



**American Nuclear Society  
Fusion Energy Division  
June 2011 Newsletter**

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**Letter from the Chair**, Lee Cadwallader, Fusion Safety Program, Idaho National Laboratory, Idaho Falls, ID.

I have three items to discuss for this letter. First, I wanted to repeat the e-message of support that our Division sent on March 21:

*“On behalf of the members of the American Nuclear Society (ANS) Fusion Energy Division (FED), I am writing to express our sympathy and concern for our Japanese fusion colleagues, as well as the people of Japan, especially the residents of Miyagi, Iwate, Fukushima, Aomori, and Ibaraki Prefectures, in the aftermath of this devastating earthquake and tsunami. This disaster is unprecedented and its cost in lives, damage and human suffering has been tragic. Yet we are confident that Japan's infrastructure will be re-built, and that the situation at the Fukushima Daiichi power station complex will be resolved. I know that many ANS members have contributed to the relief efforts for the Tohoku region and the Fukushima reactors, and our members will continue to help in whatever capacity we can.*

*We are all deeply saddened by the immense scope of the damage and we are moved by the courage and discipline shown by the Japanese as they continue to deal with the aftermath of the Tohoku quake and tsunami. This attitude is typified by the dedication and selflessness of emergency personnel and volunteers in rescuing survivors, rendering medical aid, restoring water, electricity, and natural gas services, as well as in providing for the needs of citizens who have lost their dwellings or who have been evacuated. We also recognize the heroic efforts and dedication of the power plant engineers and personnel working to stabilize the Fukushima plant. Our thoughts and best wishes are with you in this most difficult of times.”*

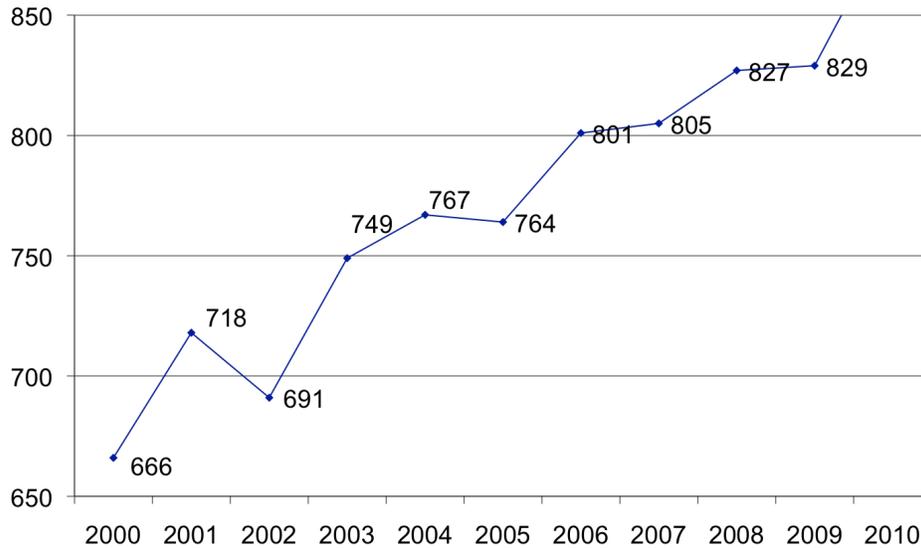
In these several months since the March 11 earthquake and tsunami, the situation at the Fukushima Daiichi site is not fully resolved. We know that the Japanese are working diligently to stabilize all of the fission reactors and spent fuel pools.

The second item to discuss is the US Fusion Energy Sciences Advisory Committee (FESAC) meeting that was held on March 7-8, 2011. The meeting video has been archived at <http://doe.granicus.com>, and minutes have been published, so I shall be brief. The FESAC news of interest for our Division is that DOE Fusion Energy Sciences remains strong in its support of students, especially those studying plasma physics - typically funding over 400 students annually and 490 in 2010. There are recent discussions on Capitol Hill about “bringing a star to earth” and that by doing so energy security can be provided for the US. The US government has renewed confidence in the ITER international project with the placement of Dr. Osamu Motojima and Dr. Rem Haange in leadership positions.

The final item to discuss is that ANS Headquarters has sent some demographic information, depicted below. Division enrollment has risen over our several year plateau of ~800 Division members, the latest 2011 data show 998 total members. Of that total, 387 are student members. The FED, one of nineteen ANS divisions, now has

membership over 8% of the total 11,500 ANS members. I believe this increase in membership, especially student membership, reflects new interest in fusion energy with new inertial fusion facilities (e.g., the National Ignition Facility (in operation) and the Laser Megajoule (under construction)) and the new magnetic fusion facility (the ITER international project (under construction)). Our division is growing and healthy.

### Fusion Energy Annual Membership



### List of Officers and Executive Committee Members, Lance Snead, Oak Ridge National Laboratory, Oak Ridge, TN.

We are pleased to welcome the new FED Executive Committee Officers and members. Lee Cadwallader (INL) was voted to complete the newly extended second year of his term as Chair and Minami Yoda (GIT) was voted to complete the second year of her term as the Vice-Chair/Chair-Elect. Mark Anderson (University of Wisconsin) was voted back into office; he agreed to serve as Secretary/Treasurer for one more year to synchronize the new officer terms. The newly elected Executive Committee members are Yutai Katoh (ORNL), Arnie Lumsdaine (ORNL), and Rene Raffray (ITER).

We would like to thank the Executive Committee members whose terms have just ended, Art Nobile (LANL), Wayne Reiersen (ORNL), and Alice Ying (UCLA). The Executive Committee members for 2011/2012 are:

#### FED Officers:

Lee Cadwallader (INL)	(11-12)	<a href="mailto:lee.cadwallader@inl.gov">lee.cadwallader@inl.gov</a>	Chair
Minami Yoda (GIT)	(11-12)	<a href="mailto:minami.yoda@me.gatech.edu">minami.yoda@me.gatech.edu</a>	Vice-Chair
Mark Anderson (UW)	(11-12)	<a href="mailto:manderson@engr.wisc.edu">manderson@engr.wisc.edu</a>	Sec./Treas.

**FED Executive Committee Members:**

Lucile Dauffy (LLNL)	(09-12)	<a href="mailto:dauffy1@llnl.gov">dauffy1@llnl.gov</a>
Paul Humrickhouse (INL)	(10-13)	<a href="mailto:paul.humrickhouse@inl.gov">paul.humrickhouse@inl.gov</a>
Yutai Katoh (ORNL)	(11-14)	<a href="mailto:katohy@ornl.gov">katohy@ornl.gov</a>
Rick Kurtz (PNNL)	(09-12)	<a href="mailto:rj.kurtz@pnl.gov">rj.kurtz@pnl.gov</a>
Arnie Lumsdaine (ORNL)	(11-14)	<a href="mailto:lumsdainea@ornl.gov">lumsdainea@ornl.gov</a>
Rene Raffray (ITER)	(11-14)	<a href="mailto:rene.raffray@iter.org">rene.raffray@iter.org</a>
Keith Rule (PPPL)	(10-13)	<a href="mailto:krule@pppl.gov">krule@pppl.gov</a>
Shahram Sharafat (UCLA)	(09-12)	<a href="mailto:shahrams@ucla.edu">shahrams@ucla.edu</a>
Mark Tillack (UCSD)	(10-13)	<a href="mailto:mtillack@ucsd.edu">mtillack@ucsd.edu</a>

**FED Past Chair:**

Lance Snead (ORNL)	(11-12)	<a href="mailto:sneadll@ornl.gov">sneadll@ornl.gov</a>
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**FED Standing Committee Chairs:**

Nominating: Lance Snead (ORNL)  
Honors and Awards: Neil Morley (UCLA)  
Program Committee: Jake Blanchard (UW)

**FED Representatives on National Committees:**

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

**Editors:**

Newsletter: Laila El-Guebaly (UW), Dennis Bruggink (UW)  
Fusion Science and Technology Journal: Nermin Uckan (ORNL)

**Liaisons to other organizations and ANS divisions:**

ANS Board: position open  
MS&T: Lance Snead (ORNL)  
IEEE: George Miley (UIUC)  
RPS: Paul Wilson (UW)

**FED Webmasters:**

Mark Tillack (UCSD) - FED Website  
Dennis Bruggink (UW) - UW Website.

**Treasurer's Report**, Mark Anderson, University of Wisconsin–Madison, Madison, WI.

As of March 31, 2011, our division had a balance of \$40,196.00. Our initial balance at the beginning of 2011 was \$38,416.00. Our income for 2011 was \$1,780 in member allocation (\$2/member, 890 members when assessed). The expenses so far this year have been a \$500 contribution to the annual ANS Student Conference that was held at Georgia

Tech in April 2011. Other planned expenses in 2011 will be \$600 for conference phone lines during the two executive committee meetings (June in Florida and November in DC), a \$500 contribution to the ANS NEED fund, and \$500 for miscellaneous expenses (which is rarely used). 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](mailto:elguebaly@engr.wisc.edu)) to be included in future issues. The ANS-FED officers and executive committee members congratulate the honored recipients of the 2010/2011 fusion awards on this well-deserved recognition and our kudos to all of them.

#### **DOE and FPA Awards**

Two awards were presented at Dr. **Erol Oktay's** retirement luncheon March 22, 2011:

- Dr. Edmund Synakowski, head of the OFES, presented **Erol** with a DOE Distinguished Career Service Award on behalf of DOE Office of Science Director Bill Brinkman.
- The Fusion Power Associates (FPA) Board of Directors presented **Erol** with a FPA Special Award. FPA President Steve Dean said: "This Special Award is to recognize the many decades of dedicated guidance you have provided to the US fusion program in general and, in particular, the assistance you have provided to the management and direction of the DIII-D tokamak program at General Atomics; your contributions to the strengthening of fusion international collaborations and to the evolution of ITER; and your assistance in guiding a coordinated US Burning Plasma Physics activity."

#### **Nuclear Fusion Award**

The International Atomic Energy Agency (IAEA) has awarded an annual prize to honor exceptional work published in the Nuclear Fusion Journal. The winner of the 2010 Nuclear Fusion Award is **J.E. Rice** for the paper "Inter-Machine Comparison of Intrinsic Toroidal Rotation in Tokamaks," Nuclear Fusion 47 (2007) 1618-1624. The award was presented on October 11, 2010 at the 23<sup>rd</sup> IAEA Fusion Energy Conference in Daejeon, Korea.

#### **Student Awards**

##### **ANS**

**Ahmed Ibrahim** (University of Wisconsin-Madison) received the Best Presentation Award in the "Fusion Energy and Plasmas" Track of the ANS Student Conference held April 14-17, 2011 in Atlanta, GA. The title of the presentation is "Global Evaluation of Prompt Dose Rates in ITER Using FW-

CADIS,” by Ahmad M. Ibrahim, Mohamed E. Sawan, Scott W. Mosher, Thomas M. Evans, Douglas E. Peplow, Paul P. Wilson, and John C. Wagner.

### **ICENES**

In May 15-19, 2011, twenty students participated in the 15<sup>th</sup> International Conference on Emerging Nuclear Energy Systems (ICENES) held in San Francisco, CA, competing for three Best Student Paper Awards:

- 1<sup>st</sup> winner: **Dain Holdener** (University of California, San Diego), “Convective Heating of the LIFE Engine Target During Injection”
- 2<sup>nd</sup> winner: **David Cereceda** (Instituto de Fusion Nuclear, Spain), “Molecular Dynamics Simulations of Screw Dislocation Mobility in Tungsten”
- 3<sup>rd</sup> winner: **Paloma Castro** (Instituto de Fusion Nuclear, Spain), “Validation of Real Time Dispersion of Tritium Over the Western Mediterranean Basin in Different Assessments: Comparison with the Chalk River Chronic HT Release Experiment Database.”

**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, 2010 to April 30, 2011), FS&T received a total of 387 manuscripts for FS&T regular issues. Of the 387 manuscripts, 120 were from North America, 152 from Asia, 110 from Europe (including Russia), and 5 from Others.

During this period, FS&T also received 109 camera-ready papers for FS&T Transactions as follows:

- 85 papers from the 8<sup>th</sup> Int. Conference on Open Magnetic Systems for Plasma Confinement (OS2010), held in Novosibirsk, Russia, July 5–9, 2010
- 24 papers from the First Int. Youth Conference (IYC2010) on Fusion Energy, held in conjunction with the 23<sup>rd</sup> IAEA-FEC in Daejeon, Korea, October 9–10, 2010.

All FS&T 2011 issues are published and/or assigned. Next FS&T open issue is in 2012.

The following dedicated issues were published during the period 5/1/10 to 4/30/11:

- Selected papers from APS-DPP 2009 Mini-Conference on Mirrors – FS&T May 2010
- Large Helical Device (LHD) 10<sup>th</sup> Anniversary - FS&T July/Aug. 2010
- Selected papers from 6<sup>th</sup> Fusion Data Validation, plus regular papers – FS&T Oct./Nov. 2010
- Selected papers from 19<sup>th</sup> IFE Target Fabrication 2010 – FS&T Jan. 2011
- Open Systems 2010 Proceedings – FS&T Transactions (Feb. 2011)
- 4<sup>th</sup> ITER Summer School (IISS2010) Lectures – FS&T April 2011
- Selected papers from 2010 EC-16 – FS&T May 2011.

The following issues are scheduled (and closed) for remainder of 2011:

- IAEA 1st Int. Fusion Youth Conference (IAEA-IYC2010) – FS&T Transactions (July 2011)
- 19<sup>th</sup> TOFE-2010 Proceedings – FS&T July & Aug. 2011

- 9<sup>th</sup> Tritium-2010 Proceedings – FS&T Oct. & Nov. 2011.

The following issues are planned for 2012 and beyond:

- Selected papers from 1<sup>st</sup> IAEA-ITER Materials 2010 – FS&T regular issue (2012)
- Selected papers from 15<sup>th</sup> ICFRM 2011 – FS&T regular issue(s) (2012)
- Selected papers from 20<sup>th</sup> IFE Target Fabrication 2012 – FS&T regular issue (2012)
- ICENES-2011 Proceedings – FS&T Transactions (Jan. 2012)
- 10<sup>th</sup> Carolus Magnus Summer School (CMSS2011) – FS&T Transactions (2012)
- JT-60U (update of JT-60 Tokamak Special 2002) – FS&T regular issue (2012)
- 20<sup>th</sup> TOFE-2012 Proceedings – FS&T regular issues (2013)
- Open Systems 2012 Proceedings – FS&T Transactions (2013)
- JT-60U (update of 2002 JT-60 Special) – FS&T regular issue (in planning)
- JA-EU ITER Broader Approach – FS&T regular issue (in planning)
- IFE-Fast Ignition (US, EU, JA) – FS&T regular issue (in planning)
- KSTAR (Korea) – FS&T regular issue (in planning).

Werner Gulden (F4E) and Kenneth Schultz (GA) completed their terms on the FS&T Editorial Advisory Board. Their time and attention devoted to the journal are very much appreciated. Welcome to three new members that were recently appointed to the Board: Laila El-Guebaly (UW-Madison), Joelle Elbez-Uzan (CEA, France), and Derek Stork (CCFE, UK). The full listing of the Board and the Editors are:

FS&T Editorial Advisory Board members:

Harald Bolt, David J. Campbell, Laila El-Guebaly, Joelle Elbez-Uzan, Jeffrey H. Harris, Satoshi Konishi, Wayne R. Meier, Stanley L. Milora, Farrokh Najmabadi, Jerome Pamela, John D. Sethian, Ronald D. Stambaugh, Derek Stork, Hideyuki Takatsu, R. Scott Willms, and Steven J. Zinkle

FS&T Editors:

Nermin A. Uckan, Editor [uckanna@ornl.gov, fst@ans.org]  
 Maurizio Gasparotto, Associate Editor, Europe [Maurizio.Gasparotto@f4e.europa.eu]  
 Masahiro Mori, Associate Editor, Asia [mori.masahiro02@jaea.go.jp]

Electronic access to FS&T is available from 1997-to-current. ANS is completing plans to start adding pre-1997 back issues within the next few years. 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](mailto:fst@ans.org).

## **ONGOING FUSION RESEARCH**

### **Fusion Nuclear Science Pathways Assessment, Goals and Progress,**

Chuck Kessel, Princeton Plasma Physics Laboratory, Princeton, NJ.

The Fusion Nuclear Science Pathways Assessment (FNS-PA) was started in late July 2010 to provide information to the Office of Fusion Energy Sciences (OFES) on the research and development needed to move forward in the fusion nuclear science area. This activity follows the *Priorities, Gaps and Opportunities* and *ReNeW* efforts, by going deeper to identify in more detail the required research, to the point of allowing OFES to

make solicitations for proposals. The actual R&D activities for the next 5-10 years, facilities for doing this work, and timing/prioritization will be reported. In addition, a table identifying DEMO power plant parameter ranges, based on power plant studies, will be used to identify the basic long term direction for the research and to motivate the required work. Finally, an examination of fusion nuclear science facility steps from where we are now to DEMO will be reported, in order to better understand the technical figures of merit, difficulties, risks, and benefits of the most critical areas for fusion development. Ultimately the goal is to design, construct and operate a fusion nuclear science facility (FNSF) to test the many technical aspects on the way toward a DEMO.

The seven topical areas that are being examined in detail are:

1. Materials science and technology,
2. Power extraction and tritium sustainability (blanket science),
3. Plasma facing components and plasma material interactions (PFC/PMI),
4. Safety, environment and RAMI,
5. Plasma duration and sustainment,
6. Enabling technologies: magnets, heating and current drive, diagnostics, and fueling/pumping/particle control,
7. Design activities.

The materials science area is being treated broadly to include structural materials, tritium breeding and other blanket materials, plasma facing materials, insulating and diagnostics materials, magnet materials, chemical compatibility, tritium material issues, and design/licensing/high temperature issues. The main science here is single to few effects phenomena. Subgroups have been assembled to address each of these areas. It is clear that materials research is required for virtually all other areas to proceed, and provides the foundation for the complex steps toward integrated systems.

A blanket, where we consider the blanket to include the first wall (FW), breeding blanket, shield, and vacuum vessel and/or strongback structure, is a complex integrated system, whose components must each provide an individual function, while overall providing the shielding, power handling, and tritium containment. The initial R&D required in this area can be reasonably summarized in the Test Blanket Module program of ITER, reported in a technical plan and cost estimate for the OFES in 2007 by US scientists. The outlined research for this development shows very clearly there is a significant amount of non-nuclear R&D necessary (which includes fission nuclear testing of materials and small components) before pursuing any fusion nuclear testing. This same program would need to take place before blankets could be designed, constructed and tested on any fusion nuclear science facility as well.

The PFC/PMI area is broken into: 1) engineering limitations for PFCs, 2) evolution of PFC materials, and 3) PFC configuration. This area includes the first wall, divertor, heating and current drive structures, and any other material surface facing the plasma. The complex loading conditions presented by the plasma in the form of heat and particles, the materials erosion, re-deposition/migration, dust production, coupling to the particle and power handling are this area's scientific challenges.

The safety and environment topical area has influences in virtually every other area, particularly since fusion has internalized the safety issues to a large extent over many years. This area covers the licensing and qualification aspects, as well as management of waste, choice of materials, constraints on maintenance and operations, and the establishment of failure modes and accident probabilities. The reliability, availability, maintainability and inspectability (RAMI) aspects are included here.

Enabling technologies is focused on areas that are critical to any fusion nuclear science facility's success, including: 1) magnets, 2) heating and current drive systems, 3) diagnostics, and 4) fueling, pumping and particle control. Although it is not clear at this point in time which detailed aspects of these areas will ultimately be pursued, it is very clear that R&D is required now in order to be prepared for the design, construction, and operation of a fusion nuclear science facility.

The plasma duration and sustainment will identify and summarize requirements of the plasma for successful FNSF and DEMO, such as plasma on-time, plasma duty cycle, performance to provide a given neutron wall loading, disruptivity, need for steady state, steady and transient heat flux in the divertor, and so forth. The other topical areas are keeping track of their plasma science issues, and these will be passed to OFES for consideration in the base plasma science program.

Design activities are an important part of any technical program, and provide a necessary "glue" to connect basic materials, integration, and manufacturing to overall fusion device design. This area includes design at all stages, from early systems analysis to identify operating points to highly detailed "ready-to-build" component design. This area provides a focus to the basic R&D, as well as providing plasma and material boundary conditions, in-service environments, integration constraints, and operation constraints. Designs are likely to evolve with the R&D activities through an iteration process.

The FNS-PA activity will provide a report in the August 2011 time frame, followed by a technical review. The participation of many scientists in the fusion nuclear science and technology community has been and will continue to be critical to the activity's success. The ultimate integration of FNS with the plasma science program will represent a major milestone for the US' commitment to fusion energy.

## **INTERNATIONAL ACTIVITIES**

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

The world-wide ITER team is transitioning from R&D and design to fabrication and construction, with visible progress on civil construction, refinement of the schedule including significant mitigation actions, activities aimed at reducing the cost, and progress on licensing.

At the ITER site, in Cadarache, France, construction of the buildings is making very visible progress:

- Excavation for the Tokamak Complex has been completed,
- Pouring of the first concrete is expected in July,
- Final excavation for the Hot Cell building and Assembly Hall has started.

The concrete work for the basement of the final ITER Office building is complete and the ground floor is progressing well. The concrete structures and most of the building superstructure for the Poloidal Field coil building are complete.

The ITER Organization and Domestic Agencies have concentrated efforts on the management of schedule performance, and cost containment and cost savings. The schedule recovery activity includes addressing the impacts of the Japanese earthquake/tsunami, which has damaged test and fabrication facilities and imposed electricity-restrictions, all of which will have impacts on the integrated schedule. The international team is identifying barriers and seeking work-arounds and re-assignments of work to mitigate the delays. The team is also engaged in activities aimed at cost reduction, committed to stay within the project's baseline cost.

More than 2/3 (68%) of the total procurement value has been assigned and detailed arrangements for the execution of the design and fabrication have been agreed upon between the ITER members.

In April, the French Environmental Authority accepted the ITER safety and environmental files for analysis and enquiries, with public engagement in the licensing process starting in June.

## **FUSION CONFERENCE**

**ICENES Explores Synergies in Fusion and Fission R&D**, Wayne Meier,  
Lawrence Livermore National Laboratory, Livermore, CA.

The 15<sup>th</sup> International Conference on Emerging Nuclear Energy Systems (ICENES) was held in San Francisco the week of May 15-19. The meeting was hosted by the Northern California Section of the American Nuclear Society (ANS) and the ANS Fusion Energy Division (FED). Nearly 180 scientists and engineers representing magnetic fusion energy (MFE), inertial fusion energy (IFE) and advanced fission communities participated. The technical program and abstracts are available on the conference web site: [www.icenes2011.org](http://www.icenes2011.org). Presentations have been posted at [www.icenes2011docs.org](http://www.icenes2011docs.org). Of the ~160 presentations, more than half were from foreign contributors, primarily from the European Union and Asia (Japan, China and Republic of Korea). A highlight of the meeting was a tour of the National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL). Student participation in the meeting was strong with over 20 students competing in a special student poster session. The winner was Dain Holdener, a University of California, San Diego student who presented his modeling on

IFE target heating during injection in the Laser IFE (LIFE) chamber. Proceedings of the meeting will be published in Transactions of Fusion Science and Technology, an ANS publication.

The meeting was strongly supported by LLNL, both technically and through the efforts of the local organizing committee. Wayne Meier (LLNL) served as the Conference Chair and Technical Program Chair, while Ed Moses and Tomas Diaz de la Rubia (LLNL) were Honorary Conference Chairs.

## **RECENTLY PUBLISHED FUSION BOOKS**

**J. Sheffield, Plasma Scattering of Electromagnetic Radiation**

[http://www.amazon.com/gp/product/0123748771/ref=pd\\_lpo\\_k2\\_dp\\_sr\\_1?pf\\_rd\\_p=486539851&pf\\_rd\\_s=lpo-top-stripe-1&pf\\_rd\\_t=201&pf\\_rd\\_i=0126387508&pf\\_rd\\_m=ATVPDKIKX0DER&pf\\_rd\\_r=1MMQBQR9B9DGP8X0HWMK](http://www.amazon.com/gp/product/0123748771/ref=pd_lpo_k2_dp_sr_1?pf_rd_p=486539851&pf_rd_s=lpo-top-stripe-1&pf_rd_t=201&pf_rd_i=0126387508&pf_rd_m=ATVPDKIKX0DER&pf_rd_r=1MMQBQR9B9DGP8X0HWMK)

**F. Chen, An Indispensable Truth: How Fusion Power Can Save the Planet**

<http://www.amazon.com/Indispensable-Truth-Fusion-Power-Planet/dp/1441978194>

**Wiley Nuclear Energy Encyclopedia: Science, Technology, and Applications**

<http://newenergytimes.com/v2/books/2011Wiley/2011Wiley.shtml>

- Chapter 5. **Basic Concepts of Thermonuclear Fusion (Laila A. El-Guebaly)**
- Chapter 31. **Historical Origins and Development of Fusion Research (Stephen O. Dean)**
- Chapter 32. **Plasma Physics and Engineering (Francesco Romanelli)**
- Chapter 33. **Fusion Technology (Lester M. Waganer)**
- Chapter 34. **ITER – An Essential and Challenging Step to Fusion Energy (Charles C. Baker)**
- Chapter 35. **Power Plant Projects (Laila A. El-Guebaly).**
- Chapter 36. **Safety and Environmental Features (Lee Cadwallader and Laila A. El-Guebaly)**
- Chapter 37. **Inertial Fusion Energy Technology (R. A. Al-Ayat, Edward I. Moses, and Rose A. Hansen)**
- Chapter 38. **Hybrid Nuclear Reactors (J. M. Martinez-Val, M. Piera, A. Abánades, A. Lafuente)**
- Chapter 39. **Fusion Maintenance Systems (Lester M. Waganer)**
- Chapter 40. **Fusion Economics (Lester M. Waganer).**

## **CALENDAR OF UPCOMING CONFERENCES ON FUSION TECHNOLOGY**

### **2011:**

ANS Annual Meeting

June 26-30, 2011, Hollywood, Florida, USA

<http://www.ans.org/>

24<sup>th</sup> Symposium on Fusion Engineering – SOFE-2011

June 26-30, 2011, Chicago, IL, USA

<https://engineering.purdue.edu/ICOPS2011/>

10<sup>th</sup> International Symposium on Fusion Nuclear Technology - ISFNT-10

September 11-16, 2011, Portland, Oregon, USA

<http://www.isfnt-10.org/>

15<sup>th</sup> International Conference on Fusion Reactor Materials - ICFRM-15

October 16-21, 2011, Charleston, North Carolina, USA

<http://www.ornl.gov/icfrm15/>

ANS Winter Meeting

October 30-November 3, 2011, Washington, DC, USA

<http://www.ans.org/>

53<sup>rd</sup> American Physical Society - Division of Plasma Physics (APS-DPP) meeting

November 14-18, 2011, Salt Lake City, Utah, USA

<http://www.apsdpp.org>

### **2012:**

ANS Annual Meeting

June 24-28, 2012, Chicago, Illinois, USA

<http://www.ans.org/>

ANS 20<sup>th</sup> Topical Meeting on the Technology of Fusion Energy – TOFE-2012

August/September 2012, Nashville, Tennessee, USA

[lumsdainea@ornl.gov](mailto:lumsdainea@ornl.gov)

24<sup>th</sup> IAEA Fusion Energy Conference

8-13 October 2012, San Diego, CA, USA

<http://www-naweb.iaea.org/naweb/physics/PS/conf.htm>

54<sup>th</sup> American Physical Society - Division of Plasma Physics (APS-DPP) meeting

October 29-November 2, 2012, Providence, Rhode Island, USA

<http://www.apsdpp.org>

27<sup>th</sup> Symposium on Fusion Technology – SOFT-2012  
September 24-28, 2012, Liège, Belgium  
<http://www.soft2012.eu/>

ANS Winter Meeting  
November 11-15, 2012, San Diego, CA, USA  
<http://www.ans.org/>

**2013:**

ANS Annual Meeting  
June 16-20, 2013, Atlanta, GA, USA  
<http://www.ans.org/>

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

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

**2014:**

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

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

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

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