American Nuclear Society
Fusion Energy Division
December 2011 Newsletter

Letter from the Chair, Lee Cadwallader, Idaho National Laboratory, Idaho Falls, ID.

In this letter, I bring news from the 2011 ANS Winter Meeting. The disastrous event at the four Fukushima power plants in March 2011 was an important focus of the meeting. The Honorable Gregory B. Jaczko, Chairman of the Commissioners of the US Nuclear Regulatory Commission (NRC), spoke about the Fukushima event and the US response to the event. This largest event in the history of the nuclear industry, affecting four co-located plants, caused every regulatory agency to question if the same event could happen in their country. Most fission power plant safety studies examine one plant at a time and one event at a time, not multiple power plants at a site and multiple disastrous events. The US NRC formed a 'Japan task force' to perform a thorough review of the Fukushima event and the safety at US fission power plants. The task force generated a list of 12 overarching safety items (including emergency power robustness, earthquake preparedness, etc.); the full 96-page NRC report can be downloaded from the website http://www.nrc.gov/japan/japan-info.html. These 12 safety items have been reviewed and approved by the NRC staff and the US Advisory Committee on Reactor Safeguards. The NRC will implement the 12 safety items in the next five years. In October 2011, the Commission selected the seven highest priority safety items for the NRC to address first. These seven items will be evaluated for their impacts to fission power plants and then made into new regulations. The other five safety items will follow.

The US electric utility industry continues construction of new fission power plants at the Summer site in South Carolina and the Vogtle site in Georgia. This activity confirms that the US remains confident in its use of fission power. Some countries are abandoning fission power; most notably Germany is not pursuing fission power like it had in the past.

Presentations at the 10th International Symposium on Fusion Nuclear Technology in September 2011 illustrated that the ITER project is moving ahead. ITER safety personnel have examined the effects of loss of all station power and the effects of earthquakes on the ability of the plant to remain in a safe configuration, and ITER would remain safe; there would not be any radioactive or hazardous material releases that would threaten the public in Fukushima-type events. ITER held public enquiry sessions on the safety and environmental documentation in the summer of 2011. In other aspects of ITER, the system designs are progressing as well. Work on pouring concrete for the ITER tokamak building retaining walls has commenced, and should be completed by February 2012.

Our Division continues to move ahead. A set of Division Rules has been drafted. The Oak Ridge National Lab organizers are making progress on the 2012 TOFE meeting; there is a separate article about that meeting in this newsletter. I hope everyone will support the coming TOFE.

FED Slate of Candidates, Lance Snead, Oak Ridge National Laboratory, Oak Ridge, TN.

The slate of candidates for the upcoming Fusion Energy Division election is now complete. This winter, FED members will receive an e-mail from ANS with the web address where they can electronically vote. The election results will be tallied in the Spring of 2012 and will be announced before the June 2012 FED meeting.

The slate of candidates is given below. The current Chair, Lee Cadwallader, will become Past Chair. The current Vice-Chair/Chair-Elect, Minami Yoda, will become FED Chair at the end of the FED Executive Committee meeting in June 2012. Our Secretary/ Treasurer, Mark Anderson, agreed to serve for another year to synchronize the new 2-year terms of the Officers, and that year for synchronization is coming to a close. Three FED Executive Committee members, Lucille Dauffy, Rick Kurtz, and Shahram Sharafat, are also reaching the end of their terms. We thank all of these members for their service. The candidates for these Executive Committee positions are:

Vice-Chair	Susana Reyes (LLNL)
Secretary-Treasurer	Stephen Combs (ORNL)

Executive Committee candidates, in alphabetical order:

Ryan Abbott (LLNL)
Satoshi Konishi (Kyoto University)
Jacob Leachman (Washington State University).

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 2011 fusion awards on this well-deserved recognition and our kudos to all of them.

APS Awards

Three awards were presented by the American Physical Society (APS) to recognize a particular achievement in plasma physics research:

- **Gregor Morfill** (Max-Planck-Institute für extraterrestrische Physik) received the James Clerk Maxwell Prize for Plasma Physics for pioneering and seminal contributions to the field of dusty plasmas, including work leading to the discovery of plasma crystals, to an explanation for the complicated structure of

Saturn's rings, and to microgravity dusty plasma experiments conducted first on parabolic-trajectory flights and then on the International Space Station.

- A team of researchers (**P. Bowe, J. Fajans, M. Fujiwara, J. Hangst, J. Wurtele, M. Charlton, F. Robicheaux, D. Van der Werf, N. Madsen, W. Bertsche, and D. Silveira**) received the John Dawson Award for Excellence in Plasma Physics for the introduction and use of innovative plasma techniques which produced the first demonstration of the trapping of antihydrogen.
- **Felix Parra** (University of Oxford) received the Marshall N. Rosenbluth Outstanding Doctoral Thesis Award for demonstrating limitations in the gyrokinetic theory of the radial electric field for plasmas in an axisymmetric magnetic field and formulating alternative procedure-insights that have inspired research around the world.

DOE Award

Nine winners of the 2011 Ernest Orlando Lawrence Award were named in eight categories for their outstanding contributions in research and development, supporting the Department of Energy (DOE) and its missions. Fusion researcher **Riccard Betti** was among those selected. He is honored for a series of impactful theoretical discoveries in the physics of inertial confinement fusion, including seminal transformative work on thermonuclear ignition, hydrodynamic instabilities and implosion dynamics, and the development of innovative approaches to ignition and high energy gains.

Edward Teller Medal

The recipient of the 2011 Edward Teller Medal is **Bruce Remington** (LLNL). He was cited for his "pioneering scientific work in the fields of inertial confinement fusion, laboratory astrophysics and high pressure material science and leadership in development of an international effort in high energy density laboratory astrophysics."

FPA Awards

Three awards were presented by the Fusion Power Associates (FPA) Board of Directors to **Ronald R. Parker** (MIT), **Keith Matzen** (SNL), and **Mike Dunne** (LLNL). The 2011 Awards will be presented at the FPA annual meeting and symposium, December 14-15 in Washington, DC:

- **Ronald R. Parker** (MIT) received the Distinguished Career Award. In selecting Dr. **Parker**, the FPA Board recognizes his decades of career contributions to fusion research and development, including his many scientific and technical contributions to fusion development, the leadership he provided to the evolution of the Alcator program at Massachusetts Institute Technology, his leadership of the MIT Plasma Science and Fusion Center, and his contributions to the evolution of the ITER project.
- **Keith Matzen (SNL)** received the Leadership Award. In selecting Dr. **Matzen**, the FPA Board recognizes his many scientific and technical contributions to fusion development and the leadership he has been providing to the US and world inertial fusion efforts, including the leadership he is providing to the field of pulsed power and its applications to stockpile stewardship, high energy density physics, and inertial fusion energy.

- **Mike Dunne** (LLNL) received the Excellence in Fusion Engineering Award. In selecting Dr. **Dunne**, the FPA Board recognizes his many technical contributions to high energy density physics and laser facility design and operations, both in the UK and in the US, and also the leadership he has been providing at LLNL to the LIFE project.

SOFE Award

Three awards were presented at the 24th Symposium on Fusion Engineering (SOFE) in Chicago, IL to **Rem Haange**, **Michael Ulrickson,** and **Wenyu Xu:**

- **Rem Haange** (ITER) received the 2011 SOFE Award for his transformational technical leadership of international fusion experiments and lifetime dedication to furthering the development of fusion energy.
- **Michael Ulrickson** (SNL) received the 2010 IEEE/NPSS Fusion Technology Award for his outstanding and innovative technical leadership in the development of plasma facing components for fusion energy, for his leadership contributions to the ITER Blanket Integrated Product Team and the US ITER Domestic Agency, and for his many years of service to the fusion energy sciences community.
- **Wenyu Xu** received the Best Student Paper Award for his SOFE paper "Thermoelectric Driven Liquid Lithium Flow for Divertor Heat Handling."

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 October 1, 2010 to September 30, 2011), FS&T received a total of 348 manuscripts for FS&T regular issues and 189 camera-ready papers for FS&T Transactions. Of the 348 regular manuscripts, 112 were from North America, 139 from Asia, 91 from Europe (including Russia), and 6 from others.

The breakdown for 189 camera-ready papers for FS&T Transactions is as follows:

- 85 papers from the 8th 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 23rd IAEA-FEC in Daejeon, Korea, October 9–10, 2010
- 80 papers from the 15th International Conference on Emerging Nuclear Energy Systems (ICENES), held in San Francisco, CA, May 15-19, 2011.

All FS&T 2011 issues are published and 2012 issues are assigned through May 2012.

The following dedicated issues were published during the period 10/1/10 to 9/30/11:

- Selected papers from 6th Fusion Data Validation – FS&T Oct./Nov. 2010
- Selected papers from 19th IFE Target Fabrication 2010 – FS&T Jan 2011
- Open Systems 2010 Proceedings – FS&T Transactions (Feb. 2011)
- 4th ITER Summer School (IISS2010) Lectures – FS&T April 2011
- Selected papers from 2010 EC-16 – FS&T May 2011
- IAEA 1st Int. Fusion Youth Conference (IYC2010) – FS&T Transactions (July 2011)
- 19th TOFE 2010 Proceedings – FS&T Jul. & Aug. 2011

• 9th Tritium 2010 Proceedings – FS&T Oct. & Nov. 2011.

The following issues are scheduled/planned for 2012 and beyond:

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

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.

ONGOING FUSION RESEARCH

Fusion Neutronics Activities at ENEA in Support of ITER and DEMO,

Maurizio Angelone, Paola Batistoni, Mario Pillon, and Rosaria Villari, ENEA Frascati Research Centre, Rome, Italy.

Introduction

For more than twenty years, the Italian Agency for New Technologies (ENEA) has been active in the development of Fusion Neutronics, performing many key neutronics experiments at the Frascati 14-MeV Neutron Generator (FNG), with the development and validation of neutronics codes and nuclear data for fusion, and with significantly support of the ITER nuclear design. Referring only to the most recent activities, ENEA has completed at FNG a new experiment on a mock-up of the ITER inboard shield for the verification/validation of the calculations of the nuclear heating on the inboard leg of the toroidal magnet. After the completion of the neutronics experiment on a mockup of the Helium Cooled Pebble Bed (HCBP) Test Blanket Module (TBM), the experiment on the Helium Cooled Lithium Lead (HCLL) TBM has been completed.

ENEA has been involved for several years in ITER and DEMO neutronics. 3D neutronic analyses are performed for the design of relevant components and safety issues. The MCNP5 code is the main tool used. The nuclear responses required for the design are the neutron and gamma fluxes and spectra, nuclear heating, dpa, He-production, tritium production as well as induced transmutation. They are obtained by neutron and photon transport calculations convolving the radiation flux spectra with the proper nuclear data. Concerning nuclear safety and waste management, neutronics calculations are needed to perform shielding analysis, activation and shutdown dose rate predictions. We provide the main results in the following sections.

Recent Neutronics Experiments

A new shielding experiment for ITER has been recently carried out [1]. A mock-up of the ITER inboard shielding blanket, vacuum vessel and TF coil was set up at FNG and irradiated with 14 MeV neutrons. The mock-up dimensions and materials composition were consistent with the current ITER design.

The primary objective of the experiment was to validate the MCNP calculations (C) of nuclear heating in the TF coil at the inboard side by comparison with the measured nuclear heating (E) in that region. The goal of the experiment was to reach an accuracy on C/E ratio 1±10%. The nuclear heating was measured by using high sensitivity thermoluminescent dosimeters (TLD) made of LiF. Doses as low as a few tens of micrograys were measured in the coil region up to about 95 cm (behind about 80 cm of bulk shield). C/E values for the nuclear heating, obtained the Monte Carlo code MCNP5 coupled with the FENDL-2.1 library, were found in very good agreement within an overall error <10% both in the shield and in the magnet region.

The shielding properties of the ITER inboard shield were also studied throughout the measurement of selected activation reaction rates up to about 95 cm. Due to the very low activity induced in the foils, the measurements in the deepest experimental positions were performed at the underground low background facility of the Laboratori Nazionali del Gran Sasso, using ultra-low background high purity germanium (HPGe) detectors. The measured reaction rates were thus compared with the results of the Monte Carlo code MCNP5 coupled with the FENDL-2.1 library. There is generally a good agreement between calculations and measurements, with some deviations within ± 15% in the shielding block.

Numerical predictions of the tritium production rate and of other nuclear loads in breeder blankets, with related uncertainties, have been validated experimentally in two neutronics experiments performed at FNG on mock-ups of the two European HCBP and HCLL TBMs (Figs. 1a and b). The two mock-ups were designed in such a way to reproduce as closely as possible all the relevant nuclear details of blanket module configurations. The experiments were carried out in collaboration with ENEA, Karlsruhe Institute of Technology (KIT), Krakow University of Science and Technology (AGH), Josef Stefan Institute of Ljubljana, and JAEA. The tritium production rates (TPR) were measured in both mock-ups by irradiating them for long times at FNG and using different probes containing ^{6}Li and ^{7}Li [2,3].

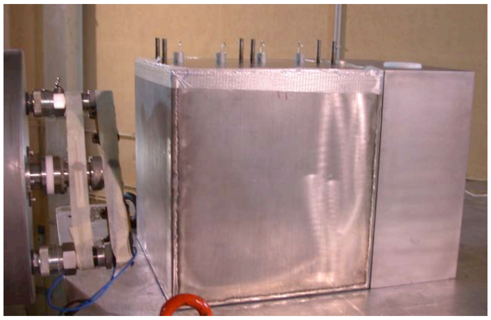	
Fig. 1a. HCPB mock-up assembled in front of FNG target.	Fig. 1b. HCLL mock-up assembled in front of FNG target.

Based on MCNP and on the EFF-3.1 and FENDL-2.1 nuclear data files, the analysis of the HCPB experiment indicated that design calculations for the tritium breeding ratio of fusion power reactors employing a HCPB type breeder blanket are underestimated by ~ 10% and hence on the "safe side" for the reactor applications. The resulting total uncertainties on C/E for the TPR prediction, including experimental uncertainties, the nuclear data uncertainties and the statistical uncertainties of the Monte Carlo calculation are about 5% at the 1σ level. The observed underestimation of the measured tritium production by less than 10% on average is at the lower bound of the assessed uncertainty margin.

The analysis of the HCPB blanket experiment turned out to be more complicated because the Pb-Li material used in the mock-up turned out to be depleted in ^{6}Li. After a very accurate characterization of the Pb-Li material, the analysis of the HCLL experiment provided a very good agreement between measurements and calculations using both EFF-3.1 and FENDL-2.1 nuclear data files, within the total uncertainty of 5.5% at the 1σ level.

3D Neutronics Analyses

In recent years, the ENEA neutronics group has been mainly involved in the design of several relevant ITER components: divertor, in-vessel coils, TBMs, equatorial port plug and radial neutron camera diagnostic system and in DEMO studies.

Recently, nuclear analysis on the Edge Localised Mode (ELM) and Vertical Stabilizing (VS) coils have been performed based on the last design specifications integrated into the 40° ITER Alite MCNP model (Fig. 2) [4].

In a first stage, the blanket/manifold original description was not modified as the coils cut across the interposing structures. In a second stage, manifolds were simulated in front of poloidal legs of ELM coils located behind gaps. In the original configuration (without front manifolds) the total nuclear power deposited on ELM coils is ~3 MW. The peak nuclear heating on the conductor is 1.7 W/cm^3 and the peak damage is 0.4 dpa.

Concerning the insulator, the maximum cumulative dose is 4210 MGy, dose rate 211 Gy/s, and neutron fast fluence $3.45x10^{20}$ n/cm^2. Nuclear parameters show a great spatial variation. Peak values are found in a limited zone close to the blanket gaps. An increase of about 50% is obtained behind the poloidal gap with respect to the parts of the coils far from the gap. Without a front manifold, the CuCrZr nuclear heating ratio between front and rear coils is ~3, whereas with front manifold it is ~5. Concerning the toroidal segments of lower ELM, the nuclear heating in the bottom coils, shielded by blanket modules, is about 50% of that in the top ones. In the presence of manifolds, the He-production exceeds the limit for vacuum vessel reweldability but only in zones where the rewelding is not foreseen. Activation analysis has been carried out with FISPACT 2007 and the results showed that the activation is high mainly in the conductor and in the front steel components.

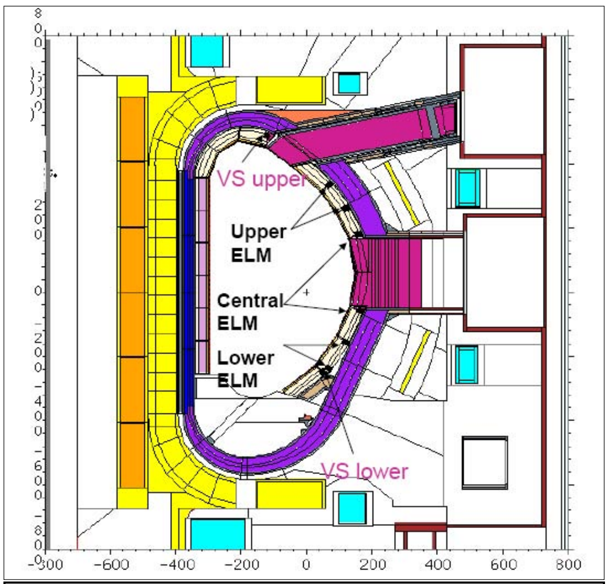

Fig. 2. Vertical section (y-z, x=0) of Alite.4 MCNP model with in-vessel coils.

For DEMO breeding blanket design, the dual-cooled LiPb (DCLL) and the water-cooled LiPb (WCLL) were studied [5]. The calculations were mainly oriented to evaluate the tritium production and the impact of the gap width between the blanket modules on the tritium breeding ratio (TBR). Results on DCLL showed that above a certain poloidal gap thickness (40 mm) the TBR is not enough to guarantee self-sufficiency and that long poloidal banana type blanket modules (without toroidal gaps) are preferable to the Multi-module segmentation. The nuclear loads on the toroidal field coils are expected to be within the limits (assuming ITER design limits). Dpa and helium production radial profiles also showed the severe irradiation conditions that will be expected in DEMO compared to ITER.

References:
[1] M. Angelone, P. Batistoni, F. Moro, M. Pillon, R. Villari, M. Loughlin, "A Neutronics Shielding Mock-up Experiment for Reduction of Uncertainty on the Prediction of the ITER-TFC Nuclear Heating," accepted for publication in Fusion Science and Technology.
[2] P. Batistoni, M. Angelone, L. Bettinali, P. Carconi, U. Fischer, I. Kodeli, D. Leichtle, K. Ochiai, R. Perel, M. Pillon, I. Schäfer, K. Seidel, Y. Verzilov, R. Villari, G. Zappa, "Neutronics Experiment on a Helium Cooled Pebble Bed (HCPB) Breeder Blanket Mock-up," Fusion Engineering and Design 82, Issues 15-24 (2007) 2095-2104.
[3] P. Batistoni, M. Angelone, P. Carconi, U. Fischer, K. Fleischer, K. Kondo, A. Klix, I. Kodeli, D. Leichtle, L. Petrizzi, M. Pillon, W. Pohorecki, M. Sommer, A. Trkov, R. Villari, "Neutronics Experiments on HCPB and HCLL TBM Mock-ups in Preparation of Nuclear Measurements in ITER," Fusion Engineering and Design 85, Issues 7-9 (2010) 1675-1680.
[4] R. Villari et al., "Three Dimensional Neutronics Analysis of the ITER In-vessel Coils," Fusion Engineering and Design 86, Issues 6-8 (2011) 584-587.
[5] L. Petrizzi, R. Villari, F. Moro, "Final Report on Neutronic Analysis of DCLL and WCLL Blankets," Task EFDA TW6-TRP-005 Del. 01, ENEA Report FUS TN BB R 030 (Dec. 2009).

International Workshop on MFE Roadmapping, H. Neilson, Princeton Plasma Physics Laboratory, Princeton, NJ.

Fusion researchers from 10 countries met 7-10 September at Princeton University to discuss the major steps on the roadmap to commercial fusion energy. The international workshop, "MFE [Magnetic Fusion Energy] Roadmapping in the ITER Era, was hosted by the Princeton Plasma Physics Laboratory (PPPL), organized by an international committee of fusion leaders, and attended by 65 participants. With the ITER project now launched on its mission to answer outstanding questions regarding the control of a burning plasma, the countries engaged in fusion research are planning, with renewed intensity, the research and major facilities needed to develop the fusion nuclear science and technology for harnessing fusion energy. The workshop filled a need for an international forum in which to exchange technical information and strategic perspectives on how best to tackle the remaining challenges leading to a magnetic fusion demonstration plant (Demo) and commercialization. The participation of leading fusion science and engineering researchers from around the world reflects a widely-felt sense of urgency in the need to collaborate more closely in meeting these challenges.

The workshop was organized around four topics: Fusion Technology, Physics-Technology Integration and Optimization, Major Facilities, and Perspectives on Demo and the Roadmap to Demo. There were 28 oral and nine poster presentations addressing these topics. The workshop closed with summary presentations on each topic. Workshop materials, including lists of the organizers and participants and all presentations and summaries, are available at http://advprojects.pppl.gov/Roadmapping.

Fusion Readiness to Move Forward

Participants from all of the ITER parties – Europe, Japan, China, Russia, India, South Korea, and the United States – presented their current thinking on the timescale for next-step fusion nuclear facilities. The speakers advocated a remarkably consistent timeline, despite some variation in the scale and scope of the facilities being considered. All said that serious planning should begin now, leading to construction in the 2020s, i.e. in parallel with ITER operation, and operation in the late-2020s to mid-2030s. Missions considered for the next step include materials R&D, component testing, reliability and availability growth, and electricity generation, all of which must be accomplished for a fusion Demo. All of these missions would require a D-T fusion plasma operating continuously for periods of weeks to months, tritium breeding leading to self-sufficiency, and remote maintenance. Options presented at the workshop range from fusion nuclear science facilities (FNSF) focused on materials research and component development to Pilot Plants or Demos designed to integrate the science and technology of a fusion system and demonstrate readiness for commercialization. At the same time, it was recognized that there is much to be done in smaller, more focused programs and facilities, utilizing computation and simulated environments to expedite progress, in order to develop the fusion nuclear science and technologies for integration and testing in large nuclear facilities. Moreover, it was agreed that ITER must be exploited to the fullest extent possible to make progress on these issues.

Need for Continued International Collaboration

The workshop underscored the necessity of continuing to collaborate internationally to resolve the outstanding challenges of fusion development. The scale and complexity of these challenges demand it. A continued international commitment to the success of ITER was seen as critical both to technical progress and to the credibility of the field. New mechanisms are needed for experts to collaborate in reaching a better technical understanding of the major development issues and the options for resolving them.

Key Roadmap Issues Requiring International Action

Workshop participants sought to identify technical issues of high strategic importance, where the choice of development strategy strongly influences the overall roadmap, and where there are divergent understandings in the world community. The result is a short list of topics, for which there is a need and an opportunity to follow up internationally with further discussion and joint work among specialists, in order to clarify the path forward:

A. **The assumptions used in fusion reactor design.**
   Fusion reactor designs depend sensitively on physics and technology assumptions used in the design. For example, assumptions about the bootstrap current fraction, overall current drive efficiency (wall plug to plasma), maximum divertor heat fluxes, radiation fraction, and tokamak operation above the no-wall beta limit have high leverage on the design. Some assumptions presume large advances over the long term. There is a need to clarify what assumptions are appropriate as a design basis for next-step facilities that could be ready to start construction in the next ten years or so.

B. The strategy for fusion materials development.

Irradiation testing is seen as a necessity, and may determine the critical path, for developing structural and first wall materials for Demo. The fusion community has long embraced the idea of an International Fusion Materials Irradiation Facility (IFMIF) to provide a fusion-relevant neutron source, but at this time there are no plans for construction of such a facility. The irradiation testing requirements to qualify materials for next-step fusion nuclear facilities may, depending on their mission, be much less than for Demo and may be satisfied with facilities that can be made available in the near term. There is a need for fusion facility planners and materials specialists to develop a plan for materials development and facility construction that is self-consistent.

C. The strategy for blanket development.

Tritium self-sufficiency is a requirement for fusion development beyond ITER, so breeding blankets will be a necessity for essentially any D-T fuelled next-step fusion nuclear facility, regardless of its mission. The blankets and associated tritium processing systems comprise a complex system with multiple functions, materials, loads, and environmental conditions. There is a need to devise a strategy for blanket technology development, addressing both materials and engineering issues that will lead to self-consistent solutions.

D. The strategy for plasma exhaust solution development.

The heat and particle exhaust requirements for high duty-factor fusion devices go well beyond those of ITER. There is a need to develop the physics and technology of plasma exhaust, including materials, divertor configurations, and operating scenarios, leading to solutions that are both self-consistent and compatible with plasma performance, energy conversion, and tritium breeding. The roles in an optimum development strategy of existing plasma devices, new non-nuclear facilities, ITER, and future fusion nuclear devices need to be understood.

E. The requirements and state-of-readiness for next-step facilities.

Plans for next-step fusion nuclear facilities generally call for construction to start in the 2020s and proceed in parallel with ITER operation. Analyses of the status of key fusion technologies needed for such facilities indicate wide readiness gaps and a need for large development programs. A self-consistent plan for closing the gaps in time to support the facility planning schedules does not exist. While the policy environment and resource availability can vary from country to country, the question of technical readiness can be judged by the international community of fusion scientists and engineers. There is a need for national programs to develop their design options in more detail, and for the international community to begin a critical examination of both the facility plans and technology programs, and foster work that will reconcile the two.

Follow-up Action

The workshop closed with a strong consensus among participants on the need for international action to follow up on the issues identified. To give one example, there is interest within the International Atomic Energy Agency (IAEA) in fostering international collaboration aimed at identifying the steps on the roadmap to commercial fusion energy. Actions toward this end might take the form of working groups, possibly organized under IAEA auspices around the key issues described above. Workshop participants agreed that such activity would be valuable for helping the world community work toward a common technical understanding of the needed steps.

INTERNATIONAL ACTIVITIES

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

The worldwide ITER team has continued its focus on completing the design and moving to construction. In Cadarache, France, buildings are progressing, with the basement of the nuclear Tokamak Building having been poured and seismic isolators being installed, the Poloidal Field Coil Building for the fabrication of the largest coils nearing completion, and the Headquarters Building at full-height with completion scheduled for Summer 2012.

The ITER licensing process has made significant progress, with the public inquiry process having been completed with a "favorable" outcome. The French regulator's experts are completing their reviews of the ITER safety documents, with reports to the regulator expected before the end of 2011.

Long-lead components are in fabrication. For example, over 70% of the US's 40 tons of Nb_3Sn superconducting strand (to be cabled and integrated into conduit for the European-fabricated Toroidal Field Coils) has been fabricated; similar percentages have been achieved by other ITER Members' Domestic Agencies. Industrial contracts have been placed; for example, Areva Federal Services, under contract to the US Domestic Agency, has completed Final Design for 5 drain tanks to be installed into the basement of the Tokamak Building and a fabrication contract has been placed; General Atomics has been awarded the contract for fabrication of the 7 Central Solenoid modules utilizing the square cable-in-conduit conductor supplied by the Japanese Domestic Agency.

The November 2011 ITER Council meeting recognized the progress made by the ITER Organization and the Domestic Agencies and noted the ITER team's successful efforts to minimize the impacts of the Great Eastern Japanese Earthquake of March 11, 2011 and to make design decisions to enable the transition to fabrication by the Domestic Agencies. The Council noted that the project is within the schedule range established at the July 2010 Council meeting. The Council received the report of the second ITER Management Assessor, which noted the effective leadership of the new management team and suggested improvements aimed at achieving even greater effectiveness. Lastly, the Council elected new leaders, including Dr. Hideyuki Takatsu as ITER Council Chair, replacing Academician Evgeny Velhikov who completed his 2-year term.

FUSION CONFERENCE

First Call for Papers for the 20th Topical Meeting on the Technology of Fusion Energy (TOFE-2012) August 27th - 31st, 2012, Nashville, TN USA,

David Rasmussen, Brad Nelson, Arnie Lumsdaine, Oak Ridge National Laboratory, Oak Ridge, TN.

Call for Papers

General Co-Chairs Brad Nelson and David Rasmussen and Technical Program Committee Chair Arnold Lumsdaine recently announced the First Call for Papers for the 20th Topical Meeting on the Technology of Fusion Energy, TOFE-2012. The Topical Meeting will be held at the Hutton Hotel in Nashville, Tennessee, from August 27-31, 2012. For more information, please visit the TOFE-2012 website www.tofe2012.org. The deadline for abstract submissions is February 1, 2012.

Sponsors

The meeting is sponsored by the ANS Fusion Energy Division and the ANS Oak Ridge/Knoxville Local Section which includes the Vanderbilt University Student Section and the University of Tennessee, Knoxville Student Section.

TOFE-2012 Program

The TOFE-2012 Topical Meeting theme is "Realizing New Technology for the Age of Fusion Energy". The meeting is a forum for sharing progress in fusion research and advancement of fusion technology as well as presenting plans for national and worldwide fusion programs. The meeting scope spans the scientific, technological and engineering issues of fusion energy research. The meeting will feature a mixture of oral presentations and poster sessions allowing for extensive interactions among the participants.

Oak Ridge National Laboratory Tour August 31

The meeting also features an optional day tour on August 31, of Oak Ridge National Laboratory's neutron and materials science facilities, including the Spallation Neutron Source and the High Flux Isotope Reactor (see Fig. 1).

Technical Topics

Submissions in all areas of magnetic fusion energy (MFE) and inertial fusion energy (IFE) are sought. Topics include:

- Progress of Major Fusion Experiments
- Materials and Component Test Facilities
- Power Plant Studies
- Next Step Facilities and the Demonstration Power Plant
- Alternate Fusion Concepts
- Fission-Fusion Hybrids
- Power Conversions
- Safety and Environment
- Non-Electric Applications of Fusion

- Plasma Engineering, Heating, and Cooling
- Plasma Material Interactions
- Fuel Handling and Processing
- Diagnostics (Plasma and Others)
- Materials Development and Modeling
- Computational Tools and Validation Experiments
- Nuclear Analysis and Experiments (Neutronics and Shielding)
- In-Vessel Components (First Wall, Blanket, Shield, Vacuum Vessel)
- Divertors and High Heat Flux Components
- Fabrication, Assembly and Maintenance
- Magnets
- IFE Driver and Chamber Technology
- IFE Target Design, Fabrication and Injection.

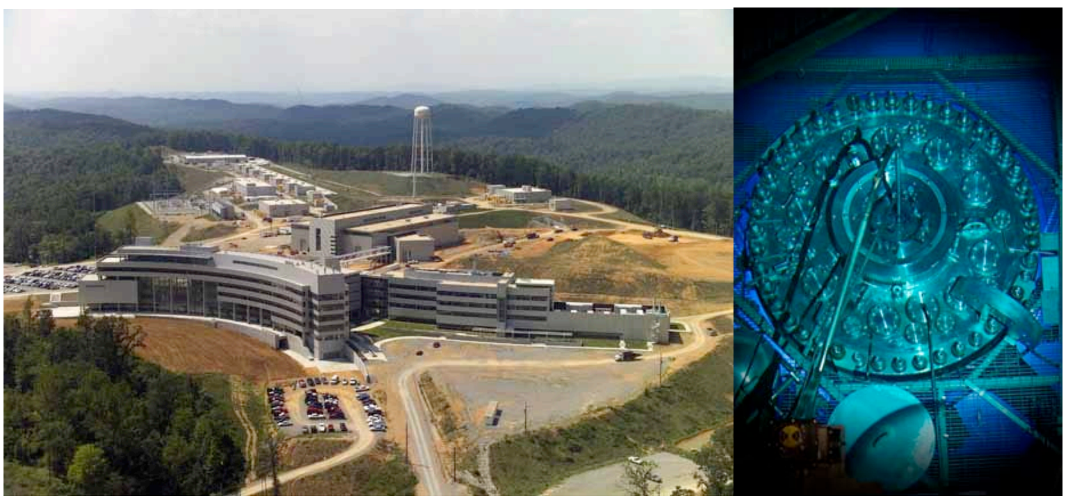

Figure 1. Spallation Neutron Source and High Flux Isotope Reactor at Oak Ridge National Laboratory.

Conference Venue

The meeting venue is the Hutton Hotel (Fig. 2) located in Nashville's West End. There is easy access to restaurants, attractions, nightlife and the Vanderbilt University campus. The Hutton Hotel website is www.huttonhotel.com.

Figure 2. Hutton Hotel, Nashville, TN.

Nashville Attractions

Nashville's most famous attractions are directly music-related. Music is the ribbon that weaves the city together, intertwining history, arts, culture and sports into one dynamic cultural package. From gospel spirituals and bluegrass to modern pop and blues, Nashville is "Music City." The downtown area of Nashville features a diverse assortment of entertainment, dining, and cultural and architectural attractions. The Broadway and 2nd Avenue areas feature entertainment venues, nightclubs and a variety of restaurants. Nashville's attractions (Fig. 3) include Music Row, Honky Tonk Highway, Ryman Auditorium, Opryland, Sommet Center, Bluebird Cafe and more. They can be reached by public transportation or short taxi rides from the Hutton Hotel.

Figure 3. Nashville "Music City" attractions.

Nashville is also known for its dedication to higher education with more than 17 colleges and universities in the Middle Tennessee region, including Vanderbilt University and Fisk University.

CLIFE (Conference on Laser Inertial Fusion Energy) 2012, Takayoshi Norimatsu, Institute of Laser Engineering, Osaka University, Japan.

General Information

The first Conference on Laser Inertial Fusion Energy (CLIFE) will be held in Pacifico, Yokohama, Japan April 25-27, 2012. This conference is chaired by H. Azechi (ILE, Japan), M. Dunne (LLNL, USA) and J. M. Perlado (IFE, Spain) collaboratively and organized by the Institute of Laser Engineering, Osaka University as one of five meetings of the Optics Photonics International Congress (OPIC) 2012. OPIC consists of the 1st Advanced Lasers & Photon Source Conference (ALPS '12), Laser Display Conference '12 (LDC '12), Conference on Laser Surgery and Medicine (CLSM 2012), International Conference on High-Energy Density Science 2012 (HEDS 2012), and this conference (CLIFE 2012). The first day (April 25) is a plenary session on laser development strategy including some tutorial lectures. On April 26 and 27, there are parallel sessions for ALPS, LDC, CLSM, HEDS and CLIFE.

During the conference, an Optics & Photonics International exhibition will be held simultaneously on April 24 to 27 at Pacifico, Yokohama. It is the largest exhibition in Japan with over 3000 participants annually. These conferences and exhibition are a good opportunity to exchange information between leading areas of science and technology.

Selected papers from CLIFE will be published in a special issue of Plasma and Fusion Research (an electronic journal of the Japan Society of Plasma Science) and Nuclear Fusion. Detailed instructions will be available at the conference website.

Background of Conference and Scope

In the field of laser fusion, ignition and burn of deuterium and tritium fuel will be achieved with the Megajoule class laser at the Lawrence Livermore National Laboratory (LLNL). A similar project aiming at ignition and burn is under construction at the Laser Megajoule (LMJ) facility in France. The energy and characteristics of these lasers are typical of that expected for one shot of a future laser fusion power plant. After ignition and burn, it is anticipated that a series of laser fusion power plants will be constructed that require operation of laser shots at a high repetition rate.

There is, however, a significant valley between current single-shot-base technologies and those required for a future power plant. We need a well-developed strategy to realize the required technologies. In the past, physics of core plasma, laser drivers, targets and systems have been discussed at different conferences such as IFSA, CLEO, TFM and ISFNT. Connection between these important elements is essential. We now offer the opportunity to get together to assess system-wide design issues to realize the potential of laser fusion power.

The 1st Conference on Laser Inertial Fusion Energy covers the following major topical fields:

- Roadmaps for power plants and national projects across the world
- Core plasma

- Physics of ignition and burn
- Target design

- Fuel Targets
  - Fabrication
  - Injection, tracking and engagement
- Laser drivers
  - Components for high rep-rate, high efficiency drivers
  - System integration
  - Cost evaluation
- Plant designs
  - Chamber designs
  - Materials
  - Final optics
- Economics, licensing, safety (including tritium control in plant) and environmental impact.

Location and Venue

Yokohama, which has developed into Japan's second largest city with a population of 3.68 million, is now home to many citizens of foreign nationalities, and with 8 sister/friendship cities and 6 sister/friendship/trade cooperation ports, is an international city representative of Japan.

In over 150 years since the opening of its port, Yokohama has played a large role in Japan's modernization and internationalization as its gateway of exchange to the world. Furthermore, Yokohama's cityscape is a fusion of lush nature and modern urbanism, and with the opportunity to experience traditional culture, a variety of cuisines, and diverse entertainment, Yokohama is truly a tourist city full of resources and attractions.

The conference venue of CLIFE is Pacifico Yokohama, Kanagawa prefecture which is located south of Tokyo. The Pacifico Yokohama convention center is conveniently located about 40 minutes from Haneda Airport and 90 minutes from Narita Airport when traveling by Limousine Bus. Pacifico Yokohama provides large space to meet the needs of world-scale conventions. All of its world-class facilities including the National Convention Hall of Yokohama, the Conference Center, the Exhibition Hall and the hotel have expanded the possibilities for conventions. Also noteworthy are easy access from the urban core and the comfortable environment surrounded by greenery and water. The modern facilities and experienced staff are available 24 hours every day.

The chairs of CLIFE encourage you and your colleagues to attend CLIFE 2012 in Yokohama for a valuable experience and enjoyable visit to an exciting city.

Submission of Summary

A one or two page summary should be submitted electronically, no later than Dec. 20, 2011. Authors are requested to submit a summary written in English, that fits within a two page 17 cm x 24 cm template, including text, figures, tables, and references. The template for papers will be available on the website.

Websites

CLIFE	http://www.ile.osaka-u.ac.jp/clife/
OPIC	http://opicon.jp/
Pacifico Yokohama	http://www.pacifico.co.jp/english/index.html
JSPF	http://www.jspf.or.jp/index.html.en
ILE, Osaka Univ.	http://www.ile.osaka-u.ac.jp/.

CALENDAR OF UPCOMING CONFERENCES ON FUSION TECHNOLOGY

2012:

ANS Annual Meeting
June 24-28, 2012, Chicago, Illinois, USA
http://www.ans.org/

ANS 20th Topical Meeting on the Technology of Fusion Energy – TOFE-2012
August 27-31, 2012, Nashville, Tennessee, USA
http://www.tofe2012.org/

24th IAEA Fusion Energy Conference
8-13 October 2012, San Diego, CA, USA
http://www-naweb.iaea.org/napc/physics/PS/conf.htm

54th American Physical Society - Division of Plasma Physics (APS-DPP) meeting
October 29-November 2, 2012, Providence, Rhode Island, USA
http://www.apsdpp.org

27th 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:

25th Symposium on Fusion Engineering – SOFE-2013
June 10-14, 2013, San Francisco, CA, USA
http://SOFE2013.org

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

11th International Symposium on Fusion Nuclear Technology - ISFNT-11
September 11-16, 2013, Barcelona, Spain
Joaquin.sanchez@ciemat.es

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, Colorado, USA
http://www.apsdpp.org

2014:

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

56th 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/