting strand (nearly 420 tons of niobium-tin (Nb_3Sn) strand, representing 90 percent of project needs) and 133 tons of niobium-titanium (NbTi) strand (51 percent of project needs) for the poloidal field conductors has been produced and much TF conductor has been cabled and jacketed in 6 Domestic Agencies. Factories and tooling for fabrication of the set of magnet coils are being constructed. The vacuum vessel segments are being fabricated in Europe and Korea. R&D and design of plasma control tools are underway, including neutral beams, electron cyclotron and ion cyclotron heating and current drive systems, pellet injection (for fueling, ELM mitigation and disruption mitigation) and in-vessel magnetic coils (for faster vertical plasma position control and creation of 3-D magnetic structures to limit gradients that drive ELMs).

The integrated project schedule was a major focus of the Council, particularly in light of delays in several systems, including the buildings and the vacuum vessel. The "Unique ITER Team", consisting of the ITER Organization and the 7 Domestic Agencies, was charged with increasing the realism of the integrated schedule by incorporation of industrial fabrication schedules, and a refined Assembly schedule, and with seeking to recover schedule.

RECENTLY PUBLISHED FUSION BOOKS

S. Dean, "**Search for the Ultimate Energy Source: A History of the US Fusion Energy Program**." Available from Springer (www.springer.com) in either hard copy (ISBN 978-1-4614-6036-7) or as an E-book (ISBN 978-1-4614-6037-4).

J. Sheffield, "**Fun in Fusion**." Elsevier Press, 2013 (ISBN 978-0-12-407793-5).

IAEA, "**Fusion Physics**." Order from IAEA (www.iaea.org/books). ISBN: 978-92-0-130410-0. Free download PDF version at: http://www-pub.iaea.org/books/IAEABooks/8879/Fusion_Physics.

G. Miley, "Life at the Center of the Energy Crisis," Imperial College Press. ISBN: 978-981-4436-48-9. Available at: http://www.worldscientific.com/worldscibooks/10.1142/8638. Code: WSSLPK25.

CALENDAR OF UPCOMING CONFERENCES ON FUSION TECHNOLOGY

2013:

8th International Conference on Inertial Fusion Sciences and Applications – IFSA-2013
September 8-13, 2013, Nara, Japan
http://www.ifsa13.org/index.html

11th International Symposium on Fusion Nuclear Technology - ISFNT-11
September 16-20, 2013, Barcelona, Spain
http://www.isfnt-11.org/

16th International Conference on Fusion Reactor Materials - ICFRM-16
October 20-26, 2013, Beijing, China
http://icfrm16.ustb.edu.cn/uploadfile/file/20121108212015 37.pdf

10th International Conference on Tritium Science and Technology – Tritium-2013
October 21-25, 2013, Nice, France
http://www-fusion-magnetique.cea.fr/tritium2013/

ANS Winter Meeting
November 10-14, 2013, Washington, DC, USA
http://www.ans.org/

55th American Physical Society - Division of Plasma Physics (APS-DPP) meeting
November 11-15, 2013, Denver, CO, USA
http://www.apsdpp.org

2014:

ANS Annual Meeting
June 15-19, 2014, Las Vegas, NV, USA
http://www.ans.org/

17th International Conference on Emerging Nuclear Energy Systems (ICENES)
Summer 2014, Antalya, Turkey
ssahin@atilim.edu.tr

19th Pacific Basin Nuclear Conference (PBNC-2014)
August 24-28, 2014, Vancouver, Canada
www.pbnc2014.org

28th Symposium on Fusion Technology – SOFT-2014
September 2014, San Sebastian, Spain

56th American Physical Society - Division of Plasma Physics (APS-DPP) meeting
October 27-31, 2014, New Orleans, LA, USA
http://www.apsdpp.org

ANS Winter Meeting
November 9-13, 2014, Anaheim, CA, USA
http://www.ans.org/

ANS 21st Topical Meeting on the Technology of Fusion Energy – TOFE-2014
November 9-13, 2014, Anaheim, CA, USA
http://www.ans.org/