American Nuclear Society
Fusion Energy Division
December 2010 Newsletter

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

I would like to thank Dr. Lance Snead, the outgoing chair of the Fusion Energy Division (FED), for his service during his term. Lance now serves as Past Chair and I have already called upon him for several tasks, which he has performed in the best tradition of service to the fusion community.

As this decade comes to a close, I note that this is an exciting time in fusion research. The National Ignition Facility was dedicated in May 2009 and the ITER project selected Cadarache as the site in June 2005. ITER continues to work toward construction. Site preparation and leveling for the tokamak buildings was completed in 2009. Earth moving for construction of the PF magnet assembly building began in the fall of 2010. The ITER Council approved a budget in July 2010, which has led to cost containment approaches that will help keep the project on budget. As you have read in the June 2010 FED newsletter, the American Society of Mechanical Engineers has formed a new division of the internationally recognized Section III design code. Section III, Division 4 is titled "Magnetic Fusion Energy Confinement Devices" and the effort dwells on writing design rules for vacuum vessels, cryostats, and other pressure retaining components used in fusion. The Division 4 stakeholder committee has been fortunate to have representatives from inertial fusion attend as well. Some may argue that this task is premature, but development of a good set of design rules takes time. This code development effort shows that parties outside of fusion believe that fusion is reaching a point to warrant codes on good design practices.

Our Division has some news and a goal as well. In the June 2010 FED Executive Committee meeting, Lance Snead gave a good discussion of the issues surrounding service as Division Chair, predominantly the idea that more time served as Chair would lead to better results. Farrokh Najmabadi, a Past Chair, agreed with these insights. The FED Executive Committee voted to lengthen the terms of Chair and Vice-Chair from one to two years. Our Secretary-Treasurer, Mark Anderson, already serves a two-year term of office. As a result, in the next ballot we will ask members to affirm the Executive Committee's decision by approving term extensions of myself as Chair and Minami Yoda as Vice-Chair. Mark Anderson has agreed to serve an additional year as secretary-treasurer to synchronize the three terms of office and we seek Division assent for that extension as well. One of our important goals is to form a Division legacy in the form of an academic scholarship for a student studying fusion. Thanks to Jeff Latkowski and the highly successful 18th TOFE he organized, the Division now has nearly half of the endowment funds needed to initiate a typical ANS scholarship of $3,000/year. Minami Yoda, Vice-Chair, and I are evaluating ways to raise the rest of the required funds. The opportunity to foster at least one fusion student is highly satisfying. I ask that anyone interested in supporting this activity contact me or the other officers.

I also want to thank the organizers of the 19th TOFE, Shahram Sharafat, Laila El-Guebaly, and Farrokh Najmabadi, for their service to the fusion community.

New ANS Fusion Fellows – November 2010, Nermin A. Uckan, 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 and Materials Science Fellow added to the honors rank: Dr. Lance L. Snead. Congratulations for a well-deserved honor.

Lance Snead, ANS member for 25 years and past chair of FED, was recognized as a Fellow of the American Nuclear Society during the ANS Winter Meeting, held in Las Vegas, Nov. 7-11, 2010.

Lance Snead is a Distinguished Research Staff member, in the Materials Science and Technology Division of Oak Ridge National Laboratory. He is recognized for his theory and experimental conduct of radiation materials science studies in support of fusion and fission power systems. His citation reads, "Dr. Snead is the leading international expert on radiation effects in silicon carbide and other ceramic composites for fusion and advanced fission reactors. His ground-breaking research includes development of a new class of radiation-tolerant ceramic composites resulting in significant advances in fundamental understanding of radiation-induced microstructural evolution in structural materials."

Lance Snead's research results with silicon carbide composites included elastic behavior of the fibers, the ceramic matrix, and the composite interface to enable an integrated and synergistic model of the material that further enabled evolutionary development of the composites and a focused view of radiation effects on the individual components of the material, such as those on amorphization of the silicon carbide matrix. He performed both neutron and ion-beam irradiation experiments and developed an innovative nanoindentation technique for measuring the fiber/matrix interfacial strength of ceramic composites, a technique now used routinely in the field of ceramic composite research. The body of work with this material has led to sufficient understanding of its behavior in a radiation environment to allow for its use in design of various components of a fusion reactor (i.e., ITER), as well as for potential application in advanced high temperature fission reactors, for example as fuel cladding.

We (FED) now have about thirty fusion Fellows. During the past couple of years, the FED community has been working actively and diligently to nominate and add one or two well-deserving colleagues a year to FED Fellows roster. 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.

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 2010 fusion awards on this well-deserved recognition and our kudos to all of them.

ANS-FED Awards

2010 Outstanding Achievement Award: This is the most prestigious award of the FED and is presented to an ANS member in recognition of exemplary individual achievement requiring professional excellence and leadership of high caliber in Fusion Science and Engineering. The award to Professor **Robert Odette** (University of California, Santa Barbara) is made in recognition of his longstanding membership in the ANS and his seminal contributions in the field of radiation material science and the understanding of fusion materials over many years of research. Of particular note is his work on (i) the scientific underpinnings of the Master Curve description of ductile-to-brittle transition temperature shifts of irradiated metals, (ii) his development of models to track the transport and fate of helium and the development of helium-tolerant nano-structured ferritic steels, and (iii) the implementation of novel irradiation effects experiments, including the development of a "helium-implanter" concept that enables exploration of microstructural evolution at fusion relevant helium to atomic displacement ratios.

2010 Technical Accomplishment Award: This award is presented in recognition of an exemplary technical accomplishment requiring professional excellence of a high caliber in Fusion Science and Engineering. The award this year to Dr. **Alice Ying** (University of California, Los Angeles) is made in recognition of her substantial and original contributions to many key aspects of ceramic pebble bed blankets, particularly experiments and modeling of time-dependent thermo-mechanics interactions and deformation of ceramic breeder and beryllium pebble beds.

Outstanding Student Paper at the 19^{th} Topical Meeting on the Technology of Fusion Energy (held November 7-11, 2010 at Las Vegas, Nevada) is presented to **Brantley H. Mills** of the Georgia Institute of Technology for his paper "Experimental Investigation of Fin Enhancement for Gas-Cooled Divertor Concepts" with co-authors J.D. Rader, D.L. Sadowski, S.I. Abdel-Khalik, and M. Yoda.

APS Awards

The American Physical Society (APS) has selected Prof. **James Drake** (U. Maryland) as the recipient of its 2010 James Clerk Maxwell Prize for Plasma Physics. Prof. **Drake** is recognized "for pioneering investigations of plasma instabilities in magnetically-confined astrophysical and laser-driven plasmas; in particular, explication of the fundamental mechanism of fast reconnection of magnetic fields in plasmas; and leadership in promoting plasma science."

FPA Awards

2010 Distinguished Career Awards: Prof. **Miklos Porkolab** (MIT) and **Dmitri Ryutov** (LLNL) have been selected to receive these Awards. In selecting Prof. **Porkolab**, the Fusion Power Associates (FPA) Board recognizes his decades of career contributions to fusion research and development, including his pioneering contributions to wave-particle interactions, plasma heating and diagnostics development and the leadership he has provided to the MIT and world fusion programs. In selecting Dr. **Ryutov**, the FPA Board recognizes his decades of career contributions to fusion research and development in both the US and former Soviet Union, including his many innovative and stimulating contributions across a broad spectrum of fusion concepts and issues.

2010 Leadership Awards: Prof. **Riccardo Betti** (U. Rochester) and Dr. **Y-K. Martin Peng** (ORNL) have been selected to receive these Awards. In selecting Prof. **Betti**, the FPA Board recognizes the leadership he has been providing to the US and world inertial fusion efforts, including his contributions to the search for efficient methods of igniting fusion targets, contributions to the emerging field of high energy density physics, and his advisory role in the Department of Energy's Fusion Energy Sciences Advisory Committee. In selecting Dr. **Peng**, the FPA Board recognizes the seminal contributions he has made to the evolution of the Spherical Torus concept, the leadership he is providing to the world effort in that area and to the identification and advocacy of its several potential contributions to fusion energy development.

2010 Excellence in Fusion Engineering Award: Dr. **Pravesh Patel** (LLNL) has been selected to receive this Award. In selecting Dr. **Patel**, the FPA Board recognizes the contributions he has made to the field of relativistic laser-plasma interactions and the leadership he is providing to the development of the fast ignition concept for inertial fusion energy.

2010 Special Awards: Former fusion program senior managers at the US Department of Energy **Christopher J. Keane** and **John W. Willis** are the recipients of FPA Board of Directors Special Awards. Dr. **Keane**'s award is in recognition of and appreciation for his managerial contributions to the inertial confinement fusion technical program achievements that occurred during and beyond his tenure at the National Nuclear Security Administration of the US Department of Energy. Dr. **Willis**'s award is in recognition of and appreciation for his managerial contributions to the magnetic confinement fusion technical program achievements that occurred during and beyond his tenure at the US Department of Energy.

Nuclear Fusion Award

The recipient of the 2010 Nuclear Fusion Award is **John E Rice**, for the paper "Inter-Machine Comparison of Intrinsic Toroidal Rotation in Tokamaks," Nuclear Fusion 47, 1618-24 (2007). This seminal paper analyzes results across a range of machines in order to develop a universal scaling that can be used to predict intrinsic rotation. The timeliness of this paper is the anticipated applicability of this scaling to ITER.

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, 2009 to September 30, 2010), FS&T received a total of 345 manuscripts for FS&T regular issues. Of the 345 manuscripts, 132 were from North America, 98 from Asia, 114 from Europe (including Russia), and 1 from Others. During this period, FS&T also received 48 camera-ready papers from the 2009 Carolus Magnus Summer School (CMSS2009) for FS&T Transactions.

All FS&T issues for 2010 are published and all FS&T 2011 issues are assigned (or committed). Next available FS&T open issue is in 2012.

The following dedicated issues were published during the period 10/1/09 to 12/30/10:
- Tore Supra Tokamak (Cadarache, France) – FS&T Oct. 2009
- 9th Carolus Magnus Summer School (CMSS2009) – FS&T Trans. Feb. 2010
- Selected papers from APS-DPP 2009 Mini-Conference on Mirrors – FS&T May 2010
- Large Helical Device (LHD) 10th Anniversary - FS&T Jul./Aug. 2010
- Selected papers from 6th Fusion Data Validation, plus regular papers – FS&T Oct./Nov. 2010

The following issues are scheduled (and closed) for 2011:
- Selected papers from 19th IFE Target Fabrication 2010 – FS&T Jan. 2011
- Open Systems 2010 Proceedings – FS&T Transactions (Feb. 2011)
- 4th International 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 (IAEA-IYC2010) – FS&T Transactions (2011)
- 9th Tritium 2010 Proceedings – FS&T double issues Jul. & Aug. 2011
- 19th TOFE 2010 Proceedings – FS&T double issues Oct. & Nov. 2011

The following issues are planned for 2012:
- Selected papers from ICFRM 2011 – FS&T regular (double) issue(s) (2012)
- JT-60U (update of JT-60 Tokamak Special 2002) – FS&T regular issue (2012)
- ICENES 2011 Proceedings – FS&T Transactions (2012)
- 10th Carolus Magnus Summer School (CMSS2011) – FS&T Transactions (2012)

Effective mid-February of 2010, FS&T has moved to Editorial Manager (EM), a new online manuscript submission and review system. You can access the site directly at http://fst.edmgr.com/ or through the home page at http://www.ans.org/pubs/journals/fst/.

Please check for your library subscription. Electronic access to FS&T is available from 1997-to-current. ANS is planning to start adding pre-1997 back issues within the next few years. Tables of contents and abstracts of papers can be accessed by anyone 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:

Timely Delivery of Laser Inertial Fusion Energy, Mike Dunne, Lawrence Livermore National Laboratory, Livermore, CA.

Why, given its many benefits, has fusion largely been ignored in energy policy considerations? One key reason is its perceived inability to impact electricity production on the timescales required to address current policy imperatives. This arises from the need for incremental construction of large-scale demonstration facilities, serially phased due to the uncertain nature of the physics schemes, drivers, and materials requirements.

While recognizing there are still substantial hurdles to be overcome, the US is now in sight of a solution that could break this paradigm and deliver fusion energy soon enough to make a difference. This is made possible by adopting a power plant design that uses the physics scheme currently being tested on the National Ignition Facility (NIF) [1], coupled to a driver solution using existing manufacturing technology, and a new concept of plant operations that overcomes the need to wait for advanced material development. The project to deliver a power plant based on this approach is known as Laser Inertial Fusion Energy (LIFE).

The starting point for LIFE has been engagement with the electric utility companies and lessons learned from previous commercialization activities in the energy market. Of prime importance are issues such as plant availability, reliability and maintainability, the cost of electricity produced, the ability to protect capital investment, and the timeliness of rollout. Past technical designs, such as the High Average Power Laser initiative, earlier concepts proposing a "minimal extension of NIF", or any scheme relying on advanced ignition targets that cannot be tested at full scale in the near term, were all rejected.

One solution proposed in 2009 [2] was to adopt a fusion-fission hybrid design that relaxed the requirements on the fusion engine. This has now evolved to encompass a pure fusion design consistent with Gigawatt electrical output. The design incorporates:

- **Demonstrated plasma performance.** In the period 2011–2012, ignition on NIF is anticipated. Assuming success, the details that emerge will be used as the basis for LIFE, allowing full scale evidence of the required physics solution. IFE driver/target illumination combinations other than one based directly on NIF evidence would almost certainly require a new ignition demonstration facility, due to the strongly nonlinear coupling between driver and target that exceeds our ability to predict with the required level of confidence.
- **High plant availability**. Through the use of new driver architecture and the adoption of the NIF solution of "line replaceable units" (LRUs), the reliability of high threat, limited life components can be largely decoupled from the plant availability. Planned shutdown times arising from fusion-specific equipment are calculated via Monte Carlo analyses to be reduced to the few-percent level.
- **Available materials.** The pace of fusion delivery has been driven in large part by the long timescales associated with advanced materials development and certification for

high-threat components. Such materials are still required, but an intermediate solution is made possible by combining the LRU concept with a first wall/blanket architecture that is decoupled from the optical system and the vacuum boundary. A gas-protected dry wall solution has been adopted to capture the ions and reduce the thermal insult from x-rays to a level consistent with using available steel materials in a NIF-scale chamber. This allows construction of a demonstration plant alongside the materials development program, rather than being contingent upon its success.

- **Fuel supply.** Some fusion plant designs require large quantities of tritium for startup, at levels comparable to the available global inventory. By virtue of the high fractional burnup in an IFE capsule, use of a NIF-scale target, and appropriate design of the coolant systems, tritium requirements can be reduced by an order of magnitude.
- **Driver technology**. The mass markets associated with solid-state components, coupled to long-standing industrial experience of diode-pumped lasers provide a supply chain that now quotes price points consistent with a commercially viable rollout *with no new R&D*. This marks a step-change from just a few years ago, bringing solid-state lasers into an affordable range for plant construction.

The construction of a pre-commercial demonstration plant based on the above approach negates the need for an additional intermediate step to a commercial plant that would otherwise add 10–20 years and multi-$B in costs. The US alone can take full advantage of its leadership and prior investment in this area.

Technical Development

There remain significant technical hurdles to overcome to deliver a working fusion plant on the required timescale at acceptable cost. The most challenging aspects are not individual sub-system development, but rather their integration into an operational plant. As demonstrated with the NIF (and other large-scale undertakings such as the Large Hadron Collider and X-ray Free Electron Laser), it is highly advisable to tackle such issues through concurrent development programs within an engineering project tasked with self-consistent system delivery. This avoids sub-optimization of component systems, drives timely delivery, substantially reduces overall costs, and allows balanced investment decisions based on mission need and residual technical risk. The Inertial Fusion Energy (IFE) success is thus reliant on timely adoption of a top-level facility design.

In progressing the technical development program, it is critically important to start from the power plant design and associated regulatory requirements to determine an overall balance of priorities. All too often, we have focused on issues that are familiar territory to the labs working on fusion research – such as the IFE driver, or target plasma physics. These are obviously essential, but should be responsive to the needs of an overall development program, not its focal point.

By integrating economic models (considering capital and running costs, supply chain availability and timeliness of delivery) with performance models, substantially different optimization choices are made compared to analyses that consider performance alone. We see qualitative changes in parameters such as the desired driver efficiency, target gain, choice of coolant, and overall plant architecture. The separability of the sub-systems of an IFE plant remains a beneficial feature, but is more appropriate to the operational phase of a power plant rather than in its developmental phase – an issue that is often misunderstood when technology programs are being formulated. A modular design provides high maintainability and system availability, while also offering through-life operational improvements based on the likely advances to emerge from ongoing physics, materials and system optimization studies.

Delivery Path

A dual-track development solution seems appropriate for IFE, given the breadth of longer-term options. This would enable a balanced program with multiple technology options developed on timescales appropriate to each. This broad-based development would complement a focused national effort on a pre-commercial power plant designed to demonstrate all the required technologies and materials certification needed for the subsequent rollout of commercial electric power.

Material availability and tritium production calculations show that the rate and scale of market penetration can meet 25% of new build plants by 2050 and significantly more thereafter. Estimates of the capital and operational cost of this approach (using the MIT model) are competitive with new nuclear and proposed solution for sequestered carbon fossil-fuel plants. The precise details of the commercialization step will of course depend on the licensing regime adopted for such power plants – an issue that needs concerted attention, and is likely to be greatly eased by adopting a pure fusion solution.

The timeliness requirements for commercial delivery are compelling. Rollout from the 2030s would remove 90-140 Gigatonnes of CO_2-equivalent carbon emissions by the end of the century (assuming US coal plants are displaced and the doubling time for roll-out is between 5 and 10 years). Delaying rollout by just 10 years removes 30-35% of the carbon emission avoidance, which at $45/MT translates to a net present value of 70–120 B$. If IFE is to be a meaningful component of the solution, a focused delivery program is urgently needed. Similar arguments hold for MFE and other low carbon options.

Summary

A delivery-focused, evidence-based approach has been proposed to allow IFE power plant rollout on a timescale that meets policy imperatives and is consistent with utility planning horizons [3]. The system-level development path builds from our prior national investment over many decades and makes full use of the distributed national capability in laser technology, manufacturing industry, fusion science and nuclear engineering. It achieves this by starting from a proven physics scheme (assuming ignition on NIF), utilizing a line-replaceable unit approach based on available technologies to mitigate the demand for novel materials, and requires acceptable levels of tritium for startup.

Much technical development work still remains, as does alignment of key stakeholder groups to this newly emerging development option. If the required timeline is to be met, then preparation of a viable delivery program is required alongside the demonstration of ignition on NIF. This enables timely analysis of the technical and economic case, and establishment of the appropriate national partnerships.

References:
[1] The NIF Project: https://lasers.llnl.gov/.
[2] E. Moses et al., *Fusion Science and Technology* **56** (2), 547 (2009).
[3] See proceedings of ANS 19th Topical Meeting on the Technology of Fusion Energy.

INTERNATIONAL ACTIVITIES

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

In July 2010, the ITER Council approved the project Baseline, consisting of the project scope, cost and schedule, with the early finish date for First Plasma being November 2019 and the start of Deuterium-Tritium operation in March 2027 or earlier. Achievement of this significant milestone enables the project to move into the construction phase in which industry is engaged for detailed design and manufacturing design, leading to contracts for fabrication. The Council also thanked Director General Kaname Ikeda for his leadership in getting the project to this stage, appointed Professor Osamu Motojima as the project's second Director General, and approved his proposed ITER Organization management structure.

The new Director-General has focused on the implementation of the ITER Baseline, with the objective of meeting the cost and schedule expectations. The Director General has initiated a set of cost-containment/cost-reduction activities in the ITER Organization (IO), in conjunction with the Domestic Agencies (DAs); these activities have identified an initial set of savings in hardware and efficiencies. The IO and DAs are working to conduct the tasks needed to maintain or recover the schedule.

In July, the ITER site was officially transferred from the French CEA to the ITER Organization and construction activities have commenced. More than 80% of the tokamak excavation has been completed in November 2010, along with foundation works for the future permanent Headquarters building and the start of the PF coil winding building.

At the November 2010 ITER Council meeting, Director-General Osamu Motojima presented a status report of the project that entered the Construction Phase immediately after the Baseline was approved. The Director General presented a new strategy for cost savings and cost containment. Indicating the progress of the design and arrangements with the Domestic Agencies, 46 procurement arrangements representing 60% of the total value of the project have been signed between the ITER Organization and the Domestic Agencies. The Council encouraged further efforts by the ITER Organization and the Domestic Agencies to improve coordination and to reduce costs. The Council approved the Annual Work Plan and the Budget for 2011 and re-elected the Chairs of the ITER Council and its subsidiary bodies.

On the US domestic front, the US Contributions to ITER Project underwent a DOE Office of Science Project Assessment (i.e., Lehman Review) in Summer 2010, consistent with the fundamental project management culture in the Department of Energy's Office of Science. The US ITER project is addressing the recommendations made by the committee.

The US ITER team is responsible for fabricating nine ITER hardware components. The focus on prototyping and design is now underway, in most cases at the level of preliminary design, with the conceptual design of over 75% of the systems having been completed earlier in 2010. The US ITER remains on schedule to complete preliminary design packages for the majority of its technical subsystems by the middle of FY 2012, enabling the establishment of the US baseline in Summer 2012. Long-lead procurements continue to ensure timely hardware deliveries consistent with the needs of the ITER Assembly Plan. US ITER will transition from R&D/design to industrial fabrication in FY 2013 following the CD-2 critical decision.

More than 200 companies and universities in 35 states and the District of Columbia have been working directly with the project. Since conception and initial start-up, US ITER Procurement has awarded more than $90M to US industries and universities.

For additional information about the ITER project, please go to http://www.usiter.org/, http://www.iter.org/ or http://www.iter.org/newsline.

FUSION CONFERENCES

15th International Conference on Emerging Nuclear Energy Systems,

Wayne Meier, Lawrence Livermore National Laboratory, Livermore, CA.

The 15th International Conference on Emerging Nuclear Energy Systems (ICENES) is being hosted by the Northern California Section of the American Nuclear Society and two ANS Technical Divisions – Fusion Energy Division and Operations & Power Division. The conference will be held May 15-19, 2011 at Hyatt Fisherman's Wharf in San Francisco.

ICENES has a long history as a venue for sharing ideas and research results on emerging nuclear energy technologies and applications. The complete list of conference topics can be found on the website www.icenes2011.org. The 2011 ICENES will focus on topics that intersect the interests of researchers and leaders in fusion and fission energy systems. Nearly 40 invited speakers have confirmed their participation. Members of the fusion community are encouraged to submit abstracts and attend the meeting.

The deadline for abstract submission has been extended to **December 10**.

Announcement of ICOPS/SOFE 2011, Charles Neumeyer, Princeton Plasma Physics Laboratory, Princeton, NJ.

General Information

The 38th International Conference on Plasma Science (ICOPS) will be held jointly with the 24th Symposium on Fusion Engineering (SOFE) in Chicago, Illinois, USA, June 26-30, 2011. The conference chairpersons are Ahmed Hassanein (Purdue University) for ICOPS and Charles Neumeyer (Princeton Plasma Physics Laboratory) for SOFE. The joint association of these two conferences follows a successful tradition of fostering close interaction between the plasma science and fusion energy communities and provides a central gathering place for the international community of researchers in basic plasma physics and plasma applications. In addition to the conference, a mini-course on Plasma-Material Interaction will be offered which will be of interest to both plasma science and fusion energy researchers. Selected papers from both ICOPS and SOFE will be published in special issues of the Institute of Electrical and Electronics Engineers (IEEE) Nuclear and Plasma Science Society (NPSS) journal *Transactions on Plasma Science*.

Location and Venue

Chicago is the third most populous city in the United States, with over 2.8 million living within the city limits. The city is a major hub for industry, business, finance and commerce, with O'Hare International Airport being the second busiest airport in the world. Chicago is the home of unique cultural expression in art, architecture, and the performing arts, including improvisational comedy, and music, such as Chicago blues and soul. The city is also known for various culinary dishes, notably deep-dish pizza, the Chicago-style hot dog, and the Chicago-style Italian beef sandwich.

The conference venue is the Hyatt Regency McCormick Place hotel, adjacent to the McCormick Place Convention Center and just outside the hustle and bustle of Downtown Chicago. Nearby attractions include the Navy Pier, Millennium Park, Art Institute, Shedd Aquarium, Adler Planetarium, Soldier Field, Michigan Avenue and State Street shopping, and more. Transportation is available via taxi and public transportation including the METRA system.

The organizing committee, as well as the IEEE NPSS, encourages you and your companions to attend ICOPS/SOFE 2011 in Chicago for a valuable technical experience and an enjoyable visit to an exciting city.

Conference Topics

SOFE Topics:

- Experimental Devices
- Fusion Development – Pathways from science to practical fusion energy
- Plasma-Material Interface
- Neutronics
- Blanket, Shield, and Vacuum Vessel
- Divertors, Plasma Fueling, and Exhaust Processing
- Plasma Heating and Current Drive

- Magnets
- Power Supply Systems
- IFE: Drivers and Other Needed Technologies
- Diagnostics, Data Acquisition, Plasma Control and Protection
- Fabrication, Assembly, Remote Handling and Maintenance
- Safety and Environmental Engineering
- Systems Engineering, Project Management, and Lessons Learned.

ICOPS Topics:

- Basic Processes in Fully and Partially Ionized Plasmas
- Microwave Generation and Plasma Interaction
- Charged Particle Beams and Sources
- High Energy Density Plasmas and their Interactions
- Industrial, Commercial and Medical Applications of Plasmas
- Plasma Diagnostics
- Pulsed Power and Other Plasma Applications.

Registration

Registration and abstract submittal will open on January 3, 2011 at: http://engineering.purdue.edu/ICOPS2011/.