Newsletter, December 1997

This issue includes the following topics:

Chairman's Message

The pace of change continues to be rapid. I would like to highlight three areas that will have important impacts on our profession: the National Ignition Facility (NIF) construction activities, the ITER construction decision, and the new ANS strategic plan.

NIF: The $1.2 billion NIF project now has $500 million committed to it through fiscal year 1998. Congress declined to appropriate all the money up front but it has voted the full requested appropriation each year of the project. It hasn't been a shoe-in. Each year there was considerable controversy. The remaining funds are within the $4.5 billion per year Stockpile Stewardship Program that Congress has supported, but we expect considerable debate each year, even though the Stewardship total is about half what the budget for nuclear weapons was during the 1980s. The fact that the Comprehensive Test Ban Treaty (CTBT) is before the Senate for ratification should, in fact, strengthen Congress' resolve to support the Stewardship program.

There is a three-story hole in the ground at LLNL in which the football stadium sized building is being built. Contracts are being inked all over the country. The total ICF Program appropriation for FY98 (including NIF) is $415 million. Anti-nuclear-weapons organizations filled suit and asked the judge for an injunction to stop construction. While the DOE has agreed to additional environmental studies, the judge has signaled several times that he will not stop construction. Thus, every indication to date is that NIF construction will be completed on schedule with the first cluster of eight beamlines available at the end of FY2001 and full construction complete in 2003. While NIF is being built for National security purposes, it will answer fundamental questions about the viability of inertial fusion as a source of electric power and contribute to fundamental sciences. DOE has accepted the recommendations of several studies and directed the NIF/ICF team to plan for expanded international collaboration on unclassified NIF experiments (about 80% of the total).

ITER: The fact that a three year transition period is being inserted between the end of the Engineering Design Activities and a formal construction decision (see C. Baker's article below) was a disappointment to many who wanted to see a construction decision immediately. Many of us have devoted much of our careers to trying to make fusion energy happen, and we'd all like to see it progress rapidly. During this period, many will be interacting with Congress to enhance interest in fusion energy.

As your Chairman, I have participated in the Fusion Energy Sciences Advisory Committee (FESAC) meetings on what to do about the ITER situation. As many of you know, a subcommittee chaired by Herman Grunder of CEBAF recommended strong support of ITER if a construction decision came forth soon. However, if it did not, the panel recommended studying lower cost options with our international partners. OFES is currently considering a new international strategy in addition to an ITER participation and will ask the FESAC for its reaction to the new strategy at the end of January. None of us have seen it yet.

The multi-billion dollar price tag for ITER could be one stumbling block in an era where it is difficult to secure funding for large science projects and new energy sources are just not a Congressional priority. This is one key reason why fusion energy is being approached on an international basis. However, it may be that we should also try to find lower cost ways to continue developing fusion energy.

I'm sure that if NIF had cost even $2 billion, it would not be under construction today, even with the strong National security implications and the pending CTBT debate. Our country, and, it appears to some extent, much of the world is continuing to back away >from large science. We must figure out if there is a way to make the fusion energy option available to future generations with smaller budgets, at least until one or more of several factors changes current thinking. Fortunately, there are several scenarios that could cause just such a change in thinking. Fixing global warming could become more of an accepted national issue. Power companies that are operating closer and closer to the margin could suffer more blackouts. Some scientific or technological event could cause another "sputnik" type of awakening to the importance of investing in science and technology. It is hard to predict if or when such things will make the climate more receptive. In the meantime I have found that there are many scientists and engineers who get even cleverer when they are told they cannot have as much money as they assumed was necessary and the whole field benefits from this imaginative thinking in the face of a challenge. I would urge us in the fusion community to respond positively to the current challenge and see how we might meet it.

ANS: The American Nuclear Society has also been shrinking as the nuclear power industry shrinks. ANS President Stan Hatcher initiated a strategic planning exercise to update the ANS's strategic long-range direction in order to meet this challenge. One of the elements of this rethink process was a pair of two-day planning sessions involving representatives of the ANS Board, the Staff, the Divisions, and the Committees. I attended representing FED. These were very lively sessions and there was much debate about what the major focus of ANS should be. Ultimately, the group did write a new plan. It was submitted to the full Board and adopted at the Winter Meeting in Albuquerque. The new ANS Mission Statement is:

> " The American Nuclear Society serves its members in their efforts to develop and safely apply nuclear science and technology for public benefit through knowledge exchange, professional development, and enhanced public understanding."

Notice the emphasis on "serves its members" and the fact that nuclear power is not singled out for emphasis. Four specific goals were adopted to support this mission:

By 2003,

1) ANS will be the recognized leader for the advancement of nuclear science and technology,

2) ANS will be its members' primary resource for professional development and knowledge exchange,

3) ANS will be recognized by the public as a credible source of nuclear science and technology information, and

4) ANS will be an active contributor to and participant in nuclear science and technology public policy issues.

Milestones and strategies were set in order to achieve these goals by 2003. Two Task Forces were established to help implement these goals: 1) Task Force on Infrastructure, Stan Hatcher Chair, and 2) Task Force on Financial Strategies, Denis O'Brien Chair.

This represents a significant change in direction for the ANS with a much stronger emphasis on being a better professional society. Many of the strategies such as stronger student support are things that our Division has emphasized for years. Here is another case where a challenge may bring about positive changes that we would all like to see. I urge those of you who might want to give input on this change in directions to give me your thoughts and/or pass them on to the above two Task Force Chairmen. Anyone wishing a copy of the new ANS Strategic Plan can E-mail Clement Wong, our Secretary/Treasurer, at wongc@gav.gat.com.

William Hogan

Reminder: 13th Topical Meeting - Nashville, June 7-11, 98

Plans are continuing for the ANS sponsored 13th Topical Meeting on the Technology of Fusion Energy. This meeting will be embedded in the ANS Annual summer meeting to be held from June 7-11, 1998 at the Opryland Hotel in Nashville. The call for papers released in October, is available on our web page at

http://www.ornl.gov/fed/ans98/ans98.html

This web site will be updated with more details as we finalize the plans and program for the meeting. Please check it out periodically. Remember, one-page paper summaries are due on January 9.

1998 FED Student Award for Fusion Science and Engineering

The Honors and Awards Committee of the Fusion Energy Division (FED) of the American Nuclear Society (ANS) is soliciting student papers for the 1998 FED Student Award for Fusion Science and Engineering. This student award will be presented at the Thirteenth Topical Meeting on Technology of Fusion Energy from June 7-11, 1998 in Nashville, Tennessee. The award consists of a Certificate of Accomplishment and a cash award. Travel support is also provided if the student attends the meeting to present their paper and receive their award. In addition, the student will be given the opportunity to publish his/her full length paper in FUSION TECHNOLOGY without a page charge. Eligibility and nomination requirements are summarized below.

Eligibility:

- Nominee must be a student sometime between September 1997 and June 1998.
- Nomination is made by a faculty member familiar with the accomplishment.
- Submit seven (7) copies of a complete research paper of journal publication caliber, plus nomination requirements listed below.

Nomination Requirements:

- Name and address of nominee
- Education (degrees with institutions, dates and field; present status, etc.)
- Nomination letter by a faculty member that includes comments on student's contributions to fusion science and engineering that would be recognized as significant by educators, scientists, and engineers; the creativity, novelty, and current and future importance of the accomplishment.

The award's purpose is to recognize a significant research accomplishment, of journal publication caliber, by a student in the fusion science and engineering area, and to encourage student involvement in future fusion energy programs.

Mail nominations to:

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Professor Gerald L. Kulcinski
Chair FED Honors and Awards Committee
University of Wisconsin-Madison
Department of Engineering Physics,
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        1500 Engineering Drive, #443
        Madison WI  53706-1687
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Nomination deadline is March 30, 1998.

Please make this announcement known to your colleagues and students.

Thank you for your cooperation.

Nominations for upcoming FED Elections

On Sunday 15 November 1997, your Division Board met and approved the following list of candidates. Early next year you will receive a ballot with the names of the candidates. It is important for all of you to return your ballot. Last year, 29% of our membership returned their ballots. Let us see if we can improve on this percentage. Also if you are interested in serving on the Executive Committee or running for office, please let the Board know. The Chairman of the nominating committee for 1999 will be Dr. W. Hogan. You can either contact him or any current member of the Board to express your interest.

The following is a list of candidates for 1998. They are listed by office seeking and alphabetical, not in recommendation.

Again, please return the ballot you receive this spring.

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                                             John Davis
                                             Past Chair
                                             Chair of Nominating Committee
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1998 Candidates

CHAIR:


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   Dr. Wayne A. Houlberg
   105 Claremont Rd.
   Oak Ridge, TN 37830
   E-mail: houlbergwa@ornl.gov
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VICE CHAIR: Vote for one (1)


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Secretary/Treasurer: Vote for one (1)


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   Dr. Sandra J. Brereton
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   E-mail: elguebaly@engr.wisc.edu
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EXECUTIVE COMMITTEE CANDIDATES: Vote for three (3)

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Status of ITER in U.S.

By: C. Baker, US Home Team Leader

ITER is in the sixth year of the presently-defined Engineering Design Activities (EDA) phase and is at a critical stage regarding its future. Looking back a number of important achievements have been accomplished. First, the ITER Project will meet its primary deliverable for the EDA, namely, to provide the information required to make a decision to proceed to construction. The EDA Agreement never envisioned a formal construction decision before the end of the EDA. Furthermore, the ITER Process of developing and implementing a truly international project team has been successful and serves as an excellent model for other international, large-scale scientific endeavors.

The ITER design effort is an unprecedented effort to address and solve the real-world challenges of producing practical fusion energy. It serves as an effective driver for the science and technology of fusion energy. International and national technical reviews were carried out this year, all of which concluded that the design meets ITER's mission requirements and is a suitable basis to proceed. Site evaluation activities are underway in Japan, Italy and Canada. The Parties are expected to provide detailed technical information on candidate sites in 1998. A coordinated, worldwide physics effort has been established to support ITER, which is stimulating further plasma science research. Much of the supporting technology R&D has been completed. Prototypes of key components are being fabricated and will be ready to be tested in the next phase.

On the international front, a recent review of the entire European fusion program concluded that ITER should be Europe's highest priority, even if built outside of Europe. The Russian Federation Government has formally authorized its officials to enter into negotiations for the construction phase. The Japanese Atomic Energy Commission has formed a high-level ITER Committee to evaluate and recommend a Japanese position regarding construction and siting of ITER in Japan - an interim report is expected in early 1998.

Because of constraints due to budgetary, political and licensing processes in the Parties, it is necessary to consider a Transition Phase between the end of the EDA and a formal construction decision. The Explorers from each Party have agreed on the outline of general tasks to be done in the Transition Period. The ITER Project Director, in consultation with the Home Team Leaders, has prepared a work plan for the Transition Phase for consideration by the ITER Governments. The U.S. Home Team is interacting with the Fusion Community to obtain input on proposed U.S. tasks in the Transition Phase. This will also depend on negotiations between the ITER Director and Home Teams.

The DOE's Fusion Energy Sciences Advisory Committee has also been charged to evaluate the U.S. role in the Transition and Construction Phases of ITER. FESAC has issued an interim report which supports continued U.S. participation but with a restructuring of its content and balance.

The following areas are being considered for U.S. participation in the Transition Phase:

- Complete testing of technology prototypes and related R&D (part of the originally planned U.S. obligation to the EDA). This has high value for the U.S. program because the results (e.g., information on magnets, high heat flux components, plasma heating and fueling, diagnostics, tritium handling) are relevant to almost all future fusion experimental devices including alternate concepts.

- Continue physics analysis and experiments to improve ITER's performance including possible design modifications to reduce costs. More effort is expected on plasma diagnostics and definition of planned experimental operating modes. This directly supports the goals of the restructured U.S. Fusion Energy Sciences Program.

- Planning for the application of state-of-the-art Information Management Technology, to both the construction of ITER and its experimental phase. This builds on and adds to U.S. leadership in this vital area for the future.

- Design and analysis in selected areas of special U.S. expertise to assist in licensing actions and to prepare for long-lead procurements. This directly supports the implementation of a burning plasma experiment somewhere in the world.

- Continued participation by U.S. industry to provide for increased readiness and risk reduction for a future decision on ITER construction.

Assessing Alternate Product Applications and Markets For Fusion

By: L. Waganer, The Boeing Company

A study of alternate fusion product applications and markets is being led by L. Waganer of The Boeing Company within the ARIES study effort directed by the University of California, San Diego. This study is being conducted to assess alternative uses for fusion other than generation of central station electrical power. A complete range of products derived from the fusion process is being examined to explore common categories of applications and markets served by these products. These products may employ a variety of fusion confinement approaches and a range of fusion fuels. Thus the products may be associated principally with energetic neutrons, high-energy charged particles, or intense radiation from the fusion process. The products considered include, but are not limited to, hydrogen production, tritium production, transmutation of nuclear waste, dissociation of chemical waste or warfare agents, desalination of water, space propulsion, radioisotope production, detection and remote sensing, radiography/tomography, radiotherapy, and altered (tailored) material properties.

A methodology based on the success or failure of previous large national and international technology development projects was developed to assess proposed fusion product applications. This evaluation methodology qualitatively evaluates a complete range of proposed fusion applications in terms of general categories of market potential, environmental considerations, economic impact, risk, and public perception. This evaluation will enable a more concentrated effort on those applications with the highest potential to best serve humankind and yet be a successful economic endeavor. An additive utility function of attribute weights and scores was chosen to describe and compare the collective attributes of the fusion product applications.

The intent of the study was to evaluate the products rather than the confinement concept or the fusion fuel. Many of the evaluation attributes, such as necessity, uniqueness, market potential, prestige, and public support, are related solely on the product itself. The remaining evaluation attributes have varying degrees of dependence of both the product and the confinement concept and the fusion fuel. The impact on the available resources, the environment, and the Gross National Product (GNP) is largely dependent on the product itself, but also to some degree on the confinement concept and the fusion fuel chosen. The attributes of investment, technical maturity, and time to market are strongly influenced by the confinement concept and the fuel used.

The range of fusion products was evaluated with the methodology, first by the author, then by a small team assisting the author and a few product advocates, and then by the entire ARIES team. This broadening constituency has helped to reduce bias introduced into the data. Sensitivity studies of the chosen attribute weighting values showed minimal changes in the resultant rankings. The preliminary ranking showed transmutation of nuclear waste, dissociation of chemical compounds, and production of hydrogen fuels to be the more promising products. This is because they all had significant market potential, could help the environment, and would have positive public support. Investment was reasonable, except for the hydrogen production; but offsetting that negative was a significant improvement in the GNP. These combinations of factors help make these applications the most favored. The application of land mine detection and remote sensing was next in that they require modest technology advances, investment, and time to market (positive attributes) which more than offset the minimal public support, prestige, improvement to the environment, and necessity for the product. Space propulsion has positive attributes because it uniquely can power a deep space probe almost indefinitely and would probably have a high prestige value. However, a large investment, long time to market, and technical maturity tend to bring its scores down. Large, central station electrical power production and local station electrical power production are products that are rated with positive potential, but the lack of economic competitiveness, the required large investment, technical maturity, and time to market draw down the other positive attributes. The remainder of the fusion products were judged to have overall positive values, but at similar or less values to that of electrical production. The only product judged to have a negative utility was the fusion-fission breeder. It had the same negative attributes as hydrogen and electricity production (costs, technical maturity, time to market) with the added negative attributes of minimal or no necessity, minimal environmental improvement, and little to no public or government support. It would improve the GNP and improve the natural resources, but this was not sufficient to offset the negative aspects of this product.

The application of the methodology is subjective and is dependent upon the current knowledge base of the products and the market environment. The methodology is flexible enough to allow new inputs and weighting factors to be employed to reassess the potential for the fusion applications in the evolving marketplace.

For more information on the assessment methodology and the preliminary results, see a preprint of L. Waganer's paper, "Assessment of Markets and Customers for Fusion Applications" presented at the 17th IEEE/NPSS Symposium on Fusion Engineering, October 6-9, 1997 (http://www.boeing.com/assocproducts/hienergy/waganerSOFE.htm).

International Activities

- Some Topics from the Fusion Program in Japan

- Under the auspices of the Atomic Energy Commission of Japan, the ITER Project Review Committee met in Tokyo on October 8. The committee consists of 23 prominent people from a broad spectrum of disciplines not limited to fusion. The committee has met seven times this year and expected to publish an interim report early 1998.

- On October 1996, JT-60U in JAERI achieved a QDT equivalent of ~ 1.05 in an advanced tokamak mode with reversed shear. This November, an advanced divertor configuration with a compact, closed divertor and W-shaped divertor plates demonstrated good helium exhaust capability, as measured by helium concentration of less than 10%. A long-pulse record was also set when a 10-keV plasma was sustained for 9 seconds by a time integrated heating of 203 MJ.

- Large Helical Device (LHD) construction is in the final stage of assembly in the National Institute of Fusion Sciences (NIFS). The installation of the bell-jar type cryostat over the superconducting helical coils started on October 30, 1997. First plasma is expected for end of March 1998.

- ITER Central Solenoid (CS) Coil manufacturing is in full swing, and the first superconducting heat treatment for the 11th and 12th layers of the CS Model Coil was completed in August 22, 1997. Uniform temperatures have been confirmed along the 4-m high winding for the duration of 240-hour heat treatment. Superconductor activation of the 11th and 12th layers of the CS Model Coil has been successful. By the end of October, winding of the Outer Module of the CS Model Coil was completed and a half of the heat treatment at 650 8C was finished.

- An ultra intense laser beam (100 TW, 100 J in 0.5 ps pulse) was completed at the Institute of Laser Engineering (ILE), Osaka University to demonstrate the fast ignitor concept of inertial confinement fusion. It is called "GEKKO XII Petawatt Module." The ultimate goal of the beam is to illuminate a high density target imploded by 12 beams from the GEKKO XII high power laser (15 kJ in 1 ns pulse).

- The closest counterpart of the ANS Fusion Energy Division in Japan is the Fusion Nuclear Technology Division of the Japan Atomic Energy Society. The Chairman of the Executive Committee is Professor Masahiro Nishikawa of Osaka University. The division, which has about 300 members, hosted the Fourth International Symposium on Fusion Nuclear Technology (ISFNT4) in Tokyo this past April and also sponsors a Summer School on Fusion Reactor every year.

- IEA Activities in Fusion Research

By: Michael Roberts, Director, International and Technology Division, Office of Fusion Energy Sciences, Office of Energy Research, US DOE

BACKGROUND: Under International Energy Agency (IEA) auspices, there are currently eight active agreements for international collaboration covering a wide range of fusion research efforts. On January 29, 1997, at the 26th meeting of the IEA Fusion Power Coordinating Committee (FPCC), the annual review of the progress in each of the agreements indicated continuation of productive work in each area. Five of these agreements are oriented toward specific fusion experimental facilities, and three are oriented toward cross-cutting topics as noted below:

"Project Agreements"

- IEA Agreement on Toroidal Physics in, and Plasma Technologies of, Tokamaks with Poloidal Field Divertors (ASDEX)
- IEA Agreement on Plasma Wall Interaction in TEXTOR
- IEA Agreement on the Three Large Tokamak Facilities
- IEA Agreement for Research and Development on Reversed Field Pinches (RFP)
- IEA Agreement on the Stellarator Concept

"Topical Agreements"

- IEA Agreement on Environmental, Safety and Economic Aspects of Fusion Power
- IEA Agreement on Fusion Materials
- IEA Agreement on Nuclear Technology of Fusion Reactors

"Inactive Agreement until a new task is identified"

- IEA Agreement on Superconducting Magnets (Large Coil Task)

PURPOSE: There are four Parties with large fusion programs, namely, the European Union (EU) and its Member States, Japan (JA), the Russian Federation (RF) and the United States (U.S.). The IEA, with Russia now participating in agreements as an Associate Contracting Party, provides a critical forum where these and other countries with fusion programs (namely, Canada and now China) are working directly together to develop more coordinated and efficient, agreement-based activities in the fusion program internationally. The mode of using Implementing Agreements provides a formal mechanism to integrate several related domestic activities into a single multinational collaboration while dealing with the legal, financial and administrative aspects of collaboration. This integration enhances the individual activities and avoids needless duplication and redundancy. The Agreements have been valuable in maximizing work in technical areas in which there are real opportunities for mutual benefit, bringing together scarce human, financial and material resources to accomplish necessary research and development in more comprehensive, cost-effective and/or rapid ways than practical by individual programs.

This Implementing Agreement mode complements the information exchange mode provided by the IAEA through its workshops, conferences, and the journal of Nuclear Fusion which operate through programs of work recommended by its International Fusion Research Council, the analog to the IEA's FPCC. Without the prior experience derived from joint multilateral activities under IEA agreements as well as the INTOR experience under IAEA auspices, it would have been significantly more difficult, and perhaps impossible, to reach an informed, multinational consensus to pursue the design of an international neutron irradiation test facility, now in process under IEA auspices, or the International Thermonuclear Experimental Reactor (ITER) project, now in process under the auspices of the IAEA.

The IEA framework also allows the U.S. to continue to play a useful role in a broad range of fusion activities even after its recent program reductions. For example, while the U.S. stellarator program remains active, this modest program does not have the benefit of a large-scale domestic facility. Through the IEA Stellarator agreement, however, the U.S. program does play an active role with JA, the EU, and the RF, working to carry out a vigorous international program involving U.S. scientists as key players, bringing to bear their strengths in theory, modeling, diagnostics, and small experiments. This same integration and multiplication of individual efforts is carried out in the other agreements as well. With their close coordination by individual executive committees who develop and approve annual programs of work, the IEA agreements can directly address and continue to support our recently restructured program.

HIGHLIGHTS (26th IEA-FPCC meeting on January 29, 1997 in Paris, France): The FPCC, during its annual meeting, endorsed the extensions for two IEA Implementing Agreements for five more years. The agreements which were extended are Plasma Wall Interaction in TEXTOR and the Environment, Safety, and Economic Aspects of Fusion Power.

A highly successful conceptual design activity for an International Fusion Materials Irradiation Facility was completed and the participants, the U.S., the EU, JA, and the RF, agreed that domestic technical reviews are needed before going on to a more detailed engineering design activity.

The FPCC supported the exploration of a Japanese proposal for an Annex III to the IEA Stellarator Agreement to support international collaboration on the JA National Institute for Fusion Science's new stellarator, the Large Helical Device in Toki.

The FPCC endorsed the proposed participation by the People's Republic of China (PRC) in the Fusion Materials Agreement. Subsequently, the IEA Committee on Energy Research and Technology (CERT) approved the PRC's participation as an Associate Contracting Party in the IEA Fusion Materials Agreement.

INITIATIVES: One of the newest activities is a set of tasks: one addresses the technical issues arising from a recently completed conceptual design of a high flux neutron source, and another is a feasibility study of a high volume neutron source. Another new activity is the exploration of the current and future uses of remote access to and participation in experiments.

NEXT IEA-FPCC MEETING: The 27th IEA-FPCC meeting is scheduled for January 28, 1998 in Paris, France.

- JET Announces World Records in Fusion Performance

JET has conducted a broad-based campaign to address issues of fusion power production and the physics of high performance plasma confinement in the geometry and operating conditions foreseen for the International Thermonuclear Experimental Reactor, ITER, currently in an advanced design state.

The key points are:

- JET has set three new world records in recent high power fusion experiments: 14 MJ of fusion energy, 13 MW of peak fusion power and a fusion Q (the ratio of fusion power produced to the net input power) of 60%.
- JET has demonstrated that in D-T there is a 25% reduction in the power needed to maintain high confinement during high fusion power operation - a very significant result for ITER.
- JET has tested the first large scale plant of the type needed to supply and process tritium in a future fusion power station.

For further information, contact Tom Elsworth (telsw@jet.uk) or visit the JET Web site: http://www.jet.uk.

Editorial Message

The ANS-FED Newsletter is issued twice yearly, in June and December. All issues are available at our Web site: http://www-ferp.ucsd.edu/ANS. At some point in the near future, we will rely heavily on electronic distribution of our newsletter. This will result in considerable savings in reproduction and postage expenses. The current intent is to send electronic copies of the newsletter to ANS members who have E-mail addresses and to some non-ANS members in the U.S. and abroad. Hard copies will be mailed UPON REQUEST to ANS members who do not have E-mail addresses.

The following request is addressed to ANS members who have received in the past hard copies of the newsletter: Please send immediately your E-mail address to
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(or bathke@lanl.gov)
or send a request in writing to receive hard copies of future issues. Write to:

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