

Newsletter, June 1997

This is the first electronic newsletter for the Fusion Energy Division (FED) of the American Nuclear Society (ANS). To obtain a readable format for the widest viewer audience possible, the format is plain ASCII text.

The FED plans on issuing two newsletters per year. The topics for this newsletter are:

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Message from the Chairman

I would like to review some of the accomplishments of the ANS Fusion Energy Division (FED) and the latest developments in the U.S. fusion program. Fusion is in a period of transition. There are greater challenges facing fusion today than in previous years. Chief among these is budgetary. At a time when magnetic fusion is making significant strides in plasma containment and understanding and when it appears to be on the threshold of achieving its goal, Congress is wavering in its support and has significantly reduced the budget over the past three years. The inertial fusion program has also made much technical progress, and their budget has increased dramatically, but exclusively for their Defense Program mission. From Congress' perspective the lack of an energy crisis reduces the need for a Demo by 2025; and, as a result, it is their opinion that fusion should focus on understanding the Science of Plasma Physics rather than on energy production. They also directed the Office of Fusion Energy Sciences (OFES) to restructure its objectives to reflect this changing role.

In an attempt to curtail this trend of decreasing budgets, the OFES held a Strategic Planning Workshop on October 22-24, 1996. An objective of this Workshop was to identify goals for measuring progress in the three program elements contained in the DOE Strategic Plan (DOE/ER-0684). The three elements are: (1) understanding the Physics of Plasmas, the fourth state of matter; (2) identifying and exploring innovative and cost-effective development paths to fusion energy; and (3) exploring the science and technology of energy producing plasmas, the next frontier in fusion research, as a partner in an international effort. Workshop participants represented the major magnetic and inertial programs; universities; and Congressional committees, in addition to representatives of the APS, IEEE, and the ANS/FED. John Davis participated on behalf of FED.

In addition to the Workshop, the ANS/FED, along with APS and IEEE, are participating in FESAC on an ex officio basis. This is an excellent opportunity for the FED, because it allows the Professional Societies to participate in an active way in the various reviews FESAC is asked to undertake. It also helps FED get a better understanding of the Issues and Challenges facing the OFES. One of the first reviews this fiscal year was to review the ITER Detailed Design Report (DDR) and to determine the adequacy of the DDR as part of the basis for a US decision to enter into negotiations past the explorer stage. This review was completed in April of this year. The ITER DDR report was accepted, based on this point in the study. Another review will be undertaken

when the Final Design Report is released in December 1997. A second review is in progress to identify the possible scenarios for US participation in ITER construction under the current budget guidelines. This subpanel is scheduled to report to FESAC in October of this year. We will update these activities in the next newsletter.

DID YOU EVER WONDER WHAT HAPPENS TO THE PUBLIC POLICY STATEMENTS CREATED BY THE DIVISION?

Contrary to popular thought, the Public Policy Statements developed by the Division are not filed in a drawer but are distributed. Recently FED updated the Policy Statement on the state of Fusion. After approval by the FED Board (June 1996), this statement was forwarded to the ANS Public Policy Committee for review and approval. At the ANS Winter Meeting (November 1996), it was reviewed and approved subject to minor changes. These changes were incorporated and the revised policy was sent to the ANS Board of Directors, who have subsequently approved the statement. The approved statement is now published on the ANS and FED web pages. The statement was also sent to the American Association of Engineering Societies for incorporation into their pamphlet on Public Policies and Priorities. The Fusion Policy can be found under Engineering Research and Innovation. This pamphlet is distributed to all member of Congress at the start of the Congressional Year.

In closing, I would like to say that it has been an honor to serve you as your 96/97 Chair of FED. I'm grateful to the members of the FED Executive Committee for their support of the division activities throughout the year. William Hogan will lead the division in 97-98. He will need the same support from all of us to continue improve our division. This doesn't mean that I am going away, but moving to the position of ex-chairman where I hope to be able to provide Bill with any support he requires to move the Division forward. We will make a good team with Bill's experience and understanding of Inertial Fusion and mine on Magnetic Fusion; we can ensure that both confinement concepts can be moved ahead. Thank you all for your support.

John Davis

Executive Committee and Officers

The Fusion Energy Division is fortunate to have 23 officers and committee chairs. We have an executive committee, a program committee, a nominating committee, an honors/awards committee, a membership committee, liaisons to other organizations, and representatives to various ANS committees. Three positions open each year for the Executive Committee. If you are interested in serving on this activity to further the goals of FED, please contact the FED Chair or any of the officers cited in this newsletter.

The FED executive committees and officers are listed below. The years of the term are quoted between brackets.

Chair:	William Hogan	(97-98)	bill-hogan@llnl.gov
Vice-Chair:	Wayne Houlberg	(97-98)	houlbergwa@ornl.gov
	(automatically becomes Chairman in 98)		
Secretary/Treasurer:	Clement Wong	(96-98)	wongc@gav.gat.com

Executive Committee Members:

Jim Anderson	(94-97)	jla@lanl.gov
Chuck Bathke	(95-98)	bathke@lanl.gov
Locke Bogart	(95-98)	elbogart@aol.com
John Davis	(94-97)	davis@lllslrv.mdc.com
Tom Dolan	(95-98)	T.Dolan@iaea.org
Don Dudziak	(96-99)	dudziak@ncsu.edu
Laila El-Guebaly	(94-97)	elguebaly@engr.wisc.edu
John Haines	(94-97)	hainesjr@fedc04.fed.ornl.gov
Grant Logan	(97-00)	logan1@llnl.gov
Kathy McCarthy	(96-99)	km3@inell.gov
Doug Post	(94-97)	postd@iterus.org
David Ruzic	(96-99)	druzic@uiuc.edu
Robert Santoro	(97-00)	santorr@sat.ipp-garching.mpg.de
Ken Schultz	(94-97)	schultz@gav.gat.com

FED Committee Chairs:

Nominating Committee:	John Davis
Honors/Awards Committee:	Gerald Kulcinski
Membership Committee:	Ken Schultz
13th Topical Committee:	John Davis
	John Haines
Liaisons to other Organizations:	John Davis -MS&T
	George Miley-IEEE
Representatives on ANS Program Committees:	John Haines
Representatives on ANS Publications Committees:	Ken Schultz
Representatives on ANS National Committees:	Kathy McCarthy

FED Newsletter Editors: Laila El-Guebaly and Chuck Bathke

ANS/FED Web site maintenance: Mark Tillack and Chuck Bathke

The FED executive committee usually meets on the first Sundays (2-4 PM) of the ANS summer and winter annual meetings. The room assignment can be obtained from the ANS secretary. All ANS-FED members are invited to attend. Please drop by to learn what the FED is doing these days.

FED Web Site

We are pleased to announce that, owing totally to the effort of Mark Tillack (UCSD), the FED World Wide Web site is now fully on line! Look for it at <http://www-ferp.ucsd.edu/ANS>; it includes the following:

FED Mission

ANS Policy Statement on Fusion Energy

Full List of Executive Committee and Officers

Executive Committee meeting minutes

FED Newsletters

Links to other Fusion Web Sites For comments on the FED Web site, contact the Web Masters Mark Tillack and C. Bathke via E-mail at: tillack@fusion.ucsd.edu and bathke@lanl.gov

The following sites have a wealth of information relevant to fusion researchers and links to other WWW locations:

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

<http://wwwofe.er.doe.gov/>

http://wwwofe.er.doe.gov/More_HTML/FusionDocs.html

The ANS FED WWW site has access to a number of Fusion Public Information resources that may be useful to you in making presentations about fusion, or even just telling others about these Web sites so they can explore Fusion on their own. Of particular interest may be the links to the fusion education programs and fusion education resources available at General Atomics, Princeton Plasma Physics Laboratory, and Lawrence Livermore National Laboratory, for both magnetic and inertial fusion information. To access the education resources, open the FED home page and then go to Educational Links.

Treasurer's Report

Our annual income mainly comes from the ANS (\$1 per person comes to FED from our membership dues), and any money we make from our bi-annual Topical meeting. For 1996, we received \$892 from the ANS and \$1800 from the Reno meeting. For the same time period, our expenses were \$2724, consisting of payments for awards, newsletter, national meetings (e.g., conference calls) and student support. Our

projected balance at the end of 1997 is \$6601. Since 1992, including surplus, our division has been keeping a balance from \$5200 to \$7500 in our account. Based on the recommendation of the Executive Committee at the last meeting in Orlando, Florida, that we should spend more on student awards and travel, the projected balance at the end of 1998 is \$3601 (this does not include any potential income from the 13th Topical Meeting to be held in Nashville).

	1996 actual	1997 projected	1998 proposed
INCOME (\$)			
- Member Dues	892	675	700
- Topical Profit	1800		TBD
- Pass Forward	7483	7451	6601
EXPENSES (\$)			
- Newsletter		100	100
- Awards	1469	325	1000
- Student Support	1000	500	2000
- Meetings	255	600	600
- Pass Forward	7451	6601	3601

Honors and Awards

The call for nominations for three major fusion awards that will be presented at the 13th Fusion Topical in Nashville, TN, will be issued in the Fall of 1997.

A brief description of each award is given below:

- THE OUTSTANDING TECHNICAL ACCOMPLISHMENT AWARD is presented to an ANS member for recognition of exemplary individual technical accomplishment requiring professional excellence of a high caliber in the area of fusion science and engineering.
- THE OUTSTANDING ACHIEVEMENT AWARD is presented to an ANS member for recognition of exemplary individual achievement requiring professional excellence and leadership of high caliber in the area of fusion science and engineering.
- THE FED STUDENT AWARD FOR FUSION SCIENCE AND ENGINEERING is presented to the student(s) who present the best paper(s) in the area of fusion science and engineering, and to encourage student involvement in future fusion energy progress.

Scientists and engineers who plan to make submissions should be preparing for those announcements. If you have any preliminary questions on these three awards, please contact:

Professor Gerald L. Kulcinski, Chairman
 ANS/FED Honors and Awards Committee
 University of Wisconsin-Madison
 Department of Engineering Physics
 1500 Engineering Drive
 Madison, WI 53706
 Telephone: (608) 263-2308
 Fax: (608) 263-4499

Fusion Energy Division Membership

The membership of the ANS Fusion Energy Division has unfortunately declined in recent years. This is surely a reflection of the fact that the magnetic fusion program that supports many of our members has

suffered a serious decline in recent years. This decline impacts us, because there are fewer journal articles and presentations at meetings from which we can learn, and it reduces the FED membership dues which support our student, honors & awards, and public outreach programs. We as a division need to try to reverse this trend.

	1992	1997	% Change
FED Membership	1070	675	-37%
OFES Budget	\$335M	\$225M	-33%
ICF Budget	\$165M	\$175M	+6%
(NIF Project	\$0	\$191M	--)

As the above table shows, our membership has paralleled the OFES budget. There does not seem to be a correlation with the ICF Program budget, perhaps because most of the ICF effort is directed toward defense rather than energy issues. However, as we move towards ITER and NIF, both of which will have significant neutron yields and thus significant nuclear concerns, ANS and FED membership will become more and more important. Many of the physicists and engineers that have worked on fusion experiments in the past did not have to worry too much about nuclear concerns. For ITER and NIF, the various components (chambers, first walls, diagnostics, etc.) WILL have serious nuclear concerns. This is the business of the ANS. We need to reach out to these currently non-nuclear physicists and engineers and convince them of the value of participation in the technical activities of the ANS and the FED to their technical work and to their careers. We request that each of you think about your colleagues and how the technical information available through participation in ANS activities could help them. Then go talk to them about the merits of joining the ANS/FED. Show them relevant papers in our journals (Fusion Technology, Nuclear Technology, and Nuclear Science and Engineering), show them the programs and proceedings of our Fusion Technology Topical Meeting , and ask them to join the ANS/FED. They can join via our WWW page at: <http://www.ans.org/>, or by calling ANS Membership Services at 708-579-8266.

The FED needs your support in this important effort.

Fusion Technology Journal Needs Your Help

The ANS journals are under increasing financial pressure. If present trends continue, they will soon become a financial liability to the ANS budget and risk being canceled. Our fusion journal, Fusion Technology, is of particular concern due to a growing number of unpaid page charges and declining library subscriptions (notably universities and Eastern Europe laboratories). It is imperative that all members of the Fusion Energy Division support our journal. In particular, we request that each member please take the following steps to keep Fusion Technology healthy:

1. Library subscriptions. Make sure the library at your organization receives a subscription.
2. Page charges. Make sure that you and others in your organization pay page charges for their papers.
3. Personal subscriptions. A good deal at \$85/year! Buy one! Just call ANS at 708-579-8266.
4. Contribute articles. For Fusion Technology to remain the leading journal, we must keep a steady flow of high-quality papers. We particularly encourage you to consider special issues and review articles.

Page charges are a particular concern. All ANS journals use page charges in order to offer subscriptions to members and libraries at significantly lower cost than that of commercial journals. Although ANS policy is to publish papers even if page charges cannot be paid, Fusion Technology counts on these page charges to balance its budget. Since page charges are levied after the paper is accepted, and the paper is written after the work is finished, difficulty frequently arises in paying these page charges since the grant or contract that sponsored the work is actually over. To help with this situation, ANS has established a new policy, and is willing to arrange with the authors to prepay estimated page charges while the contract is in place, for a paper they expect to write at the conclusion of the work. To take advantage of this new

arrangement, and prepay your page charges, contact Mary Beth Gardner at ANS Headquarters, 708-352-6611.

If you have further suggestions, please contact Ken Schultz, our division's representative to the ANS Publications Steering Committee or George Miley, Fusion Technology Editor (g-miley@uiuc.edu).

13th Topical Meeting on Technology of Fusion Energy

Plans are progressing 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. With the ITER-EDA Phase coming to a close near this time and the NIF project proceeding toward construction, this meeting will occur at an especially pivotal time for the fusion program. Participation in the meeting is expected to be quite strong.

Look for the First Call for Papers that will be sent in August. Abstracts will need to be submitted near the end of the year with papers due at the meeting. Accepted papers will be published in a special issue of Fusion Technology.

Get ready for a great meeting in Music City USA!

Highlights of Ongoing Fusion Research

1- Chemical Reactivity Experimental Work at INEEL

The Fusion Safety Program (FSP) at the Idaho National Engineering and Environmental Laboratory has been investigating chemical reactivity of fusion plasma facing materials experimentally for several years. Of particular interest is hydrogen production when hot plasma-facing surfaces are exposed to steam during a Loss of Coolant Accident. Materials studied experimentally include beryllium, tungsten alloy, carbon, stainless steel, niobium, and copper. Hydrogen production is measured by more than one method to increase confidence in the data. Measurement methods include direct measurement by mass spectrometer, gas chromatograph, or collection of gas, and indirect measurements such as hydrogen based on weight gain, thickness of oxide layer, and material recession.

In these experiments, the sample is brought to temperature under an argon gas purge. Either inductive and tube furnace heating can be used. Once the sample is at the desired test temperature, steam is allowed to flow through the system. Test times vary from very short (minutes) to long (hours) depending on the reactivity of the material and the test temperature.

Current chemical reactivity work is primarily in support of the International Thermonuclear Experimental Reactor (ITER). The first chemical reactivity tests on irradiated beryllium were done by the FSP in 1996 for the ITER project. The aim of these experiments was to determine the effect of irradiation on the chemical reactivity of the beryllium. Additional tests are planned for the summer of 1997 to further investigate this.

Recent attention has been focused on the chemical reactivity of tokamak dust. Because there are three plasma-facing materials planned for use in ITER: beryllium, carbon, and tungsten, the dust will likely be made up of all three of these materials. The dust may be more porous than the solid material already tested, providing increased surface area for chemical reactivity. The FSP will focus on chemical reactivity of tokamak dust during FY-98.

2- National Ignition Facility at LLNL

The National Ignition Facility (NIF) is an \$1.2 billion ICF facility in which a 1.8 MJ solid state laser will compress and heat an ICF target to ignition conditions. In ICF targets designed for high energy gain, the objective is to compress a lot of cold fuel and heat only a small portion of the center (i.e. the "spark plug"). Then the DT reactions in the center ignite more of the cold, surrounding fuel through deposition of the alpha energy. Ignition is defined as when the alpha deposition doubles the temperature obtained from the laser compression and heating alone. The NIF received authority to begin construction (Critical Decision 3) from the DOE on March 7, 1997 and a formal groundbreaking ceremony was held on May 29, 1997 with a list of distinguished speakers led by Secretary Pena.

Preliminary design (Title I) was completed last Fall and the team is well along into final design. In March initial site preparation work at LLNL began with the movement of some utility lines and parking lots. The excavation of the three story basement is scheduled to begin in July with substantial concrete pouring in the Fall. Through FY97, NIF has been appropriated about \$270 million. The administration has requested all remaining funds for NIF in the FY98 budget request.

A lawsuit to stop NIF has been filed by non-government organizations (NGOs), led by the Natural Resources Defense Council. The suit is actually against the entire Stockpile Stewardship and Management Program (SSMP) of which NIF is a key element. A Programmatic Environmental Impact Statement (PEIS) for the SSMP has been completed and a Record of Decision filed on December 19, 1996. Within that PEIS was contained the environmental documentation for NIF to satisfy the National Environmental Policy Act (NEPA) requirements. The NGOs have filed suit asserting that the PEIS process was flawed. They have asked for an injunction to stop all new activities within the SSMP, including NIF, until the case is heard. The hearing on the lawsuit was held June 17 with the decision on the request for an injunction due June 27, 1997. In the meantime construction on NIF is proceeding on schedule for a 2003 completion date (with initial operating capability in 2001).

International Activities

1- Fusion Research Activities at IAEA

The IAEA provides many services to facilitate nuclear fusion research: provision of nuclear data, atomic and molecular data, and plasma-material interaction data; the journal Nuclear Fusion; the biennial Fusion Energy Conference (Montreal 1996; Yokohama 1998); Coordinated Research Programs (CRPs); Technical Committee Meetings (TCMs); Advisory Group Meetings (AGMs); the book Energy from Inertial Fusion; the World Survey of Activities in Controlled Fusion Research; Technical Cooperation projects in developing countries; and provision of auspices for ITER.

The purposes of a CRP are to advance the research and to help developing countries improve their research capabilities. A joint research topic is selected, and each participant works on an appropriate aspect of the problem. A CRP typically involves about 6-15 participants, of which many are from developing countries, and lasts 2-5 years. Here are some recent CRP topics:

- Software development for numerical simulation and data processing,
- Plasma heating and diagnostics systems in developing countries,
- Lifetime prediction for a fusion reactor first wall,
- Plasma-interaction induced erosion of fusion reactor materials,
- Radiative cooling rates of fusion plasma impurities,
- Tritium retention and release from fusion reactor plasma facing components,
- Atomic and plasma-wall interaction data for fusion reactor divertor modeling, - Applications of Plasma Physics and Fusion Technology, - Reference data for thermo-mechanical properties of fusion reactor plasma facing materials.

Up to 50 participants, nominated by their governments, may attend a TCM, which typically lasts 2-4 days. The proceedings are usually published in a technical journal or as an IAEA TECDOC. Here are some

recent TCM topics:

- H Mode Physics,
- Alpha Particle Physics,
- Fusion Reactor Safety,
- Fusion Reactor Design,
- Inertial Fusion Energy,
- Research Using Small Tokamaks,
- Fusion plasma diagnostics,
- Advances in Computer Modeling of Fusion Plasmas,
- Steady State Operation of Tokamaks.

Advisory Group Meetings typically have 3-8 experts who discuss a specific issue and write a report. AGMs have been held on Inertial Fusion Energy and on Third World Plasma Research. In addition, the International Fusion Research Council, comprised of twelve senior fusion researchers, meets annually to advise the Agency on fusion matters. The IAEA is also coordinating its activities with those of the International Energy Agency (part of the Organization for Economic Cooperation and Development, Paris), which has 8 implementing agreements in various areas of fusion research.

2- Recent International Developments

In spite of the reduction of experimental programs in the USA, several new experiments are planned in other countries, for example:

- The Mega Ampere Spherical Torus (MAST) experiment will be built in England, following their success with the START experiment.
- The Institute for Plasma Research, Bhat, India, is designing the SST-1 superconducting tokamak, which will study the issues related to steady state operation of tokamaks, such as heat removal, particle control, and radiative layers.
- The Korea Basic Science Institute, Taejon, Korea, is designing a superconducting tokamak with $R \sim 1.6-2.0$ m, several MA current, and a pulse length of minutes. This experiment is expected to become operational in about 2002. To support this large project, the KBSI fusion research staff is being increased from 30 people to about 150 people. A superconducting tokamak is also being planned in China.
- The Large Helical Device, to start operation in March 1998 in Toki, Japan, is expected to confine plasmas with volume-averaged betas over 5% and $n\text{-}\tau\text{-}T > 10^{20}$ keV s/m³ with $T > 10$ keV, which is equivalent to a D-T plasma energy multiplication factor Q about one third. The achievement of such parameters in a stellarator could have significant impact on future research. The Wendelstein 7X stellarator in Greifswald, Germany, is beginning construction and will use modular coils that would have maintenance advantages in reactors. These new stellarators each cost hundreds of millions of dollars.

Thus, many countries recognize the need for fusion power and are continuing to build on current achievements.

Calendar of Upcoming Conferences on Fusion Technology

Fusion Power Associates Annual Meeting and Symposium
August 27-29, 1997, Aspen/Snowmass, Colorado
<http://aries.ucsd.edu/fpa/72570.707@compuserve.com>

Joint Conf. of 11th Int. Stellarator Conf. and 8th Int. Toki Conf. on

Plasma Physics and Controlled Nuclear Fusion (ITC-8)
29 September - 3 October, 1997, Gifu, Japan
itc8@nifs.ac.jp

17th IEEE/NPSS Symposium on Fusion Energy
October 6-10, 1997, San Diego, CA
<http://aries.ucsd.edu/SOFE97/>

Innovative Approaches to Fusion Energy (IAEA-TCM)
October 20-23, 1997, Pleasanton, California, USA
davalos1@llnl.gov

8th Int. Conference on Fusion Reactor Materials - ICFRM-8
October 26-31, 1997, Sendai, Japan
<http://www.icfrm8.nucle.tohoku.ac.jp/>
icfrm8@fusion.imr.tohoku.ac.jp

1997 ANS Winter Meeting
November 16-20, 1997, Albuquerque, NM
<http://www.ans.org/>

12th ICF Target Fabrication Specialists' Meeting
February, 1998, Jackson Hole, WY
lforem@lanl.gov

13th Topical Meeting on Technology of Fusion Energy
June 7-11, 1998, Nashville, TN

17th IAEA Fusion Energy Conference
October 20-26, 1998, Yokohama, Japan.
ide@naka.jaeri.go.jp

20th Symposium on Fusion Technology - SOFT 98
September 1998, Marseille, France

5th Int. Symposium on Fusion Nuclear Technology - ISFNT-5
October 1999, Rome, Italy

Any comments on FED newsletter!?

The FED newsletter will be issued twice a year. It can be accessed at: <http://www-ferp.ucsd.edu/ANS>. If you have newsworthy items to be considered for the next newsletter or if you have comments on this newsletter, please send them to: elguebaly@engr.wisc.edu or bathke@lanl.gov. We would like to hear from you...

Please share this newsletter with your colleagues as our E-mail distribution list is incomplete and excuse duplicate messages resulting from the overlap of some project E-mail aliases. The ANS membership form is our primary source for E-mail addresses. Unfortunately, not all FED members have included their E-mail addresses in the ANS membership form. Also, some E-mail addresses are misinterpreted as the form is often completed by hand. If you have not received an electronic copy of this newsletter or if you are aware of others (who need not be ANS members) who wish to receive this newsletter, please send an E-mail to: elguebaly@engr.wisc.edu

The content of this newsletter represents the views of the FED Executive Committee and does not constitute an official position of any U.S. governmental department or international agency.