



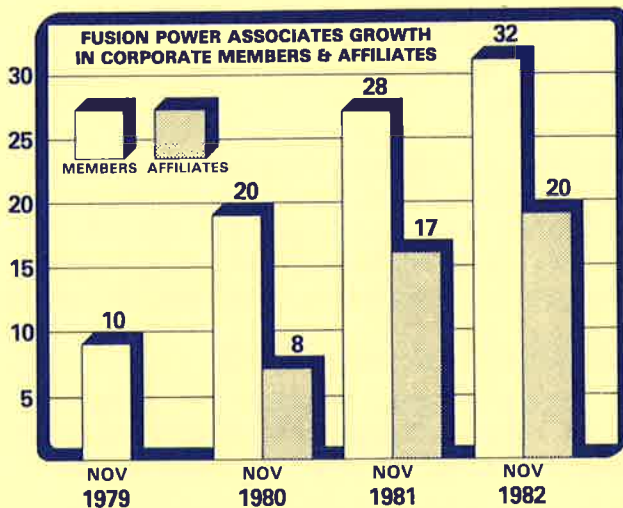
# FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20879

(301) 258-0545

## GROWTH IN MEMBERS AND AFFILIATES

Steady growth in the number of corporate members and affiliates continued during 1982. We now have a total of 32 members and 20 affiliates, compared to 10 members and 8 affiliates when we began in the fall of 1979. In addition we now have a total of 256 individual affiliates. We thank all our members and affiliates for their continued interest and support.



## GLASS APPOINTED FPA TREASURER

Dr. Alexander J. Glass, president of KMS Fusion, Inc., has accepted an appointment by the FPA Board of Directors to act as treasurer of FPA. Glass replaces Dr. Bernard J. Eastlund, vice president of BDM Corp., whose term on the FPA Board recently expired.

## FORMER FPA BOARD MEMBERS HONORED

The Board of Directors of Fusion Power Associates has voted to present certificates of appreciation to former members of the board, in recognition of their important contributions during the formative years of Fusion Power Associates. The former board members so-honored are: Henry J. Gomberg, Bernard J. Eastlund, Sherman Naymark, Glenn Sorenson and Alvin W. Trivelpiece.

## 1982 LEADERSHIP AWARDS PRESENTED

The Board of Directors of Fusion Power Associates has announced its selection of Harold P. Furth and John H. Nuckolls to receive the Fusion Power Associates leadership awards for 1982. The awards are given periodically to persons who have shown outstanding leadership qualities in guiding the evolution of fusion towards becoming a practical energy source. Furth is director of the Princeton Plasma Physics Laboratory. Nuckolls is associate program leader of the inertial confinement fusion program at Lawrence Livermore National Laboratory. Previous award recipients were Solomon J. Buchsbaum, Robert L. Hirsch, Mike McCormack, Paul Tsongas and Edwin E. Kintner.

## TFTR MAKES FIRST PLASMA

In the early morning hours of Christmas Eve 1982, Santa payed a visit to the Plasma Physics Laboratory at Princeton University and gave the scientists there their first plasma in the Tokamak Fusion Test Reactor (TFTR). We congratulate Paul Reardon, Don Grove and all those who have worked so hard to make TFTR a reality. We also especially commend some of the senior program managers who have backed this important project over the years. They include: Bob Hirsch, Mel Gottlieb, Harold Furth, Len Reichle and Nelson Grace. The initial operation of this large fusion test reactor is truly a major accomplishment along the difficult road to commercial fusion power.

## FIRST LARGE SC COIL ARRIVES FROM JAPAN

The first of 6 large superconducting test magnets has arrived at Oak Ridge National Laboratory. Although the Japanese magnet was the last to be initiated, it was the first to be completed, checked out and shipped to Oak Ridge. The other five coils include two from Europe and 3 from the U.S. The second coil is scheduled to arrive in February from General

Dynamics Convair Division. The purpose of the 6-coil test facility is to obtain engineering data for the optimized design of future super-conducting fusion devices.

#### DEAN VISITS JAPANESE FUSION FACILITIES

As part of a U.S. team, headed by Dr. William R. Ellis, Director, Mirror Confinement Systems Division, DOE, FPA president Steve Dean participated in the "Japan-U.S. Workshop on Review of Mirror Experiments" at the University of Tsukuba, Japan, December 6-10. While there Dean and Fred Coensgen of LLNL were also invited to tour the JT-60 tokamak construction site at the Japan Atomic Energy Research Institute (JAERI). JT-60 is a somewhat larger device than the largest tokamaks being built elsewhere, such as TFTR at Princeton and the JET at Culham. Dean noted, with envy, that the Japanese had selected a site for the follow-on Experimental Power Reactor, next to the JT-60 site and were effectively establishing a Center for Fusion Engineering (CFE) at the JAERI site. The CFE, a concept called for in the U.S. by the Magnetic Fusion Energy Engineering Act of 1980, has been sidetracked in the U.S. by the White House Office of Science and Technology Policy (OSTP). While in Japan, Dean was also invited to meet with a fusion task force of the Institute for Future Technology in Tokyo. He discussed aspects of systems analysis for fusion planning and presented a seminar on the benefits of international cooperation, based on a recent published study (see P.J. Kortman and S.O. Dean, in Nuclear Technology/Fusion, Vol. 2, No. 3, page 492, July 1982).



#### INESCO FORMS ADVISORY COMMITTEE

INESCO, a San Diego-based company formed by Dr. Robert W. Bussard to develop small commercial fusion devices based on the RIGGATRON™ concept, has hired a group of consultants to act as a scientific and technical advisory committee. Former congressman Mike McCormack will chair the committee, whose other members are Melvin B. Gottlieb, Robert Gross, Edwin E. Kintner, Robert Krakowski, John Landis, Larry M. Lidsky, Ronald Parker, Marshall N. Rosenbluth, Norman Rostoker and Martin Summerfield.

#### REPORTS AVAILABLE

"Future Engineering Needs of Magnetic Fusion" --report of the Committee on Magnetic Fusion of the National Research Council, Herbert H. Woodson, chairman. Available from John M. Richardson, National Research Council, Commission on Engineering and Technical Systems, 2101 Constitution Ave., Washington, D. C., 20418. No charge while supplies last. (202) 334-3344.

"Implications of Compact Fusion Concepts and Their Relationship with the Federal Program" --summary of a workshop organized by FPA for the National Science Foundation, Stephen O. Dean, Chairman. Available from FPA. No charge.

#### FPA REQUESTS ADDRESS CORRECTIONS

Are you receiving your newsletters promptly? If not, be sure we have your correct address including building numbers and mail stops.

*William R. Ellis (DOE) working to strengthen US-Japan ties in mirror fusion research. l to r: Steve Dean; Takaya Kawabe (U. of Tsukuba); Syoichi Miyoshi (Director, Plasma Research Center, U. of Tsukuba); Bill Ellis; and Hidetake Kakihana (Director, Inst. of Plasma Physics, Nagoya U). Back of head belongs to Bob Borchers, Deputy Director of the Mirror program at LLNL.*



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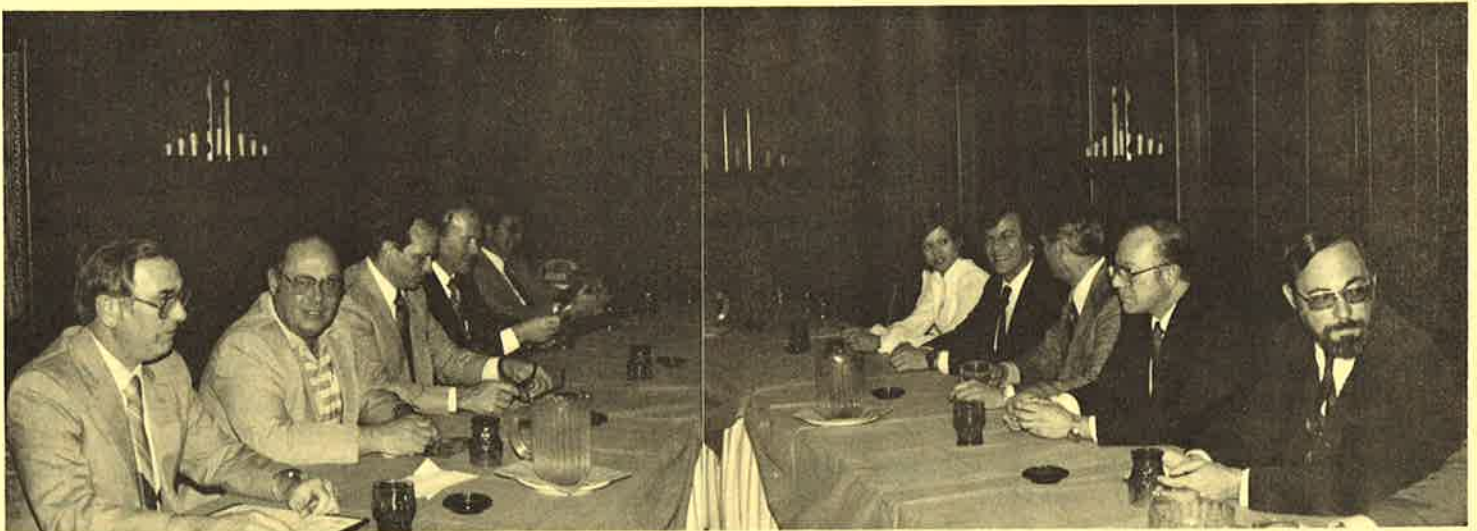
## NEW MEMBER

The University of Rochester Laboratory for Laser Energetics, LLE, has upgraded its participation in Fusion Power Associates from that of affiliate to become our thirty-third full member. Dr. Robert L. McCrory, Jr., director of LLE, will represent the university. The University of Rochester has been a leading contributor to inertial fusion research. LLE research expenditures since 1972 have totaled more than \$90 million, over half of which has come from private sources. Dr. Robert L. Sproull, president of the University of Rochester, gave the luncheon address at FPA's recent annual meeting in San Diego. We welcome the University of Rochester's participation as a member of Fusion Power Associates.

## FUSION BUDGETS

The Administration's FY 84 fusion budget requests (in \$ million) to Congress, and compared to previous years, is shown below:

	FY 82 Actual	FY 83 Continuing Resolution	FY 84 Presidential Request
<u>Magnetic Fusion</u>			
Operations	\$295	\$362	\$393
Equipment	42	39	38
Construction	114	46	36
Totals	<u>451</u>	<u>447</u>	<u>467</u>
<u>Inertial Fusion</u>			
Operations	122	140	127
Equipment	11	11	12
Construction	76	39	13
Totals	<u>\$209</u>	<u>\$190</u>	<u>\$142</u>



FPA Board of Directors meeting in San Diego, January 7. (l. to r.) board members Kummer, Reardon, Forsen, Matson; FPA vice president G. Kulcinski; FPA Ass't. Sec-Treas. Ruth Watkins and board members Davidson, Staudhammer, Bolta and Yonas. Also attending, but not shown here, were FPA board chairman Krall, vice-chairman Reichle, president Dean, board members Rose, Williams, and Zeifang; and guests Kathryn Bruner (representing board member Ohkawa), Sue Stephenson (LLNL), Robert L. Hirsch, and Mike McCormack.

## MFAC

The Magnetic Fusion Advisory Committee (MFAC) met at Livermore on January 10-11 to receive the report of "Subpanel 3" chaired by Harold Forsen of Bechtel. That subpanel was charged to review the potential of upgrading the TFTR facilities at Princeton for engineering tests late in the decade. The subpanel concluded that upgrades to the TFTR device itself, while desirable, could not provide sufficient nuclear engineering data. Rather, they recommended a new device be constructed, which could be sited at the TFTR facility, as the "technically preferred option." This new device (called DCT-8 by some and TFCD by others) would provide ignition and long fusion burn times. A preconceptional design by Princeton suggests that the device would outperform the previously advocated FED device and cost only about half the FED cost (about \$1 billion vs \$2 billion). This would be accomplished by putting copper coils inside the superconducting coils. The copper coils serve the dual purpose of shielding the superconducting magnets and allowing higher magnetic field at the plasma.

The MFAC accepted the subpanel's recommendations "in principle" and forwarded the report to DOE with the following "ancillary comments and recommendations.

"1. The Magnetic Fusion Advisory Committee agrees that the near-term demonstration of ignition and long-pulse equilibrium burn constitutes the technically necessary next major step for tokamaks beyond the TFTR break-even demonstration.

2. The Committee notes that such a step represents an evolution in the strategy of the tokamak program plan defined by Panel #1. The mission of the TFTR Upgrade is raised to the level of a Tokamak Fusion Core Demonstration (TFCD). The scope of the tokamak Engineering Test Reactor (ETR), as the last step before commercialization, can be enhanced correspondingly.

3. In order to provide a reactor-relevant configuration on the road to a tokamak ETR, a superconducting coil device such as DCT-8 is highly desirable. However, lower-cost options for the achievement of ignition and long-pulse burn, using copper coils, should continue to be investigated. The technical merit of copper-coil options

relative to superconducting-coil options should be determined in the light of budgetary constraints and technological needs.

4. While the construction costs for an equilibrium burn experiment of the DCT-8 type are substantially smaller than those for the FED or for a tokamak ETR, it is clear that incremental funding above the base program level will be required for timely implementation.

5. Following a review of MFTF-B upgrade options, it is recommended that MFAC integrate and prioritize the findings and recommendations regarding tokamaks and tandem mirrors (Charge #1), alternate fusion concepts (Charge #2), TFTR upgrade options (Charge #3) and MFTF-B upgrade options (Charge #4) within the context of the overall fusion program strategy and projected fusion budgets."

The next MFAC meeting is scheduled to take place May 3-4 at Princeton Plasma Physics Laboratory.

## FPA ANNUAL MEETING

One hundred people from 55 institutions attended FPA's third annual meeting and participated in a symposium on the "Readiness and Reasons for an Accelerated National Development Program." In his opening remarks, FPA board chairman Nick Krall stated, "acceleration is a vector; vectors point in a certain direction. Let's remember that there has been a vector direction in the fusion program since its inception. Not towards physics, necessarily, or towards engineering, but really in the direction of imagination and innovation." "The danger we face," Krall said, "is that even ourselves, or our peers or our bureaucracy might predetermine what we can do and, more important, what we cannot do."

In his opening remarks, FPA president Steve Dean recalled recent reviews of fusion by two committees, headed by Bob Hirsch of Exxon and Sol Buchsbaum of Bell Labs, respectively. Dean said, "The net result of these two reviews was to make a statement that fusion was ready and well enough advanced scientifically for an enhanced engineering component and for the establishment of a national goal to produce the end-product. In the two short years since those reviews, it appears that the 'powers-that-be' in the executive branch have lost touch with those conclusions." "It turns

out," Dean said, "that in spite of the fact that our fusion engineers have been anxious to get on with solving our engineering problems, there has been a growing number of people, especially at high levels in the U.S. government, who make statements that sound as though our engineering problems are so incredibly difficult that perhaps they are impossible of solution."

In his keynote address, Prof. Herbert Woodson, director of the Center for Energy Studies at the University of Texas made the first public presentation of the results of the National Research Council report on the Future Engineering Needs of Magnetic Fusion." Woodson stated that "the future engineering needs of magnetic fusion are well on their way to clear definition and none currently identified appear to be of such a character as to preclude solution." "Specifically," Woodson said, "two areas were thought to warrant the greatest need for further engineering effort: the engineering needs for materials to be used in the severe plasma and nuclear environment of a reactor; and those for the breeding, recovery and control of tritium." Woodson stated that "a recurring theme throughout this (NRC) exercise was the crying need for a realistic fusion environment with which to develop and test materials, components and systems." "A deuterium-tritium fusion device, with or without reactor

relevance, is sorely needed in the program," he said. Speaking to the fusion community, Woodson said, "You can be justifiably proud of what has been accomplished in the fusion program. You have developed considerable talent in tackling the unknown and achieving the difficult." Noting that "research" and "development" are not mutually exclusive activities, Woodson said, "The national fusion program appears to me to be planned in great detail as an orderly development program should be. But the program actually requires dramatic breakthroughs and inventions that generally come from a more freewheeling research program." Though "we must guard against becoming prisoners of preconceived answers," he said, "a goal-oriented, milestone-laden program does not have to, and should not, sacrifice flexibility."

On the second day of our meeting, DOE Office of Fusion Energy director John Clarke gave the keynote address to open a panel discussion on "The Pace of Fusion Development." SAI executive vice president Ed Frieman was moderator of the panel. The panelists were Ron Davidson (MIT), John Emmett (LLNL), Ed Kintner (Titan Systems), Mike McCormack (McCormack Associates), and Bob Hirsch (ARCO Gas and Oil Co.).

In his keynote address, Clarke said that the preparation of a plan to implement the Magnetic Fusion Energy Engineering Act of 1980 had



*Panelists at FPA Symposium January 7 in San Diego discuss "The Pace of Fusion Development." (l. to r.) Ronald C. Davidson (MIT), moderator Edward A. Frieman (SAI), John L. Emmett (LLNL), Edwin E. Kintner (Titan Systems, Inc.), Mike McCormack (McCormack Associates, Inc.) and Robert L. Hirsch (ARCO Oil and Gas Co.).*

gotten bogged down in "frank and comradely discussions within the executive branch to reconcile what are really two legitimate functions of government: the preparation of and proposal of plans to spend the public monies and the guarding and making sure that the public money is spent on the things of the highest priority for the country." The result of those discussions, Clarke said, was to consider the fusion program to consist of two parts: a "base program" and a "reactor engineering program." The base program is "to be a program that is capable of making steady, demonstrable scientific and technological progress toward the ultimate goal of fusion." The reactor engineering program "is one which can accelerate the translation of the scientific and technological successes of the base program into a practical and useful fusion reactor." A base program "can be defined at roughly the current level of the U.S. program," Clarke said, but the reactor engineering program "requires a significant increase in funding and this increase would require a change in fusion's fair share of the budget, and therein lies the difficulty." "The virtue in distinguishing these two types of programs and planning for them independently lies in the world of practical politics," Clarke said.

Fusion Power Associates will publish the complete text of the panel discussions in the near future. Brief highlights of the discussions are as follows:

Ron Davidson urged the DOE to "take immediate steps in the budget process to restore program momentum and to return to an accelerated course of development consistent with the significant technical progress that the program has experienced." The "...remaining necessary and sufficient conditions ('for strong support of fusion') center on having Washington policymakers who are well-informed and have progressive attitudes toward the development of a credible energy policy for both the long term and the near term," he said.

John Emmett said, "Very simply, my view is that fusion is only going to be accepted when it is the most economically attractive alternative to energy going, period."

Ed Kintner said that present U.S. energy policy is based, as near as he could tell, on the following assumption: "Energy is not the most important material question to man. Weapons are. The economic problem isn't the high cost of energy, its the low cost of energy. There are no diplomatic or military problems associated with energy. You simply establish a rapid deployment force. That may cost you a little more than developing energy sources, but its a lot more fun."

Mike McCormack stated that the great expansion of fusion funding in the 1972-74 period had "absolutely nothing to do with the Arab oil embargo," contradicting an assertion earlier by John Clarke that expansion of fusion funding depends primarily on "external forces." The expansion "was brought about because suddenly the magnetic fusion program came out of the doldrums with the development of the tokamak and, secondly, because a dynamic new leader, Bob Hirsch, came on the scene and was given the freedom to act." McCormack advised "Make no little plans. They lack the fire to stir men's blood."

Bob Hirsch said that the pace of fusion development depends on the level of funding, program management and mother nature. Hirsch felt that in the light of what is happening to other government programs, fusion should be thankful the budget is level. Also, Hirsch said, "I believe that perceptions of future fusion cost will have a significant and growing impact on program funding. He urged management to find ways to enhance pace within existing budgets by reducing and/or terminating programs.



*FPA board chairman Nick Krall (r.) talks to FPA leadership award recipients John Nuckolls and Harold Furth.*



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## SPECIAL EDITION

U.S. DEPARTMENT OF ENERGY  
FY 1984 BUDGET SUBMISSION

### OVERVIEW

In Washington, one rarely hears talk anymore of merging the Department of Energy into the Department of Commerce. A look at the DOE's FY 1984 budget submission probably shows the reason. The Department of Energy has become the "Department of Nuclear Weapons."

Over 50% of the DOE budget is now for nuclear weapons. And, as shown in the table, no energy program even comes close to representing 10% of the total effort. In a year when most programs are decreased, an additional one billion dollars is requested for weapons. The increase is not for research and development, but for the manufacture and stockpiling of warheads for a variety of missiles.

### INERTIAL FUSION

Although the DOE weapons program is responsible for protecting the nation's long range interests in developing inertial fusion, and in spite of the large increase in the weapons budget, a policy of slow starvation, begun two years ago, continues. Operating funds for inertial fusion are down from \$140M to \$127M, construction funds are down from \$39M to \$13M and total funds are down from \$190M to \$142M.

### MAGNETIC FUSION

The magnetic fusion budget is up slightly from \$447M to \$467M. The distribution of these funds (\$M) is as follows:

	<u>FY 1983</u>	<u>FY 1984</u>
Operations	\$361.6	\$392.7
Equipment	39.5	39.5
Construction	46.0	36.5
Total	<u>\$447.1</u>	<u>\$467.1</u>

The magnetic fusion operations budget breakdown is as follows:

	<u>FY 1983</u>	<u>FY 1984</u>
Applied Plasma Phys.	\$ 73.3	\$ 76.0
Toroidal Conf. Sys.	137.7	144.2
Mirror Conf. Sys.	43.3	41.9
Develop. & Techno.	74.3	77.3
Planning & Projects	29.0	48.7
Program Direction	4.0	4.6
Total	<u>\$361.6</u>	<u>\$392.7</u>

### Department of "Energy" (\$ In Millions)

	<u>FY 1983</u>	<u>FY 1984</u>
Nuclear Weapons	\$5,514	\$6,636
Energy Production	830	871
Nuclear Fission	816	848
Strategic Petroleum Res. 2,	316	742
High Energy Physics	422	490
Magnetic Fusion	447	467
Basic Energy Sciences	283	350
Nuclear Waste Disposal	217	307
Environment	227	211
"Support Activities"	241	172
General Sciences	131	155
Inertial Fusion	190	142
Fossil Energy	311	138
"Other Energy Functions"	175	108
Solar and Other		
Renewables	263	102
Conservation	410	101
"Supp. Res. & Tech. Ana."	46	58
Policy and Management	6	4
Totals	<u>\$12845</u>	<u>\$11902</u>

A more detailed breakdown of the operating budget is as follows:

	<u>FY 1983</u>	<u>FY 1984</u>
<u>Applied Plasma Phys.</u>		
Adv. Fusion Concepts	\$ 18.6	\$ 19.9
Exper. Plasma Res.	16.8	17.1
Theory	22.3	23.3
MFE Computer Network	15.6	15.7
<u>Toroidal Conf. Systems</u>		
Research Operations	55.5	63.7
Major Device Fab.	10.1	8.2
TFTR	72.1	72.3
<u>Mirror Conf. Systems</u>		
Research Operations	37.3	38.7
Major Dev. Fab.	6.0	3.2
<u>Development &amp; Technology</u>		
Magnetic Systems	16.4	16.8
Plasma Engineering	18.6	17.5
Reactor Materials	16.8	19.0
Systems Engineering	12.6	11.9
Environment & Safety	2.8	3.0
Applications	1.6	1.0
Reactor Engineering	5.5	8.1

The major "surprise" disappointment in the magnetic fusion budget is the proposed termination of the EBT-P project. In 1979, DOE established an elaborate competitive bidding process with industry for this \$100 million project. With no public announcement, DOE now wishes to walk away from this project on the basis of a two sentence statement in the budget submission as follows: "At the proposed funding level, the attendant programmatic consideration of timeliness and technical priorities do not allow us to proceed with the construction of EBT-P project in FY 1984. Funding priorities and technical development will determine whether a next step EBT-P device can be reconsidered in future years." Industry, collectively has spent over \$5 million of private funds on the EBT job. McDonnell Douglas Astronautics Company, the original "winner" now is proposed to be left "holding the bag."

"TIMES"  
Trenton, N.J.  
Dec 29, 1982

LEITON, J. J.

The successful startup of the fusion reactor at Princeton University's Plasma Physics Laboratory brings the possibility of "safe" nuclear energy considerably closer.

The fusion project is a rarity among programs aimed at breaking American dependence on oil and gas, however, in that it is still moving ahead. The Clinch River breeder reactor continues to be funded, but that's more a political project than energy project now. Other energy programs — synfuels, solar, biomass, water power, etc. — are barely stirring.

The virtual disappearance of interest in alternative energy sources is a complete reversal of national priorities in only three years. In 1979, energy and its associated problems topped the national agenda.

The Reagan administration took office committed to letting energy problems solve themselves in the private marketplace under the guiding hand of oil companies. Solar research funding — never high at its apogee — was cut to the bone.

In the 1983 budget, the administration has provided only \$83 million for renewable, or "soft," energy research and development. That is less money for a year than the Pentagon spends in an hour and a half. It hardly seems cost effective to spend 11 times as much on a rapid deployment force to secure oil and gas than to develop substitutes so the U.S. doesn't have to send troops all over the world for energy.

But that is what we are doing.

So far, the U.S. is getting away with a philosophy of "Live for today and let tomorrow take care of itself." The Organization of Petroleum Exporting Countries (OPEC) is in bad shape because the worldwide recession its prices helped to cause threatens even the OPEC members.

High energy prices — and they still are high — are now accepted as normal. Hundreds of thousands of people in the United States and other developed countries are cold every winter as a result, but that, too, is now accepted as normal. Maybe it is time for economists to create a new category for us, the de-developing nations.

High prices, plus fuel efficiency in cars, combined with the worldwide recession to create OPEC's current problems.

So we will probably get away with it for awhile longer. But we were startled in 1973 and 1978 and learned nothing from those oil shocks. OPEC was shocked this time, too. If we didn't learn from our experiences, the OPEC countries probably won't learn from theirs.

When history repeats itself — as it almost surely will as long as we depend on non-renewable energy sources — we won't be any readier than we were the first two times.





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## FPA FINANCIAL STATUS

Fusion Power Associates' financial position as of December 31, 1982, and compared to 1979/80 and 1981, is as follows:

	1982	1981	1979/80 (15 mos.)
<u>Income</u>			
Fees and Dues	\$ 94,720	\$ 42,290	\$107,500
Research	446,716	120,883	0
Other	13,125	37,102	10,495
Carryover or (Deficit)	( 3,360)	4,307	0
Total	\$551,201	\$204,582	\$117,995
<u>Expenses</u>			
Research	446,773	127,787	13,276
Education	28,325	32,019	8,307
Corp. Mgmt.	47,883	48,136	92,105
Total	\$522,981	\$207,942	\$113,688
Carryover or (Deficit)	28,220	( 3,360)	4,307

## NEW BOARD MEMBERS ELECTED

Fusion Power Associates by-laws provides for five members of our Board of Directors to be elected from organizations outside of our membership. These board members are elected by the remainder of the board, who in turn have been elected by the representatives of our member organizations. The five members so-elected, to serve three year terms commencing February 1, 1983, are as follows:

Ronald C. Davidson, MIT  
 T. Kenneth Fowler, LLNL  
 Melvin B. Gottlieb, Princeton Univ.  
 Robert L. Hirsch, Arco Oil & Gas Co.  
 John H. Nuckolls, LLNL

We welcome them to our board of directors. The next meeting of the board will take place on May 4, 7:00 P.M. at the Scanticon Hotel, Princeton, NJ.

## U.S. STELLARATOR AUTHORIZED AT ORNL

The DOE Office of Fusion Energy has authorized ORNL to construct an  $\ell=2$  torsatron/stellarator as a follow-on activity to the ISX-B tokamak. The new stellarator, to be known as the Advanced Toroidal Facility-1 (ATF-1), will utilize power supplies, diagnostics and auxiliary heating currently in use on ISX. The ATF-1 is being considered as part of the development of understanding of toroidal physics, rather than as an "alternate concept" and hence will be managed as a part of the tokamak program by the Toroidal Confinement Systems Division headed by Dr. N. Anne Davies. At ORNL the project will be under the direction of Dr. John Sheffield. The proposal to build ATF-1 was reviewed by a panel under the chairmanship of Dr. Harold Weitzner of NYU. The device will cost about \$20 million and will be operational in late 1986. It's goal is to study energy transport in the collisionless regime and to reach beta values in excess of 5%.



John Sheffield (l) and Mike Saltmarsh (c) who will build the new U.S. stellarator, ATF-1, at Oak Ridge; shown here with another happy machine builder, Paul Reardon of TFTR fame.

## EBT-REVIEWED

An intensive technical review of the EBT physics data base took place in Oak Ridge during the week of February 14. ORNL scientists, headed by Lee Berry, had become concerned that the data did not support the previously advertised value of about 4 ms for the energy confinement time in EBT-S. Thomson scattering measurements of electron temperature in the plasma core gave values of 100-200eV; whereas soft x-ray measurements, the previous standard, gives values of a factor of two or more higher, depending on other variables. A "data review panel", headed by Dick Post of MIT concluded that both the particle and energy confinement time in EBT-S were about lms. Furthermore, they felt that verification of the EBT neo-classical scaling law was impossible from the present data set. They urged emphasis on more vigorous data analysis and improved experiments and diagnostics. An EBT "Senior Program Review Committee" also met in ORNL to consider the data review panel's report and to offer advice to DOE. This committee was headed by Fred Ribe of the University of Washington. Other members were Herb Berk, Ron Davidson, Steve Dean, and Ken Fowler. This committee accepted the findings of the data review committee, expressed "disappointment" at the low values of temperature and confinement time achieved in EBT-S to date, recommended that top priority be given to experiments aimed at raising these values in EBT-S, that DOE establish and monitor a set of milestones to measure the performance of the EBT-S group, that the future of the EBT program be determined by success or failure to meet these milestones and that the design of EBT-P remain flexible while these issues are clarified.

## CONGRESSIONAL HEARINGS

The House Science and Technology Committee will hold authorization hearings on DOE's FY 1984 budget request for magnetic fusion on March 15-16. On March 15, 2:00-4:30PM in Room 2318, they will hear from DOE witnesses. On March 16, same time and place, they will hear from non-government witnesses. The currently scheduled non-government witnesses are Steve Dean (FPA), Ken Matson (AIF), Harold Agnew (GA Technologies), Mike McCormack, Leon Shohet (University Fusion Association), John Dawson (UCLA), and William Drummond (U. of Texas). Other magnetic fusion hearings for government witnesses are as follows:

February 28 - Senate Authorizations  
9:30 A.M. Dirkson Bldg. 336

March 8 - Senate Appropriations  
2:00 P.M. Dirkson Bldg. 192

March 10 - House Appropriations  
10:00 A.M. Rayburn Bldg. 2362

Hearings on inertial fusion are scheduled as follows:

March 1 - House Armed Services

March 8 - House Appropriations



*FPA board member Jim Williams and GA Technologies' Kathryn Bruner talk to HS&T staff scientist Harlan Watson at FPA's recent annual meeting and symposium.*

## CANADIAN SCIENCE WRITERS ASSOCIATION (CSWA)

The CSWA advises us that they would be pleased to accept american memberships. The associates is open to professionals involved directly or indirectly in the communication of science, technology, medicine, environment, resource issues and social science. The annual fee is \$30. Contact Hugh E. Quetton, Membership Chairman, Box 79, First Canadian Place, Toronto, M5X 1G8.

## UNIVERSITY OF ILLINOIS H.S. PROJECT

The University of Illinois is seeking money and/or materials to distribute information about fusion to high schools in the midwest. They are especially interested in getting appropriate reference materials into the hands of high school science teachers. If you can provide materials, ideas or contributions to this project, contact Dr. George Miley at (217) 333-3772.

### CENTER FOR FUSION ENGINEERING

The University of Texas has established a "Center for Fusion Engineering" at the main campus at Austin. The interim director of the center is Dr. Herbert Woodson who states "We hope to provide solutions for some of the major materials-science and heat-transfer problems." The engineering center complements two existing centers--for experiments and theory--at Texas and is funded in part by the Texas Atomic Energy Foundation.



*Herb Woodson (l), interim director of the U. of Texas new Center for Fusion Engineering talks to FPA board member Pete Rose*

### NEW MFAC SUBPANEL FORMED

A new MFAC subpanel has been formed, under the chairmanship of Prof. Robert Gross of Columbia University, to study the long-term role of universities in the fusion program. The panel will meet at Columbia March 24-25, will make an interim report at the May 3-4 MFAC meeting at Princeton, with a final report due in July. The panel is asked to "give a clear (and concise) summary of present university-based fusion research...." research...." The charge to the panel also states: "The impact of university research programs, student training, etc. on fusion energy development should also be assessed and documented." The subpanel is asked "In formulating recommendations regarding the evolving role of universities in fusion energy development, be sure to identify research and development activities where joint university-laboratory and university-industry programs would be advisable."

### SHIVA LASER TEAM HONORED

Laser Focus magazine has selected the Lawrence Livermore National Laboratory as a recipient of one of its Technical Achievement Awards "for its major achievement in the engineering design and construction of high power lasers in the Shiva laser system. Other awards were presented to General Motors Corp., Western Electric Engineering Research Center, Coherent Inc., and Spectra-Physics. The awards honor those who have produced outstanding advances in laser technology and laser application. The awards will be presented at a ceremony at the Conference on Lasers and Electro-optics (CLEO) in Baltimore, MD, May 17-19, 1983.

### LASER USERS FACILITY

Persons interested in receiving a time allocation to use the National Laser Users Facility at the University of Rochester must submit proposals by April 1, 1983. For details contact Thomas C. Bristow at (716) 275-2074. Successful applicants will perform experiments using the 24-beam, 12 trillion watt OMEGA laser system.



*Dr. Richard L. Schrieffer, director of the DOE Office of Inertial Fusion, speaks at the recent FPA symposium.*

### MEETINGS

The following meetings of interest are coming up soon:

March 15-16. Congressional Hearings, 2318 Rayburn Bldg., 2-4:30 P.M.

March 24-25. MFAC Subpanel on University Roles in Fusion. Columbia Univ. Contact Prof. Robert Gross (212) 280-2967

April 13-15. Fourth Topical Conference on Atomic Processes in High Temperature Plasmas. Princeton. Fee \$85. Contact Dr. R. Hulse, PPPL, Box 451, Princeton, NJ, 08544

April 26-28. Fifth Topical Conference on the Technology of Fusion Energy. Knoxville. Contact P. N. Haubenreich, ORNL (615) 574-1457

May 3-4. MFAC Meeting Princeton. Contact Lenore Ledman (301) 353-3598

May 4. FPA Board of Directors Meeting Scanticon/Princeton

May 5. TFTR Dedication, Princeton

May 17-19. Conference on Lasers and Electro-Optics (CLEO). Baltimore

May 23-25. IEEE International Conference on Plasma Science, San Diego. Contact J. L. Luxon (619) 455-3418

May 26-31. Annual Meeting of the American Association for the Advancement of Science. Detroit. Contact Rolf Sinclair (202) 357-7997.

#### PEOPLE

John W. Landis, senior vice president of Stone and Webster Engineering Corp. and member of the FPA board of directors has been named to be a member of DOE's Magnetic Fusion Advisory Committee (MFAC).

Mel Greer, former ERDA controller and influential staff member of the House Appropriations Committee, has joined Stone and Webster Engineering Corporation in Boston.

Robert L. Hirsch has left Exxon to become a vice president of Arco Oil and Gas Co. Bob can be reached at Arco, P.O. Box 2819, Dallas, TX, 75221 (214) 422-6811.

Al Boch, project manager for the EBT-P project at ORNL, has retired from the laboratory effective February 1. He is replaced by Harold McCurdy.

J. Nelson Grace has left his post as director of DOE's Princeton Office to join the Nuclear Regulatory Commission in Bethesda, MD, as director of the Clinch River Breeder Reactor Program Office.

Bob McCrory has been named director of the University of Rochester Laboratory for Laser Energetics.

#### FUSION POWER REPORT

For a timely, independent and informative view of what is happening in fusion, we recommend the monthly newsletter "Fusion Power Report" put out by Business Publishers, Inc., P.O. Box 1067, Silver Spring, MD, 20910. Subscriptions are \$137 per year. For a free sample contact the editor: David Gitlitz at (301) 587-6300).

#### MORE ON DOE'S BUDGET PRIORITIES

In our February 10 special edition on the DOE budget, we pointed out that weapons has become the majority stockholder in DOE. This fact has not been lost on others, as the following editorial from the February 1, 1983, San Jose Mercury indicates:

#### EDITORIAL

### A waste of Energy

<sup>E 451</sup>  
**P**RESIDENT Reagan is staying the course in regard to the nation's energy needs as he sees them. The \$11.15 billion Department of Energy budget he submitted to Congress Monday is long on cash for nuclear warheads and short on money for almost everything else. The rationale, as spelled out in the administration's formal budget statement, is to "let market forces work."

The president proposes to spend \$1.9 billion in the coming year to fill the nation's strategic petroleum reserve at the rate of 145,000 barrels a day, but that is at best a stopgap, and an expensive one at that.

It's disturbing that \$6.4 billion, or 57 percent of the \$11.15 billion sought for the Department of Energy, is earmarked for nuclear warhead production and for other defense-related nuclear energy programs. Looked at another way, Energy's proposed 1984 budget is down 14 percent, while its nuclear component is up 16 percent. This has been accomplished by cutting conservation programs 73 percent, to a scant \$74.4 million, and cutting back cash for the development of solar and other renewable sources of energy by 60 percent, to \$102 million.

And we don't see market forces installing energy-conserving insulation in the homes of 1 million poor Americans, as the Department of Energy has done in the past. There are no funds for that program in the 1984 Reagan budget; gone, too, is the \$48 million that insulated schools and hospitals last year, along with the grants that enabled the states to run their own conservation programs.

This is shortsighted, as is the president's

desire to spend \$270 million next year to start building the Clinch River nuclear breeder reactor. Congress nearly killed that particular boondoggle last year; it should finish the job this year.

Nor are we overjoyed that the Federal Energy Regulatory Commission's operating budget has been cut in half, to a proposed \$34.6 million. FERC is responsible for monitoring and enforcing complex federal regulations that govern the natural gas and electric utilities industries.

By contrast, the Nuclear Regulatory Commission, which supervises the nuclear power industry, is penciled in for \$467 million, about what it got this year. Given the industry's demonstrated need for careful surveillance, the NRC's budget is probably reasonable.

One other small portion of the Energy Department's proposed nuclear spending is valuable and should be preserved by Congress: the \$467 million the administration is asking for Princeton University's Tokamak fusion reactor.

If there is to be long-range energy independence for the United States, it may come from the ability to produce a sustained and controlled fusion reaction — the same reaction that, in a single burst of energy, produces a hydrogen bomb. The advantage of the fusion reactor, of course, is that it could, in effect, use seawater for fuel, instead of dangerously radioactive uranium or plutonium.

Princeton's Tokamak research reactor has produced a number of breakthroughs in this field, and its work should be continued.



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## NEW MEMBER AND AFFILIATE REPS

Several of our member and affiliate companies have designated new individuals to be their representatives to Fusion Power Associates. Wallace D. Henderson replaces Bernard J. Eastlund for BDM Corp. John E. Glancy replaces Edward A. Straker for Science Applications, Inc. P. M. French replaces Tom Varljen for Westinghouse. E. J. McGlinn replaces A. B. Van Rennes for Bendix Corp. F. L. Branca replaces J. M. Evans for Kansas City Power and Light Co. We welcome our new representatives to participation in Fusion Power Associates.

## NEW ERAB FUSION REVIEW

The Magnetic Fusion Energy Engineering Act of 1980 (Public Law 96-386, Sec. 7) requires that every three years the DOE Energy Research Advisory Board (ERAB) establish a technical panel on magnetic fusion to review the conduct of the national magnetic fusion energy program. The Act was passed October 7, 1980. Consequently, in a letter dated Feb. 24, 1983, Secretary of Energy Donald Hodel has asked ERAB chairman Lou Roddis to establish such a panel and to report the results of its review at the November 3-4, 1983, ERAB meeting.

The fusion Act specifies that the ERAB panel should review the Comprehensive Program Management Plan called for in Sec. 5 of the Act which was to be submitted to Congress "not later than Jan. 1, 1982." This plan is now 15 months overdue. The Act also requests the ERAB panel to review and make recommendations on:

- o "the type of future facilities needed to meet the goal of this Act along with their projected completion dates;
- o "the adequacy of participation by universities and industry in the program;

- o "the adequacy of international cooperation in magnetic fusion and any problems associated therewith; and
- o "institutional, environmental and economic factors limiting, or prospectively limiting, efforts to achieve commercial applications of magnetic fusion energy systems."

In his letter to Roddis, Hodel states that "the Department has not been able to implement fully some specifics of the Act due to budgetary limitations but has attempted to proceed, as much as possible, in accordance with the intent of the Act." Hodel asks the ERAB panel to give him their views on:

- o the adequacy of the various procedures for external advice, including work of the Magnetic Fusion Advisory Committee and the National Research Council study entitled "Future Engineering Needs of Magnetic Fusion."
- o "The validity of the Department's approach, given the budgetary stringencies, that make it impossible to implement all the requirements of the Act and the previous advice of ERAB."

Roddis, in turn, has established a "Magnetic Fusion Energy Panel" consisting of himself as chairman and the following members, only three of whom (underlined) are ERAB members: Solomon J. Buchsbaum (Bell Labs) Thomas B. Cochran (National Resource Defense Council); Merrill Eisenbud (NYU Medical Center); John S. Foster, Jr. (TRW), Eugene G. Fubini (E. G. Fubini Consultants, Inc.); Roy W. Gould (Cal. Inst. of Tech.); Thomas Johnson (U.S. Military Academy), W. K. H. Panofsky (Stanford Linear Accelerator Center); John W. Simpson, (Consultant); Weston M. Stacey, Jr. (Georgia Inst. of Technology.)

## HEAVY ION FUSION

Tentative dates have been set for four meetings: one each at Princeton Plasma Physics Laboratory (June 10-11) and Lawrence Livermore National Laboratory (July 1), and two in Washington, D. C. (Aug. 29-30, and Oct. 4-6). Information on the activities of the panel can be obtained from ERAB executive director Tom Kuehn (202) 252-8933 or from Lenore Ledman (301) 353-3598.

Responsibility for carrying out research on heavy ion fusion has been transferred within DOE from the military to the Office of Energy Research. Dr. James Leiss, Assoc. Director for High Energy and Nuclear Physics, reporting to Dr. Alvin W. Trivelpiece, will be responsible for the program. Technical direction will be provided by Dr. Roger Bangerter of the Los Alamos National Laboratory. The FY 1983 budget for the program is \$2 million. The FY 1984 request to Congress is for \$5 million.

## AMERICAN PHYSICAL SOCIETY RESOLUTION ON NUCLEAR WAR

The 30-member elected Council of the American Physical Society has adopted the following resolution on nuclear war:

Whereas nuclear war is an unprecedented threat to humanity;  
Whereas the stockpile of nuclear weapons distributed around the globe contains the explosive power of more than one million Hiroshima bombs;

Whereas a general nuclear war would kill hundreds of millions of people;

Whereas the aftereffects of general nuclear war are certain to be catastrophic for the survivors and could destroy civilization;

Whereas any use of nuclear weapons, including use in so-called "limited wars," would bring with it substantial risk of escalation to general nuclear war;

Whereas thirty years of vigorous research and development have produced no serious prospect of effective defense against nuclear attack;

Whereas nuclear arsenals of the United States and the Soviet Union are more than adequate for deterrence;

Whereas the continuation of the nuclear arms race will not increase the security of either superpower;  
Whereas the proliferation of nuclear weapons to additional countries, especially in areas of high tension, would substantially increase the risk of nuclear war;

Whereas there has been no progress for several years now toward achieving limitations and reductions in strategic arms, either through ratification of SALT II or the negotiation of a replacement for it;

Whereas negotiations intended to achieve a comprehensive nuclear test ban have been indefinitely

Whereas negotiations intended to prevent or inhibit the spread of nuclear warfare to outer space have been suspended;

Be it therefore resolved that The American Physical Society, through its elected Council, calls on the President and the Congress of the United States, and their counterparts in the Soviet Union and other countries:

to intensify substantially, without preconditions and with a sense of urgency, efforts to achieve an equitable and verifiable agreement between the United States and the Soviet Union to limit Strategic Nuclear Arms and to reduce significantly the number of such weapons and delivery systems;  
to conduct, in a similar spirit, negotiations to restrict the use and limit the deployment of battlefield and intermediate-range nuclear weapons;

to resume negotiations to prevent the spread of warfare into outer space;

to take all practical measures to inhibit the further proliferation of nuclear weapons to additional countries;

to take all practical actions that would reduce the risk of nuclear war by accident or miscalculation;  
to continue to observe all existing arms-control agreements, as well as SALT II;

to avoid military doctrines and deployments that treat nuclear explosives as ordinary weapons of war; and

to initiate serious negotiations to ban the testing of nuclear weapons in all environments for all time as called for in the Non-proliferation Treaty.

**APS president Robert Marshak** (Virginia Polytech), shown at right, and Neal F. Lane (Rice University), chairman of the APS Panel of Public Affairs, present the resolution on nuclear-arm limitation passed by the Council to the press and public at the APS January meeting.





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## TFTR DEDICATION

On May 5, Princeton Plasma Physics Laboratory sponsored a gala dedication for the recently completed Tokamak Fusion Test Reactor (TFTR). Secretary of Energy Donald Paul Hodel was the principal speaker. Other dignitaries present included presidential science advisor George A. Keyworth and DOE Director of Energy Research, Al Trivelpiece. Former fusion director Bob Hirsch, whom Princeton Lab Director Harold Furth referred to as the "godfather of TFTR" was also present.

TFTR is the first of three fusion test reactors designed to pass the "breakeven" point; the other two are nearing completion in Europe and Japan. The TFTR was initiated in 1975 and obtained "first plasma" on December 24, 1982.

In his remarks, Trivelpiece stated that he thought a turning point in the fusion program was a 1973 meeting in Key Biscayne when fusion program leaders committed themselves to reaching breakeven conditions in a deuterium-tritium plasma as the next major objective of the program. TFTR was the result of that commitment.



THE WHITE HOUSE  
WASHINGTON

April 29, 1983

On behalf of the American people, I am indeed honored and privileged to extend warm congratulations and best wishes to all those gathered for the dedication of the Tokamak Fusion Test Reactor.

At this significant moment, you not only are dedicating a new institution, but perhaps launching a truly historic program that will lead man to a new era of unlimited energy. Your pioneering work brings mankind's ancient dream of an inexhaustible energy source closer to reality. The spirit of inquiry and achievement that is manifested in this undertaking stands as a noble tribute to our accumulated knowledge and sense of exploration. All Americans applaud projects designed to expand the boundaries of man's understanding.

This event marks a timely and farsighted advance toward one of the most momentous aspirations in the history of science: the harnessing of nature's own process of thermonuclear fusion as the ultimate supply of energy for our planet. For more than three decades, a dedicated research community has persisted in the awesome task of unlocking -- and eventually taming -- the fusion process.

The willingness to plan ahead, rather than merely focus on immediate concerns, is the hallmark of a society with vision, with faith in its ability to shape its destiny, and with confidence in the future. This confidence is fully demonstrated by America's efforts in fusion research. Please accept my congratulations on the notable achievement in reactor design being celebrated today. May it open the door to a new world of progress for all mankind.

*Ronald Reagan*

*Princeton showed itself to be a fount of charm and beauty as well as knowledge and technical excellence, as this welcoming committee for the TFTR dedication amply illustrates. From the left: Carol Phillips, Sallie Young, Dolores Mazalewski, and Pam Johnson*

## HIRSCH RECEIVES ANS AWARD

Former director of the U.S. fusion program Dr. Robert L. Hirsch has been awarded the ANS Fusion Energy Division (ANS/FED) Outstanding Achievement Award. The award was announced at a banquet ceremony during the Fifth Topical Meeting on the Technology of Fusion Energy, in Knoxville, April 26-28. In announcing the award, Dr. Nermin Uckan, Chairman of the ANS/FED Honors and Awards Committee cited Hirsch's "long and distinguished record of providing leadership to the fusion program." The award announcement stated that, "Although he left the government in 1977 to join the Exxon Corp., Bob Hirsch continued to have a profound influence on fusion policy. In 1979-1980, he chaired the Fusion Advisory Committee for the House Science and Technology Committee which began the process that eventually led to the Fusion Energy Engineering Act of 1980."

Unable to attend the ceremony in person, Hirsch asked FPA president Steve Dean to accept the award in his behalf and to read to the assemblage the following remarks:

"I am deeply honored to have been selected to receive the American Nuclear Society Outstanding Achievement Award. It has always been my hope that my efforts in fusion would contribute to the ultimate goal of building a practical, economical fusion power reactor, and your award suggests that my contributions are appreciated. Thank you very much.



*Although he was unable to attend the ANS banquet, Bob Hirsch (l) picked up his ANS award at the FPA Board of Directors meeting May 4. Looking on are board members Ken Matson, John Nuckolls, Kathryn Bruner (representing board member Tihiro Ohkawa), and Mel Gottlieb.*

"Since I left active participation in the fusion program, I have become deeply involved in a number of other major energy technologies in industry. These experiences have deepened my understanding of what it takes to develop and commercialize new large-scale power systems. Such endeavors are clearly very difficult, especially where many of the related subsystems are not close to existing commercial practice.

"These experiences have not changed my view on the time scale to develop practical fusion power, however. There is no doubt in my mind that the task is doable and that it can be accomplished by the turn of the century, if funding and management are adequate.

"My 'Crystal Ball' is not good enough to tell me what the economics of fusion power will be because we can still only dimly perceive the various related issues. However, because we have such a plethora of options, I have faith that a system that will make economic power in the early 21st century is not only possible but probable.

"The fusion community has many major challenges these days--both technical and non-technical. But good things never come easy, and fusion is clearly a significant 'good,' so don't let the problems get you down. Rather, let them serve to strengthen your will to succeed.

"Once again, thank you for this high honor and best of luck in your future endeavors."

### FPA BOARD MEETING

Fusion Power Associates' Board of Directors met in Princeton on May 4. The primary decision made was to prepare a fusion policy statement on behalf of the association to be presented to the ERAB fusion review panel (see our April newsletter). The policy statement would also be given to leaders of the executive and legislative branches. A subpanel of the board was appointed to draft the statement. The subpanel members are Steve Dean, Len Reichle, Bob Hirsch, and Harold Forsen.

### MFAC MEETING

The Magnetic Fusion Advisory Committee (MFAC) met at Princeton on May 3-4. They reviewed the report of "Panel 4" which had studied several options to upgrade the MFTF-B mirror fusion facility at LLNL. In a May 4 letter



to DOE Director of Energy Research, Al Trivelpiece, MFAC chairman Ron Davidson transmitted the following MFAC findings and recommendations:

"1. MFTF-B will remain a unique facility in the fusion program for the foreseeable future and full advantage should be taken of this resource.

"2. Of the MFTF-B upgrade options considered, the 'alpha + T option' has several attractive features, including the potential capability of testing nuclear technology issues at reactor-level conditions. LLNL and the mirror community should be encouraged to continue a vigorous study program investigating possible upgrades of MFTF-B including higher-Q options.

"3. The physics data base for tandem mirror research needs considerable expansion before commitment to a major upgrade of MFTF-B. However, the mirror program is entering an important phase of experimentation with TMX-U, TARA, and MFTF-B. The Magnetic Fusion Advisory Committee recommends that the desirability and technical readiness for a commitment to an upgrade of MFTF-B be re-evaluated by MFAC in the future on the basis of significant experimental progress, further theoretical work, and continued study of upgrade options.

"4. The Magnetic Fusion Advisory Committee finds that the evaluation of the proposed MFTF upgrade option calls for resolution within the overall fusion program of three basic issues of programmatic logic and priority:

- a. The coordination of the tokamak and tandem mirror strategies;
- b. The relationship between fusion reactor core development and fusion-related nuclear technology;
- c. The critical issues to be addressed by the the nuclear technology program.

"The committee notes that these three issues will be addressed in response to the charge to MFAC Panel #6."

#### MFAC GETS NEW CHARGE

Davidson was also in possession of a May 2 letter from Trivelpiece commending MFAC for its work to date and asking MFAC to "provide us with an analysis leading to identification of the highest priority scientific and technological issues which must be addressed in the fusion program." The text of the Trivelpiece letter follows:



*MFAC Executive Assistant Lenore Ledman and chairman Ron Davidson were among those who arrived early for the TFTR dedication.*

"Dear Ron:

"The issues that you have been addressing over the last year are fundamental to the magnetic fusion program. Your findings and recommendations have been valuable to us in formulating our program strategy and in coming to agreement on the general level of support appropriate for fusion in the federal budget. Now that a base program has been established, we would like you to reexamine the previous work that you have done and integrate and prioritize the findings and recommendations in the first four charge areas within the context of the overall fusion program strategy and projected fusion budgets. Please provide us with an analysis leading to identification of the highest priority scientific and technological issues which must be addressed in the fusion program.

"These should be chosen carefully to assure both continuous progress in the program and maintenance of an internationally competitive position for the United States in fusion development. This analysis should lead to a specification of the types of new facilities which will be involved in the base program in the future. We will use your recommendations to help us phase research activities within our program in such a way as to make the best use of available resources and existing facilities and to allow the smooth introduction of required new facilities.

"In addition, please identify scientific and technological opportunities in the program which would justify increased program support.

"Because of the fundamental nature of the question and long-term effect which could follow from your answer, please take an appropriate length of time in preparing a thoughtful response.

Sincerely,  
A. W. Trivelpiece"



*Veteran tokamak machine builder Don Grove talks to a reporter at the TFTR dedication.*

#### KEYWORTH RESPONDS TO APS

Presidential science advisor George A. Keyworth clearly annoyed at the American Physical Society's issuance of a statement against nuclear war (see our April newsletter), has a rebuttal in the May issue of Physics Today. Keyworth's rebuttal is followed by a rebuttal of Keyworth by APS president Robert E. Marshak. Keyworth claims that the APS statement on nuclear war is a "political" statement and that it is against APS policy to make political statements. Keyworth states that "the nuclear freeze is today a blatantly political issue. It figures in politics at all levels, from budding Presidential campaigns to local council races. And it is hardly non-partisan. The point is that when we seek to impose ethical standards through the political process--then those ethical concerns become political issues."

Keyworth states further that "My own reaction is that the APS resolution urges, instead, that we return to the 'let's-all-be-reasonable fellows approach that has led nowhere for decades. In fact, a cynical person might be led to conclude that the recent flurry of nuclear freeze activities and nuclear-war resolutions has been prompted by fear that this comfortable 'moral' position could well be eroded if the President's firm negotiating stance proves finally to be the key to real breakthroughs in arms reductions."

Speaking with the endorsement of the APS executive council, APS president Robert E. Marshak replied, citing several specific examples, that "statements on public issues are indeed rare for APS Council but by no means unprecedented." "In all such public interventions, Council, the elected governing body of APS, has striven to express its concern in a thoughtful, objective and non-partisan manner," Marshak said.

Marshak continued, "Despite the emotionalism of the issue, careful and patient deliberations, spanning a two-year period, preceded the issuance of the nuclear-weapons statement. Starting with Executive Committee endorsement of the National Academy of Sciences resolution, and continuing with thorough discussion by POPA of a draft prepared by several recognized experts within the society, Council action was finally taken last January.

"Council's resolution did intend to communicate a sense of urgency on the issue of nuclear weapons, but it did not take a stand on 'nuclear freeze,' 'no first use' and other currently popular approaches to nuclear-arms control. Council tried hard to transcend partisan politics and to provide a technically unflawed contribution to the nuclear arms debate. The Administration has announced its firm intention to 'reduce the risks of war ...by dismantling the nuclear menace' (President Ronald Reagan, commencement address, Eureka, Illinois, 9 May 1982). Our governmental leaders should, therefore, welcome the balanced tone of APS Council's resolution and embrace its sober message. I hope that Keyworth will see things in the same vein."



*And then there were the dignitaries. How many can you name?*



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### MEMBER BENEFIT

Members and affiliates of Fusion Power Associates visiting the Gaithersburg/Germantown area can now get a special rate of \$49.50 plus tax for a single room (\$59.50, double) at the Sheraton Potomac Inn on Shady Grove Road near I-270 in Rockville, Maryland. Included in the rate are free continental breakfast, daily complimentary cocktail, daily complimentary copy of the Washington Post, HBO in your room and free chauffeur service to the airport. To make your reservations, call Tana Cobb at the Sheraton (800) 638-8559, identify yourself as a member or affiliate of Fusion Power Associates and ask for our corporate rate. Or call us and we will make your reservations for you. Do not make your reservation through a travel agent. Also, remember we are always glad to have you stop in at our office when you are in the area.

### ANNUAL MEETING REPORT AVAILABLE

A summary report of our annual meeting and symposium last January in San Diego is now available. It contains the keynote addresses, luncheon address and panel discussion on the readiness and reasons for an accelerated U.S. fusion program. The keynote addresses were by Herb Woodson (U. Texas) and John Clarke (DOE). The luncheon address was given by Bob Sproull, president of the University of Rochester. Panelists were Ron Davidson (MIT), John Emmett (LLNL), Ed Kintner (Titan Systems), Mike McCormack (McCormack Associates), and Bob Hirsch (Arco Oil and Gas Co.). The papers present a readable and stimulating set of arguments on the basis for supporting a vigorous fusion effort. Copies will be sent to all those who attended the meeting. Others can purchase copies from us for \$5.00.



FPA president Steve Dean and Ass't. Secretary-Treasurer Ruth Watkins aboard the brigantine sailing ship "Rendezvous" during the FPA annual meeting.

### EUROPEAN FUSION ENGINEERING GROUP FORMED

While the United States embarks on yet another policy review of its fusion program, the European fusion program, under Euratom leadership, has taken a more direct step towards implementing the engineering effort required to make further progress toward practical fusion power. Twenty-five design engineers under the direction of Romano Toschi will set up shop at Garching, West Germany, to design the Next European Torus (NET). This is similar to the process set up to design and eventually construct the Joint European Torus (JET) which is nearing completion in Culham, England. According to the announcement, the goal of NET is to prove the engineering feasibility of fusion, following the scientific feasibility demonstrations expected from JET and TFTR.

Additionally the Max Planck Institute and the Karlsruhe Research Center in Germany have recently set-up a group called Nuclear Fusion Development Associates to look at the design of commercial fusion reactors.

### ERAB FUSION REVIEW BEGINS

The DOE's Energy Research Advisory Board (ERAB) will officially begin its triennial review of the fusion program on June 10-11 at the Princeton Plasma Physics Laboratory. The Meeting is open to the public. Some panel members (see our April newsletter) have noted that DOE has failed to implement either of the key recommendations ERAB made in its fusion report 3 years ago even though those recommendations were written into law by the Congress. Those recommendations were:

- o Undertake a broad program of engineering experimentation and analysis under the aegis of a Center for Fusion Engineering (CFE), operated by a strong single-line management.
- o Construct a Fusion Engineering Device (FED) and bring it into operation in this decade.

The ERAB Magnetic Fusion Panel will receive presentations from the DOE Office of Fusion Energy and from MFAC Chairman Ron Davidson on the morning of June 10 and from PPPL in the afternoon. Their next meeting will be held July 7-8 at LLNL, with meetings scheduled August 30-31 and October 4-6 in Washington, D. C. Their final report is due to be presented to the full ERAB on November 3-4. It will be hard for the ERAB fusion panel to improve on its report of three years ago.

### DOE SETS 1984 FUSION TECHNOLOGY FELLOWSHIPS

DOE will continue to expand its popular and productive fellowship program in 1984, raising the number of fellowships from 18 in 1983 to 24 in 1984. The program is aimed primarily at senior college undergraduates who wish to pursue graduate studies in fusion technology. Information on the program can be obtained from Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, TN, 37830.

### JACK DUGAN ADDRESSES ANS MEETING

Dr. Jack Dugan, Staff Director of the House Science and Technology Committee's Subcommittee on Energy Research and Production, gave the banquet address at the recent ANS Fusion Technology Conference in Knoxville, TN. Jack was pinch-hitting for Congresswoman Marilyn Lloyd. Dugan, a plasma physicist, said that Mrs. Lloyd "salutes you as talented and resourceful people involved in a great scientific and technological enterprise which promises great payoff for this nation."

Dugan emphasized that the subcommittee's actions to enhance the fusion budget were meant "to insist on consideration of erecting an engineering development base for magnetic fusion" and he stated that "the committee is strongly on record that the national program must include industry in the planning and conceptual design activity for the next generation of devices."

Referring to the long overdue fusion Comprehensive Program Management Plan, Dugan said that the drafts of the plan had been so "sanitized" within the Executive Branch that "it appears that even if we do get a plan, it will be virtually useless as any roadmap for meaningful alternatives to the present flat funded budgets." Dugan said that "Mrs. Lloyd feels that it is most important to the community and industry to have the DOE make a decision on the next generation of devices and more clearly delineate the path to technology demonstration and, ultimately, to the construction of a prototype plant." Referring to DOE statements that their new strategy is that the 1980's will be a period of "product definition" for fusion, while the 1990's will be for "product development", Dugan said that Mrs. Lloyd "feels presently there is all too much definition and not enough product." Dugan said that Mrs. Lloyd hoped that some "middle ground strategy" could be found "between the Administration's presently flat-funded program and the major funding commitment called for in the Magnetic Fusion Energy Engineering Act of 1980."

Mrs. Lloyd feels, Dugan said, "that an infusion of an additional \$250 million from FY 1984 to FY 1988 will be worth more than a billion dollars in program momentum over the long run." Copies of the complete text of Dugan's remarks are available from Fusion Power Associates.



Dr. John V. Dugan, staff director of the House Science and Technology subcommittee on Energy Research and Production spoke at the ANS Fusion Technology Conference.

#### REICHLÉ COMMITTEE REPORT

In a letter report to Congresswoman Marilyn Lloyd, Len Reichle, executive vice president of Ebasco Services and Chairman of the Fusion Advisory Panel to Mrs. Lloyd's subcommittee, advised that the U.S. would experience "deterioration of leadership" due to the flat-funding psychology of the Administration combined with "vigorous rates of progress abroad." Reichle urged vigorous implementation of the recommendations of the National Research Council (see our February 1983 newsletter) on the utilization of industry. Reichle stated, "We wish to reiterate our previously stated conviction that the development of fusion power should enjoy the highest national priority. Fusion power is of vital importance to our global future, socially, economically and politically. The United States can take the lead or play the costly game of catch-up."



Among those attending the TFTR dedication at Princeton May 5 (l to r): James R. Thompson, Deputy Director, PPPL; Alvin W. Trivelpiece, Director of Energy Research, DOE; John F. Clarke, Associate Director for Fusion, DOE; Donald Paul Hodel, Secretary of Energy; Harold P. Furth, Director, PPPL; Melvin B. Gottlieb, former Director, PPPL; and Marshall N. Rosenbluth, U. of Texas.

#### GAO AUDITS FUSION ACT

The General Accounting Office has been looking at DOE's claim (see our March 1982 newsletter) that "it is continuing to carry out the intent of the Act insofar as is possible with the budgets that can be made available." The audit was requested by Representatives Fortney H. Stark, Jr., of California and Marilyn Lloyd of Tennessee.

GAO states that "DOE, citing budget constraints, does not now plan to build the Fusion Engineering Device or the commercial demonstration reactor called for in the act." Rather, GAO says, DOE "Plans to build only one more reactor." The GAO audit also notes that DOE has not complied with several management and planning requirements of the act. "For example," GAO says, "the act's required comprehensive program management plan, due in

January 1982, has not yet been submitted to the appropriate congressional committees." Instead, GAO says, DOE is "revising its fusion energy development strategy" without informing the congress. DOE needs to justify and explain to congress its new strategy vis-a-vis the strategy legislated by Congress, GAO says. GAO also notes that DOE did not submit a plan to establish a Center for Fusion Engineering, also a requirement of the act. Copies of the GAO report (GAO/RCED83-105) can be obtained from GAO, Box 6015, Gaithersburg, Maryland, 20760 (301) 275-6241.

#### HEAVY ION FUSION CLARIFICATION

The DOE Office of Energy Research program for Heavy Ion Fusion (see our April newsletter) is directed at evaluation of the viability and efficacy of high energy accelerators for use in inertial fusion. Heavy ion target design and system studies remain under the cognizance of the Assistant Secretary for Defense Programs, DOE.

#### MARS BROCHURE ISSUED

Lawrence Livermore National Laboratory has issued a brochure describing the features of its Mirror Advanced Reactor Study (MARS). MARS is a tandem mirror with an ignited central cell. Electron cyclotron resonant heating and negative ion beams maintain the electrostatic confining potential in the end plugs. The MARS design was carried out by LLNL with assistance from TRW, General Dynamics Convair Division, Ebasco Services, Science Applications, Inc., University of Wisconsin, and Grumman Aerospace Corp. Copies of the brochure can be obtained from Dr. Carl Henning, LLNL, L-644, Box 5511, Livermore, CA, 94550 (415) 422-0235.

#### TFTR AUDITED

The DOE's Office of the Inspector General has issued a report (DOE/I6-0189) auditing the TFTR project. Copies of the report are available from the Technical Information Center, P.O. Box 62, Oak Ridge, TN, 37830. The report states that the project is estimated to cost \$578 million, including \$85 million to upgrade the TFTR capability to a higher level than was originally specified.

The report criticized DOE and PPPL for holding the advertised construction project cost to \$314 million by shifting costs to the operating budget. The report also criticized the practice of awarding fixed price contracts for items which had been incompletely designed or developed. The report states that "seventeen major contracts, each for a fixed price, had increased in cost from a total of \$96 million to \$156 million."

#### MEETINGS OF INTEREST

June 10-11 ERAB Fusion Panel at PPPL. Contact Lenore Ledman at DOE (301) 353-3598.

June 22-29 Short Course on Millimeter Infrared Wave Technology, MIT, \$450, Gayle Fitzgerald, Room 7111, MIT, Cambridge, MA 02139.

July 7-8 ERAB Fusion Panel, at LLNL.

July 11-13 U.S. Japan Workshop on Advanced Bumpy Torus Concepts, Rancho Santa Fe, CA. Contact R. L. Miller, AMPC, Inc., 2210-P Encinitas Blvd., Encinitas, CA, 92024 (619) 436-6125



FPA Board members Ed Gerry (Schafer Assoc.), Ken Fowler (LLNL), John Landis (Stone and Webster), and former Board member Paul Reardon (Brookhaven) at our recent Board of Directors meeting.



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**Speaking Out:** Congresswoman Marilyn Lloyd of Tennessee

## MRS. LLOYD ON FUSION

Congresswoman Marilyn Lloyd, chairperson of the House Science and Technology Committee's subcommittee on Energy Research and Production was interviewed by John Graham in the June issue of Nuclear News. Among other topics, the following exchange on fusion took place:

Graham: "What about fusion? I perceive--but I may be wrong--that fusion is no longer on the mainline of energy R&D, but then what is?"

Lloyd: "I am more optimistic than you are, John, but you are right--budgetary constraints and the lack of priorities by the Administration, especially by OMB, have hurt the program.

"The program still has a great deal of momentum, but the focus on the next generation of machines is not as sharp as it was a few years ago because of funding limitations. My Subcommittee recently recommended a significant add-on in fusion to allow some flexibility for enhancing industry and university involvement. As admirable as the goals were of the Magnetic Fusion Engineering Act of 1980, the demonstration timetable for the fusion option has slipped, chiefly because of drastically increased funding pressures. It is a program where our only significant disagreement with the Administration is one of degree, since it is very high-risk, long-term payback R&D. I believe that flat funding of the program has sidetracked it somewhat, but I think we can get it back on a more optimistic timetable with tailored add-ons over the next few fiscal years. The Administration unfortunately seems bent on retaining a scientific emphasis and not providing any measurable funding for engineering development or reactor systems technology."

## ERAB FUSION NON-MEETING

When is a meeting not a meeting? This was the key issue addressed at the scheduled first meeting of the new ERAB Magnetic Fusion Panel at Princeton June 10-11. As the meeting was about to commence, DOE officials announced that they could not make presentations to the panel and that the panel could not officially meet because DOE had not followed its own administrative procedures in setting up the panel and announcing the meeting. After much discussion on how to salvage the considerable effort expended in

assembling the distinguished group of panelists and presentors, it was agreed to allow the panelists as a "collection of individuals to listen to presentations by Princeton Plasma Physics Laboratory personnel.

DOE still is hoping to get its act together in time to hold the next ("first") meeting of the panel at LLNL on July 7-8. Presentations at the meeting will be by Ron Davidson for MFAC, Herb Woodson for the National Research Council fusion study and by Ken Fowler and LLNL staff. Presentations by Office of Fusion Energy personnel have been postponed until the August 30-31 meeting in Washington. All meetings are open to the public. Mike Saltmarsh of ORNL has been named technical secretary to the panel. Information on local arrangements for the July 7-8 meeting at LLNL can be obtained from Olga Jones at LLNL (415) 422-9862. Non-citizens must let Olga know they are coming three days in advance.

#### FUSION TECHNOLOGY DEVELOPMENT PLAN AVAILABLE

The Office of Fusion Energy's Division of Development and Technology has published a Fusion Technology Development Plan (DOE/ER-0166, May 1983). The document provides program descriptions, milestones and resource requirements for some seventeen different program planning elements grouped under four headings: Engineering Reactor Design and Development, Plasma Technology, Reactor Technology and Facilities. The document also discusses "spinoff" applications of fusion technology. Almost two years in the making, completion and publication is a credit to the skills of director Bob Dowling and his staff.

#### DEVELOPMENT AND TECHNOLOGY DIVISION ORGANIZATION

Recent reorganization in the OFE Division of Development and Technology resulted in the following distribution of responsibilities under director Bob Dowling:

Plasma Technology Branch: Don Beard, Acting Chief, is responsible for magnetic systems (Don Beard), and plasma engineering which includes neutral beam and ion rf heating (Stan Staten) electron heating, particle control and direct conversion (T.V. George).

Reactor Technology Branch: Greg Haas, Chief, is responsible for high heat flux components and plasma interaction systems (Marv Cohen), tritium systems, environment and safety (Gene Nardella), blanket and shield and non-electric applications (Sam Berk), materials and radiation facilities (Ted Reuther and Marv Cohen).

Reactor Systems Branch: Phil Stone, Chief, is responsible for reactor and blanket systems studies (Al Opdenaker) and reactor design (Phil Stone).

#### ANS FUSION DIVISION LAUDS FELLOWSHIPS

In a May 24 letter to Dr. Alvin Trivelpiece, Director of DOE's Office of Energy Research, ANS Fusion Division Chairman Ken Schultz of GA Technologies, Inc. stated, "On behalf of the ANS Fusion Energy Division, I would like to commend you for your Department of Energy Magnetic Fusion Energy Fellowship Program." Noting the "breadth" and "newness" of the field, Schultz stated, "Not only are the graduate students able to finish academic requirements at a university with a major fusion program but they are also required to spend at least three months at a national laboratory or industrial organization, working on a fusion project. This practical experience assures that their studies are tied in closely with the national program. As a result, the graduating students are able to step in immediately to mainstream fusion efforts.

"The engineering departments in the fusion area are in many cases eager to attract the very best students because of the keen competition for graduate students in engineering. The MFE program assures us that the very best students can be attracted to fusion studies, but more importantly it gives a strong signal to all students that the U.S. is dedicated to being a world leader in fusion and that long term career opportunities exist in this challenging field.

"The timely commercialization of fusion will be dependent on the innovative and bright students that are now being trained under the MFE fellowship program. Already MFE graduates have been hired and



are making an impact in fusion engineering. The high profile and success of the MFE fellowship program as administered by Oak Ridge Associated Universities is a tribute to the government's commitment to the future."

### FMIT ACCELERATOR PROGRESS

While international discussions proceed slowly on how to complete the Fusion Materials Irradiation Test Facility (FMIT) at Hanford, progress continues on the FMIT accelerator at Los Alamos National Laboratory. On May 27, the first beam was produced at 2 MeV. Ed Kemp leader of the effort, noted that 2 MeV was the first step in going to 5 MeV in about a year and later to 35 MeV in 1989. Work on the accelerator began in 1978.

### U.S.-CHINA FUSION PROTOCOL SIGNED

The U.S. DOE and the Chinese Academy of Sciences have signed an agreement laying the basis for cooperation in the field of magnetic fusion research. The protocol, signed in early May during a visit to Peking by the U.S. President's Science Adviser George Keyworth, treats the exchange of personnel, information, and instrumentation for engaging in fusion research and experimentation. Under the terms of the agreement, each government will commission universities as well as private and government-run facilities to participate in the exchanges. Several detailed issues, including patent agreements, must be resolved before any specific formal exchange programs can begin in fusion, according to Mike Roberts of DOE/OFE.

### FPA AUDIT REPORT AVAILABLE

The CPA firm of Brager and Christopher has completed an audit of FPA's financial condition as of December 31, 1982 (see our March newsletter). Copies of the audit report are available on request.

### PARTICLE BEAM CONFERENCE SET

The 5th International Conference on High Power Particle Beams will take place at the Sheraton Palace Hotel in San Francisco September 11-15. Topics will include high-power electron and ion beam acceleration and transport, diode physics, inertial confinement fusion and collective ion acceleration.

(Contact Dr. Richard J. Briggs, Program Chairman, Lawrence Livermore National Laboratory, P.O. Box 808, L-321, Livermore, CA 94550.)



The Novette laser at LLNL was dedicated in late January by (l. to r.) Lab director, Roger Batzel; Associate Director for Lasers, John Emmett, and DOE Deputy Assistant Director for Military Applications, Major Gen. William W. Hoover, USAF. One arm of the 2-arm Novette emits as much energy as all 20 arms of its predecessor, SHIVA. Novette is also the predecessor of the 10-arm Nova laser now under construction and scheduled for operation in late 1984.

### TOKAMAK NEXT STEP GAINS SUPPORT

The "Tokamak Fusion Core Demonstration" (TFCD), proposed by Princeton Plasma Physics Laboratory, is gaining favor and momentum in the fusion community as a possible "next step" device in the tokamak program. The TFCD evolved during the recent MFAC deliberations as a middle ground between advocates of a new engineering tokamak (a la the Fusion Engineering Device called for in the Fusion Act) and those who wish to upgrade the TFTR device at Princeton. The TFCD is an ignited, long-pulse tokamak with high neutron wall loading per pulse but limited lifetime fluence capability. It is projected to cost slightly less than \$1 billion if built at the Princeton site

and somewhat over \$1 billion if built at a new site. Though the device is most likely to utilize superconducting coils, copper coil and hybrid copper/superconducting coil options are also being evaluated. One rapidly evolving physics area in tokamaks, where the impact on TFC design could be profound, is the concept of using "bean shaped" plasmas to permit access to the so-called "second stability" regime of higher beta, hence higher power density, operation. As has happened often in the past, tokamak advocates are torn between the desire to embark soon on a next step device based on conservative (D-shaped, moderate beta) plasmas and designing a more advanced machine based upon less-proven (bean-shaped, high beta) ideas.

### FUSION BUDGETS

Congress has appropriated \$470.75 million for magnetic fusion and \$169.7 million for inertial fusion for FY 84. This compares to the President's request for \$467M and \$142M, respectively, and compares to FY 1983 levels of \$447M and \$190M, respectively.

### PEOPLE

Ed Kintner has left Titan Systems to accept a vice-presidential level position with GPU Nuclear Corp., 100 Interpace Parkway, Parsippany, NJ 07054. Ed will oversee a variety of areas for GPU, including issues associated with Three Mile Island. Ed can be reached at (201) 263-6155.

Lenore Ledman, assistant to John Clarke and to MFAC, has left the DOE Office of Fusion Energy to become Program Manager, Advanced Counterfeit Deterrence Program, U.S. Dept. of the Treasury.

Mike Monsler has left LLNL to become Vice President, Fusion Programs, at KMS Fusion, Inc., Box 156, Ann Arbor, MI 48106 (313) 769-8500.

Mike Saltmarsh has been named Coordinator of the development and technology elements of the ORNL fusion program. Mike will also coordinate the plasma technology element for the Toroidal Program Planning Office which is being established at Princeton under Paul Rutherford.

Julian Dunlap has been named Section Head of the Tokamak Experimental Section, replacing Saltmarsh; Jim Lyon has been named Associate Section Head and Stellarator Coordinator, both at ORNL.

John Soures has been named Deputy Director and Len Goldman has been named Associate Director for Development and Education of the University of Rochester Laboratory for Laser Energetics.

Caldwell McCoy has left the DOE Office of Fusion Energy to join NASA as the Director of the Information Systems Office at NASA (Washington, D. C. 20546). He can be reached at (202) 755-3503.

### MEETINGS

July 26-29 IAEA Symposium on Energy Removal and Particle Control in Toroidal Devices, Princeton. Contact Erol Oktay, DOE, (301) 353-4928.

August 15-19 Cryogenic Engineering Conference, Colorado Springs. Contact Carl Henning, LLNL, (415) 422-0235.

August 22-26, 7th International Conference on Structural Mechanisms in Reactor Technology, Chicago. Contact Robert Dowling, DOE, (301) 353-5378.

September 5-9 11th European Conference on Controlled Fusion and Plasma Physics, Aachen, FRG. Contact Dave Nelson, DOE, (301) 353-3287.

September 5-9 8th International Conference on Magnet Technology, Grenoble, France.

September 7-17 International School of Plasma Physics. Workshop on Mirror and Alternate Concepts, Varenna, Italy.

September 12-16 7th Symposium on Sources and Ion Assisted Technology, Kyoto, Japan.

September 19-22 3rd Topical Meeting on Fusion Reactor Materials, Albuquerque, NM. Contact Mark Davis, Sandia National Laboratories.



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## NEW AFFILIATE

Atlantic Richfield Corporation, Dallas, TX, has become the 18th affiliate of Fusion Power Associates. Dr. Robert L. Hirsch, vice president, will represent the company. We welcome ARCO to our association. We are especially pleased to have Bob Hirsch's continued interest in the fusion program. Bob is currently serving on our Board of Directors. Fusion Power Associates now has 31 members and 18 affiliates, compared to 10 members and no affiliates when we incorporated in August 1979.

## TFTR SETS NEW FUSION RECORD

In its first serious series of experiments the Tokamak Fusion Test Reactor (TFTR) at Princeton validated an important size scaling law and set a new record for confinement by reaching energy confinement times of 0.15 sec. This was the first time confinement in excess of one-tenth second has been achieved for high temperature, high density plasma. The time was longer than was predicted by the scaling law used to design TFTR (the so-called "Alcator scaling" in which confinement is proportional to the square of the plasma radius). The time was in agreement, however, with a more modern scaling law (the so-called "neo-Alcator scaling" in which confinement is proportional to the square of the major radius of the machine and the first power of the radius of the plasma). The plasma was produced with ohmic heating alone, reaching temperatures of about 1 KeV at densities of  $3 \times 10^{12} \text{cm}^{-3}$ .

## ERAB FUSION PANEL

The DOE's Energy Research Advisory Board (ERAB) Magnetic Fusion Panel met at Livermore July 7-8 and scheduled its next meeting in Washington August 30-31. Fusion Power Associates, various industries and universities, as well as the DOE Office of Fusion



ERAB fusion panel member Sol Buchsbaum (center) arrived late for the formal meeting, but Princeton's Harold Furth (l.) and Livermore's Ken Fowler (r.) brought him up to date at dinner.

Energy, will make presentations at the Aug. 30-31 meeting. Major areas of interest to the panel, which seem to be emerging from the review process, are (1) apparent discrepancies in the planning assumptions of DOE, MFAC, PPPL and LLNL; (2) the appropriate roles for international cooperation projects; and (3) the nature and timing of the next major fusion construction project.

A major issue which may also surface in the ERAB considerations is the weight to be given to long range suitability factors in choosing the site of the next major fusion device. This issue stems from the clear evidence that Europe and Japan are choosing their next machine sites with an eye to their suitability for the operation of fusion power test reactors. There is a concern in the U.S. fusion community that we may lose our edge in the world effort in the 1990's.

## NEW SOLID STATE LASER DEVELOPMENTS UNDERWAY

For years the laser fusion program has been plagued by the criticism that neodymium glass laser efficiencies were too low (about 1%) to be used in a fusion power plant (which requires laser efficiencies greater than 10%). This has given rise to the search for the so-called "Brand-X" laser, a new laser which would have all the required properties of efficiency, proper wavelength and repetitive pulse capabilities. Livermore scientists John Emmett, Bill Krupke and John Trenholme have analyzed potential routes to achieving the desired combination in a report (UCRL-53344) entitled "The Future Development of High-Power Solid State Laser Systems". With the assistance of two glass firms, Livermore is developing new ways of making glass lasers which show promise of exceeding 10% efficiency with multiple pulse capability. In addition, under Krupke's direction, Livermore is exploring replacing the glass substrate with various crystals, a technique which shows promise of increasing the efficiency even further. Success in this area would be a major breakthrough in the search for the "Brand-X" laser, would extend the utility of facilities like NOVA and accelerate the testing of fusion pellets in the future.

## JET MAKES FIRST PLASMA

The Joint European Torus (JET) at Culham, England, described by all who have seen it as a magnificent facility, has come on line making first plasma June 25. The successful completion of JET is a tribute to the effort of all the European nations working together under Euratom coordination. JET workers praised the effort of European industry in meeting their commitments to developing and delivering high quality components on cost and schedule. Although JET has come on-line only 6 months later than TFTR, the official schedule for adding high power heating to JET is more leisurely than that for TFTR, so that JET plans to achieve breakeven conditions in 1989 compared to 1986 for TFTR. JET is a larger device, however, so that many scientists expect European accomplishments to surpass those of the U.S. in the late 1980's.

## NEW MIRROR RESULTS

Scientists at the Lawrence Livermore National Laboratory announced in early July the first evidence of improved confinement in the TMX-Upgrade experiments. The experiments are aimed at demonstrating the formation of the



Olga Jones (l.) and Janet Sitzberger from the Livermore magnetic fusion program office arranged a reception with traditional wines from the Livermore valley as part of the ERAB fusion panel meeting.

so-called "thermal barriers" which prevent plasma from leaking out the ends of the device. The experiments show clear evidence of suppressing the end-loss. Before claiming definitive results on thermal barrier formation, the Livermore scientists wish to increase the density of the confined plasma to a somewhat higher value than the few times  $10^{11}$  value of the present experiments.

## TFCD

The Tokamak Fusion Core Demonstration (TFCD) concept, which we reported last month as one gaining increasing acceptance in the fusion community, received an additional boost last month in the form of a letter dated July 8 from DOE fusion director John Clarke to Princeton fusion director Harold Furth. In the letter, Clarke asks Furth to provide "definitive planning and budget documentation for the further development of the TFCD project in FY 84 and FY 85." "We should be prepared and organized to proceed with project preparation activities early in FY 84", said Clarke. Clarke indicated in an attachment that Princeton should assume "that FY 84 TFCD funding will be approximately \$5M to \$10M for all activities and that FY 85 funding will be approximately \$20M." Princeton is seeking line item authorization for the project in FY 1986. Though

cautioning Furth that "It should be understood that we do not have an approved TFCD project ...at this time", nevertheless, Clarke said, "...it is essential that PPPL approach this planning on the assumption that the project is real." Clarke also noted that TFCD would not necessarily be sited at Princeton and that "the final decision on sites will be made after option details have been developed." Copies of the letter are available from Fusion Power Associates on request.

#### MIT TOKAMAK PLANS ALSO GAIN

In addition to the TFCD project, the tokamak community is rallying around the need for a new superconducting, long pulse hydrogen tokamak at MIT. The MIT tokamak is envisaged to be a much more modest venture than the TFCD. MIT has characterized the new machine (called "Alcator-DCT") as a "minutemak" as compared to today's machines which they dubbed "secondmaks." The device would test the physics of plasma shaping with divertors. The plasma would be heated by rf, reaching temperatures approaching 10 keV, maintained for several minutes.

#### FUSION ENERGY EDUCATIONAL DEVELOPMENT SEMINAR

Fusion Power Associates will sponsor the 5th biennial seminar for senior secretaries and administrative personnel working in the fusion program September 20-22, in Oak Ridge, TN. This seminar will include a workshop on data processing/word processing interface and a tour of the Watts-Bar Nuclear Power Plant, as well as tours of the fusion facilities. The seminar is an opportunity to meet your counterparts from other sites and to strengthen your role in the fusion program. Contact us for further details.

#### EBT CONCEPT EVOLUTION

A workshop on Elmo Bumpy Torus concept evolution was held in Rancho Santa Fe, CA, July 11-13. The meeting was co-hosted by Ray Dandl's company, Applied Microwave Plasma Concepts, Inc. and Oak Ridge National Laboratory with the assistance of JAYCOR. The meeting was rich in new ideas going by a variety of colorful names, to wit: Elmo Bumpy Square, Elmo Snakey Torus, Bumpy Bean Torus, Twisted Racetrack EBT, etc. In fact, so many new ideas are now on the table to be tested that it will be a challenge to the EBT community to focus their experimental resources wisely.



Lee Berry and Nermin Uckan of ORNL were among the fusion community leaders attending the EBT workshop.

#### MUON CATALYSIS

Fusion, in addition to occurring in high temperature plasmas, can also occur in a D-T hydrogen molecule, during the natural vibration of the molecule if the inter-atom spacing of the atoms in the molecule can be reduced. This can occur if the electron which binds the molecule is replaced by a negative muon. Negative muons must be produced in an accelerator and last only a microsecond. Consequently, it has long been believed, based on theoretical estimates of mesomolecular formation rates that the muon would decay before catalyzing a sufficient number of reactions to repay the energy invested in creating the muon. In 1977, a series of theoretical papers in the Soviet literature predicted more rapid molecule formation, and revived the hope that a muon might catalyze about 100 fusion reactions before the decay. Since this is about 20 times the rest mass energy of the muon, it reopens the question of obtaining net energy from the muon catalysis. In a series of brilliant experiments beginning in 1981, and only recently completed, Steve Jones of the Idaho National Engineering Laboratory, working with co-workers from INEL and Los Alamos at the Meson Physics Facility, demonstrated the catalysis of 70 reactions per muon experimentally. Because of inefficiencies in producing muons and other inefficiencies in a total system, it still seems unlikely that practical amounts of fusion power could be economically generated using this

technique. On the other hand, prudence suggests we keep an open mind with regard to this fascinating new development and, in any case, we express our admiration to the experimental physics team for their fine work.

### CPMP

Remember the long lost fusion "Comprehensive Program Management Plan" (CPMP)? CPMP found his way home on June 29 when Energy Secretary Donald Paul Hodel sent him to Congress after an eighteen month truancy. The plan retained most of the features we found objectionable in earlier drafts (flat budgets, no major new facilities until the end of the decade, and a "shoot-out" between mirrors and tokamaks near the end of the decade) and dropped the features we had praised in an earlier draft (clearly delineated milestones and accelerated options) (see our June and September 1982 newsletters).

In a statement to the press, FPA president Steve Dean said that the final version of the CPMP "was not reviewed in the fusion community and did not reflect the options we wanted. The strategy portrayed in the CPMP represents a planned delay of at least a decade in achieving practical fusion power." Copies of the CPMP can be obtained from Dr. Michael Roberts, U.S. DOE Office of Fusion Energy, Washington, D. C. 20545. (301) 353-3068.

### DOE ANNOUNCES FY 83 SMALL BUSINESS AWARDS

Six fusion projects were among 106 small business awards announced by DOE July 7. The awards, chosen from among more than 1700 submitted, were for an average of \$50,000 each for 6 months. DOE taxed the fusion program about \$800,000 for the award kitty but fusion got only about \$300,000 worth of projects in return.

Three of the six awards went to members of Fusion Power Associates: Maxwell Laboratories, Inc., Applied Microwave Plasma Concepts, and KMS Fusion, Inc. Other awards went to Omega-P, Inc. of New Haven, CT, Rasor Associates, Inc. of Sunnyvale, CA, and TERA Advanced Services Corp. of Berkeley, CA.

The DOE announcement indicates that each of the award winners will be considered for a "phase 2" follow-on contract which could amount to \$200,000-\$500,000 over 2 years. However, DOE indicated they expected only 30% to 50% of the phase 1 winners to receive

the follow-on contracts. DOE expects to solicit FY 1984 proposals in December 1983.

### GENERAL DYNAMICS COIL ARRIVES IN OAK RIDGE

The large superconducting coil, built by General Dynamics Convair Division, arrived in Oak Ridge recently and was installed alongside a similar coil which arrived previously from Japan (see our January newsletter). The two coils are part of a six coil array which is being assembled as part of the internationally-sponsored Large Coil Test Facility at ORNL.



Ray Beuligmann (l.), head of the fusion effort at General Dynamics Convair Division is happy to see his coil complete and delivered. He is shown here talking to Pete Staudhammer of TRW at a recent Fusion Power Associates Board of Directors' meeting.

### MEETINGS

Aug. 30-31 ERAB Magnetic Fusion Panel in Washington, D. C.

Sept. 5-9 11th European Conference on Controlled Fusion and Plasma Physics Aachen, FRG. Contact Dave Nelson, DOE, (301) 353-3287.

Sept. 20-22 Fusion Energy Educational Development Seminar, Oak Ridge, TN. Contact: Z. Buchanan (615) 574-0988, or Ruth Watkins (301) 258-0545.



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## FPA BOARD ISSUES POLICY STATEMENT

The Fusion Power Associates Board of Directors has issued a "Policy Statement" on Fusion Energy Development." The statement will be presented to the DOE Energy Research Advisory Board's Magnetic Fusion Panel, will be distributed to government officials and will form the basis for our public positions and congressional testimony.

Our first policy recommendation is that the development of practical fusion power receive a higher national priority than it is now receiving and is based on our belief that the availability and affordability of energy are essential elements to healthy and vigorous industrial society and that assured energy supply is an important determinant of world peace and security and a requirement for progress of future generations.

Our second policy recommendation is that the engineering aspects of fusion development be given substantial additional effort now.

Our third policy recommendation is that commitments be made now to new and improved experimental facilities. It is based on our belief that such commitments are urgently needed to insure continued program momentum and progress into the 1990's.

Copies of the policy statement are available from FPA on request.

## ANSEL ADAMS URGES REAGAN TO SUPPORT FUSION

In a letter dated July 18, to FPA president Steve Dean famed nature photographer Ansel Adams stated "I am sure you must know of my recent visit with President Reagan in Los Angeles. I asked 'Why do you not take ten or twenty billion dollars from your defense budget and apply it to a crash program for



Ansel Adams, tours the Lawrence Livermore National Laboratory fusion facility as guest of Ken Fowler, Associate Director for Magnetic Fusion.

the development of fusion power?' He gave no response to this although I added 'Its success would certainly free us from depending on imported fuels.'" In addition Adams stated, "As you must know I am not a scientist but I have many friends who are deeply involved in many directions and who have expressed deep interest in the potential of fusion power. I remain dedicated to the concept of fusion power (as a citizen) and I wish I was in position to do more about it!"

## ERAB FUSION PANEL MEETS IN WASHINGTON

The ERAB Magnetic Fusion Panel met in Washington, D. C. August 30-31. Testimony was received from the Office of Fusion Energy and various industrial, university and utility groups. Copies of FPA president Steve Dean's testimony is available from FPA on request.

## MFAC PROPOSES NEW FUSION PLAN

Following the August 2-3 meeting of the Magnetic Fusion Advisory Committee (MFAC), chairman Ron Davidson sent a letter to DOE Director of Energy Research Al Trivelpiece suggesting that DOE scrap its recently issued Comprehensive Program Management Plan (CPMP) and instead adopt a "new strategy" which is being developed by MFAC subpanel 6. According to Davidson, the new strategy would have four principle features: (1) "Initiation in FY '86 of the TFCD (Tokamak Fusion Core Device), a moderate-cost tokamak reactor device (less than \$1B PACE) designed to achieve ignition and long-pulse equilibrium burn", (2) "Potential utilization of the MFTF upgrade to provide a cost-effective means for quasi-steady-state testing of blanket and power-systems components, complementary to TFCD," (3) "Vigorous pursuit of the broad U.S. base program in magnetic confinement, including new machine starts where appropriate, at approximately the present total level of effort" and (4) "Utilization of D&T programs in plasma and magnet technology in support of specific hardware requirements for the TFCD and of other major fusion facilities, so as to minimize overall program cost."

According to Davidson's letter, "Carrying out the above program will require a budget increase of 25-40 percent, after inflation, over a period of several years. With current inflation taken into account, the minimum FY 85 budget should have an increase of about 15 percent above the FY '84 level: Base Program \$510M; TFCD Design Activities \$25M; Total \$535M." Copies of the letter are available from FPA on request.

## U.S.-SOVIET COOPERATION EXCHANGE

Despite all the political maneuvering going on these days between the U.S. and U.S.S.R. governments, reason finally prevailed and the two sides have agreed to extend the very fruitful cooperation agreement which has existed between the U.S. and the U.S.S.R. in fusion research. The agreement is for 3 years, extendable to 5 years by mutual agreement. Scientists from both countries are delighted with the news. Recent U.S. fusion scientists visiting the Soviet Union have experienced especially cordial welcomes from their counterparts. They include Tom Simonen (LLNL), Paul Rutherford (PPPL), Herb Berk (U. Texas), Dieter Sigmar (ORNL) and Tihiro Ohkawa (GA Technologies, Inc.).



At the ERAB magnetic fusion panel meeting July 7-8 John Gilleland (GA Technologies, Inc.), ERAB chairman Lou Roddis and Mike Saltmarsh (ORNL).

## SUPERCONDUCTING MAGNET SETS RECORD

On May 11, 1983 the High Field Test Facility superconducting coil system at LLNL reached a peak field of 11.4 Tesla, the highest ever achieved in a coil of this size (18 tons with 40-cm diameter bore). The Nb<sub>3</sub>Sn conductor recovered from a heat flux of 0.34 W cm<sup>-2</sup>, twice the design value of the MFTF coils. Success of these tests validates the choice of multi-filamentary Nb<sub>3</sub>SN conductors for use in the high field axi-cell coils in MFTF-B. Our congratulations to group leaders Ed Dalder, his predecessor Don Cornish and to their co-workers Jon Zbasnik, Ron Scanlon and the entire superconducting magnet development group.

## AVS MEETING TO FEATURE FUSION SESSIONS

One of the most active, relatively new and growing fusion groups is the Fusion Technology Division of the American Vacuum Society. Formed in 1980, the division now has over 400 members. The officers of the division are Bill Lange (Westinghouse) chairman, Fred Dylla (Princeton) chairman-elect, Bob Langley (ORNL) secretary, and Tony Chargin (LLNL) treasurer. The division has been active in getting fusion sessions at various society meetings. The IV International Vacuum Congress (September 26-October 1, 1983 in Madrid, Spain) will feature 13 sessions related to fusion technology. The 30th National Vacuum Symposium of the AVS (October 31-November 4, 1983 in Boston) will have 11 sessions on fusion technology.



## FUSION ENERGY EDUCATIONAL DEVELOPMENT SEMINAR

Fusion Power Associates is sponsoring the fifth in a series of biennial Fusion Energy Educational Development Seminars at Oak Ridge, September 20-22. The purpose of these seminars is to assist senior secretaries and administrative personnel by enhancing their understanding of the fusion program and their role in it.

The seminar will include lay-language briefings on the history and current status of the fusion program and will include tours of fusion facilities at ORNL. The seminar will also feature a workshop on administrative issues such as office automation, networking, training and personal development. The banquet speaker will be Ms. Rose Wood, former secretary to John Clarke when he was director of the Fusion Energy Division at ORNL. Rose is now Head of Administration, Separation Systems Division at Union Carbide Nuclear Co., Inertial fusion programs will be presented by Mike Monsler, vice president of KMS Fusion, Inc., and Maj. Charles Whited of the U.S. DOE Office of Inertial Fusion. Magnetic fusion programs will be presented by scientists from ORNL, including Bill Morgan, John Sheffield, Jim Scott, Julian Dunlop, Marty Lubell, and Hal Haselton. On Thursday, September 22, ORNL director Herman Postma will give the group an overview of all ORNL activities and Les Price will describe the role of the DOE Oak Ridge Operations Office. One of the most important and useful activities of this group has been the preparation of the "Fusion Facilities Directory" and other educational brochures. The Directory is an invaluable resource document which includes telephone numbers and travel information for all major fusion sites. The 1984 edition of the directory is in press. Copies can be ordered from Fusion Power Associates.



Attendees at the 4th Fusion Energy Educational Development Seminar at Los Alamos in 1981. Do you know all these people? You should! Without them fusion progress would soon grind to a halt.

## BENEFACTORS

Fusion Power Associates has been the recipient of voluntary, tax-deductible contributions from a significant number of individuals during the past year. These contributions have helped us greatly, not just because they give us additional income to carry on our activities, but more importantly because they raise our morale by letting us know that you really believe in what we are doing. We thank the following persons who have made such additional contributions in 1983.

Donald J. Anthony	Kirby W. Fong	H. C. McCurdy
James F. Baur	John D. E. Fortna	Allan T. Mense
S. Locke Bogart	E. R. Frantz	Martha Dean Murphy
E. H. Bryant	Roger Fritzel	James A. Phillips
Robert B. Campbell	Bryon P. Fusini	Gregory A. Pick
Duk-In Choi	Kenneth Gentle	Carl W. Pierce
Andrew H. Colman	Michael Gouge	Warren E. Quinn
Donald Correll	Willard E. Hobbs	James Rome
Hatice S. Cullingford	Mark D. Hoover	Marian Dean Schwenbeck
William F. Cummins	Angus L. Hunt	James W. Shearer
Ali Dabiri	Bela Karlovitz	Richard J. Temkin
Kenneth W. Ehlers	Yoshiake Kazawa	John Trojanowski
Harold P. Eubank	Yim T. Lee	John Wilgen
William N. Felenchak	Thomas A. Leonard	Albert Yang
Joel H. Fink	James F. Lyon	W. E. Zisch
Michael W. Foley	John B. McBride	Klaus Zwilsky

### HAPPILY EVER AFTERS

Wedding bells are ringing for:

John Clarke, director of the U.S. magnetic fusion program at DOE and Lenore Ledman, former member of the Office of Fusion Energy, on September 24 in Washington, D. C.

John Nuckolls, associate program leader of the inertial confinement program at LLNL and member of FPA's Board of Directors, and Amelia Liaskas, on July 29 in Walnut Creek, CA.

Al Mense, fusion scientist at McDonnell Douglas Astronautics Company and former science consultant for the House Subcommittee on Energy Research and Production and Ramona Stelford, on August 6 in St. Louis.

Don Zeifang, attorney and former member of FPA's first Board of Directors and Kathleen Hallahan, on September 24 in Washington, D. C.

We wish them all a long and happy life together.

### ERRATUM

In our August newsletter the density in the recent TFTR experiment was erroneously reported as about  $2 \times 10^{12} \text{cm}^{-3}$ ; it should have read  $2 \times 10^{13} \text{cm}^{-3}$ . Our apologies to Dale Meade and the talented TFTR crew.



Lenore Ledman (r.) who will wed John Clarke on September 24 is shown here at her engagement party talking to John Willis of DOE's Toroidal Systems Division and his wife, Beth. In the background is Jim Decker, who will soon head a new office of science computers for Al Trivelpiece at DOE.

### DOE, OMB PLAN FLAT BUDGETS FOR FY 1985

Sources within the administration indicate that DOE has received planning guidance from OMB which would hold FY 1985 fusion funding to a cost of living increase. DOE must now decide whether to request more from OMB than the "guidelines." Final FY 1985 request numbers will not be known until the President submits his budget to Congress in January.



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## FPA ELECTS OFFICERS

The Fusion Power Associates Board of Directors has elected Dr. Robert L. Hirsch and Dr. Harold K. Forsen to be chairman and vice chairman, respectively, of the FPA Board. They will serve two year terms commencing October 1. The Board also re-elected Dr. Stephen O. Dean to an additional two year term as president of the association. Other officers, on continuing appointment, are Donald L. Kummer, corporate secretary and Alexander J. Glass, treasurer.

Dr. Hirsch is a vice president of ARCO Oil and Gas Co., and a former director of the U.S. magnetic fusion program. Dr. Forsen is manager, Engineering and Materials, for Bechtel Group, Inc. and a former vice president of Exxon Nuclear Company.

## ELLIS LEAVES DOE FOR NRL

On October 11, Dr. William R. Ellis will join the U.S. Naval Research Laboratory as Associate Director of Research and Director, General Sciences and Technology Directorate. In his new position, Bill will be responsible for the activities of several NRL divisions, including the Space Science and Plasma Physics Divisions and the Laboratory for Computational Physics. Since 1975 he has been responsible for the management of the magnetic mirror and EBT fusion programs at DOE. Members of the mirror and EBT communities hosted a dinner in Bill's honor at the Hyatt Regency in Cambridge, MA, on September 28. Bill can be reached at the U.S. Naval Research Laboratory, Code 4000, Washington, D. C., 20375, (202) 767-2557.



Dr. William R. Ellis, formerly Director, Magnetic Mirror Systems Division, DOE and now Associate Director of Research, U.S. Naval Research Laboratory.

## PROGRAM PLAN HEARING SCHEDULED

The House Committee on Science and Technology, Subcommittee on Energy Research and Production will convene a hearing on October 20 at 9:00 A.M. in Room 2325 of the House Rayburn Building to discuss the DOE's "Comprehensive Program Management Plan" (CPMP) for magnetic fusion. Witnesses invited to testify include John F. Clarke, director of the DOE Office of Fusion Energy; Leonard F. C. Reichle, chairman of the Subcommittee's Magnetic Fusion Advisory Panel; Stephen O. Dean, president of Fusion Power Associates, and Ronald C. Davidson (MIT), chairman of DOE's Magnetic Fusion Advisory Committee. The subcommittee is

soliciting views on the "strength and weaknesses of the plan as a whole and on the major milestones discussed in the plan." In addition, views are solicited on "the appropriate level of engineering development necessary for program balance and healthy industrial involvement."

### MFAC SUBMITS PRIORITIES REPORT

In a letter dated September 28, to DOE Director of Energy Research Al Trivelpiece, the Magnetic Fusion Advisory Committee (MFAC) transmitted the report of its "subpanel 6", evaluating the balance and priorities of the magnetic fusion program.

The Committee urged DOE to adopt a "new program strategy," (described in our September newsletter). Cornerstone of the recommended program is the "initiation in FY 86 of the Tokamak Fusion Core Experiment (TFCX), a moderate cost tokamak reactor device (less than \$1 billion PACE) designed to achieve ignition and long-pulse equilibrium burn." MFAC states that "a delay in decision making (on TFCX) would not add to the critical data base and would only lead to loss of momentum in the U.S. program and loss of the technical capability for leadership in world fusion research." The recommended program requires funding, according to MFAC, of \$535M in FY 1985. Copies of the letter to Trivelpiece and the Executive Summary of the MFAC report are available from Fusion Power Associates on request.

### ERAB FUSION PANEL NEARS CONCLUSION

The Energy Research Advisory Board (ERAB) magnetic fusion panel met October 4 in Oak Ridge to hear a summary of the development and technology activities and to hear programmatic views from ORNL and LANL. The panel is scheduled to make its report to the full ERAB on November 3-4 in Washington.

At its previous meeting, August 30-31, FPA president Steve Dean presented the Policy Statement recently adopted by our Board of Directors. In addition, Dean made the following remarks:

"Because of the rapidly evolving nature of proposals for next generation fusion devices, Fusion Power Associates has not taken a position on any particular new or upgraded

devices. I remain convinced, however, that the principles I presented to the Buchsbaum panel three years ago for selecting a next generation device remain valid today. These were:

- " . The purpose of the next major fusion device should be to extend the level of accomplishment beyond the maximum projected performance capability of TFTR, JET and JT-60, as measured by any or all of the following: Q,  $n\tau$ , pulse duration, beta, duty cycle, and/or total fusion energy released.
- " . In addition to its detailed physics and engineering goals, the next major device should have one or more goals which can be easily perceived by the public as a step toward practical fusion power.
- " . The cost of the next device should not exceed approximately \$1 billion.
- " . Important features of the next device, compared to its predecessors, should be improved reliability, maintainability and availability and the concept should have reasonable prospects of extrapolation toward a practical fusion power source."

At its October 4 meeting, the ERAB fusion panel discussed a first draft of its report. Although changes in opinion could still occur during the coming month, it seemed clear from the discussions that the panel has reached a consensus on at least two points. First, it will find fault with the DOE's recently issued Comprehensive Program Management Plan (CPMP) citing most of the flaws we have pointed out in previous newsletters. Especially objectionable to the panel is DOE's stated objective of holding a "shootout" between tokamak and mirror concepts at the end of the decade. Secondly, the panel will likely endorse the immediate initiation of a new tokamak project (like TFCX) to produce ignition and long pulse equilibrium burn as the first priority of the fusion program. The ERAB panel believes the project should begin now even under relatively flat budget assumptions. In response to an ERAB panel question, DOE acknowledged that such a possibility was possible,

although they stated that about a 20% increase in total fusion program funding would be required before the end of the decade.

#### AWARDS

The American Physical Society Division of Plasma Physics (APS-DPP) will present the 1983 James Clerk Maxwell Prize to Harold P. Furth, during its annual meeting in Los Angeles November 7-11. The prize is presented to Furth "for his extraordinary scientific and intellectual leadership of research on toroidal magnetic confinement fusion." Furth, director of the Princeton Plasma Physics Laboratory, was also a recipient of the Fusion Power Associates Leadership Award in 1982. The Maxwell Prize is sponsored by Maxwell Laboratories, Inc. of San Diego, CA, an FPA member.

The APS-DPP will also present the 1983 Award for Excellence in Plasma Research at the meeting. This award is being given jointly to Bruno Coppi, D. Bruce Montgomery, Ronald R. Parker, Leonardo Pierani and Robert J. Taylor, for their "pioneering research contributions" to the Alcator A tokamak project at MIT.

The American Nuclear Society will present the 1983 ANS Mark Mills Award to Stanley K. Borowski during ceremonies at the ANS annual meeting in San Francisco, October 31-November 4. Borowski, a recent Ph.D. graduate from the University of Michigan now employed at the ORNL Fusion Engineering Design Center, will receive the award for his paper "RF-Assisted Current Startup in the Fusion Engineering Device."

The DOE has presented a Meritorious Service Award to Lewis E. (Ed) Temple, Jr. Ed is Acting Director, Construction Management Support Division, Office of Management Research at DOE and has been instrumental over many years with assisting in the management of many fusion construction projects, including Doublet III, TFTR, and MFTF-B.

#### NRC TO STUDY INTERNATIONAL COOPERATION

At the request of the DOE Office of Fusion Energy, the National Research Council Energy Engineering Board has established a "Committee on International Cooperation in Magnetic Fusion." The Committee will be chaired by Joseph G. Gavin, Jr., president of the Grumman

Corporation. The study, which is to take 15 months to complete, is to identify, review and discuss a variety of potential ways to conduct international cooperation in fusion and to recommend further courses of action. The committee is expected to seek the views of leaders of the U.S. and foreign fusion programs through a series of workshops. Other members of the Committee include Bob Borchers (LLNL), Mel Gottlieb (Princeton U.), Joe Hendrie (BNL), Don Kerr (LANL), Bill Manly (Cabot Corp.), Arthur Morrison (Martin Marietta Corp.), L. Manning Muntzing (Doub and Muntzing), Daniel Simpson (Westinghouse Hanford Co.), Bill Stacey (Georgia Institute of Technology), and Robert Uhrig (Florida Power and Light Co.).



Recent visitors to GA Technologies' Doublet III fusion experiment, l. to r., Tihiro Ohkawa, vice president, John Gilleland, director, Congressman Duncan Hunter (R-CA); Secretary of Energy, Donald P. Hodel.

#### NEWS FROM GA TECHNOLOGIES

The Department of Energy and Japan Atomic Energy Research Institute (JAERI) have signed an agreement to extend the two governments' cooperation on the Doublet III fusion program at GA. The agreement was signed by John Clarke, Associate Director for Fusion Energy at DOE, and Susumu Murayama, Executive Director of JAERI. The new pact amends the existing five-year agreement, which began in August 1979, to extend the cooperation until August 1988. Through this arrangement JAERI has provided

funding to upgrade Doublet III, particularly with added neutral beam heating and electrical power equipment, as well as supporting expenses of increased operating time. In return, a JAERI team of scientists has shared in the experimental operation and results of Doublet III. Under the extended agreement, a portion of the JAERI funding will augment DOE funds in the construction of the Big Dee, a major reconfiguration of Doublet III, scheduled to begin operation in late 1985. The extension calls for a joint research program on Big Dee in which the GA and JAERI scientists will join as a single research team to investigate D-shaped and divertor configurations in high-temperature neutral beam and radio frequency heated plasma.

In May, the Department of Energy and GA personnel signed the management plan for the \$40 million Vessel Modification Project for Doublet III. This signifies that this new project has been officially approved by DOE as a "Major Device Fabrication" project (MDF). The modification will dramatically increase the performance potential of the facility and address issues crucial to fusion reactor design."

#### LASER FUSION NEWS

Los Alamos National Laboratory has announced successful testing of one arm of the two-armed Antares laser. The test produced a uniform five-foot-diameter burn pattern from a 12 trillion watt pulse lasting a billionth of a second. LANL expects to operate both arms of the laser to a total power of 30 trillion watts in October. The Antares project began construction in 1977. Full scale experiments with pellet implosion are to begin in early 1984.

LANL also announced the successful testing of a long-lasting thyatron switch for pumping excimer lasers. The new switch has been running continuously for more than a month on LANL's Pulsed Power Test Facility; previous versions degraded in tens of hours. The switch reverses itself 500 times a second and has shown no sign of wearing out after more than a billion shots.

KMS Fusion announced the development of "the worlds fastest holographic movie camera." The camera has a shutter speed of 20 trillionths of a second and can take up to four separate pictures in less than a billionth of a second.

#### NEW NEWSLETTERS

The Canadian Fusion Fuels Technology Project (CFFTP) of Ontario Hydro will issue a quarterly newsletter. The first edition is dated September 1983. Persons wishing to receive the newsletter should contact CFFTP, 2700 Lakeshore Rd., Mississauga, Ontario, L5k 1J3, Canada (416) 823-7387.

Stellarator News is a new newsletter published by Oak Ridge National Laboratory, edited by Jim Rome and Jim Lyon. Persons wishing to receive the newsletter should contact Jim Rome, Fusion Energy Division, P.O. Box Y, Oak Ridge, TN 37830 (615) 574-1306.

#### AMERICAN ENERGY AWARENESS WEEK

A variety of events nationwide will mark the observance of American Energy Awareness Week October 23-29. For information on what may be happening in your area, call (202) 861-0792.

#### FUSION FELLOWSHIPS

The application deadline for the 1984-85 DOE Magnetic Fusion Energy Technology Fellowship program is January 30, 1984. The fellowships support graduate study and research at DOE-designated participating universities with recognized ongoing programs in magnetic fusion energy technology. Applicants are normally senior undergraduates who will receive baccalaureate degrees in engineering or the physical sciences. Fellows undertake practicums off-campus at DOE-designated participating centers of magnetic fusion energy research and development. The awards are for 1 year and are renewable. Annual stipends are \$12,000; tuition and fees are paid. At present, 24 fellows at 10 universities are working towards master's degrees (maximum 2 years) or doctoral degrees (maximum 4 years). Applicants must be U.S. citizens or permanent resident aliens. Fellowships are sponsored by the DOE Office of Fusion Energy, Division of Development and Technology. Universities and students wishing to participate in the 1984 Magnetic Fusion Energy Technology Fellowship Program should request information from David H. Garber, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, TN, 37830 (615) 576-3428.



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## PEOPLE

Don Kummer, board member and corporate secretary of Fusion Power Associates has been named Vice President, C<sup>3</sup>I, McDonnell Douglas Astronautics Company. Don was previously in charge of MDAC's fusion activities.

Bob Borchers has been named Associate Director for Computations, Lawrence Livermore National Laboratory. Bob was previously Deputy Associate Director for Magnetic Fusion.

John Nuckolls, a member of FPA's Board of Directors, has been named Associate Director for Physics, Lawrence Livermore National Laboratory. John was previously Associate Program Leader, Inertial Confinement Fusion, at LLNL.

Richard Bolton, Project Director, Tokamak de Varennes, has replaced Claude Richard as representative to Fusion Power Associates for the Institut de recherche d'Hydro-Quebec.

Fred Bernthal has been named a commissioner of the Nuclear Regulatory Commission. Fred was previously chief legislative assistant for energy science and technology to Senator Howard Baker.

Danny Boggs has been named Deputy Secretary of DOE. He was previously Assistant Director of the White House Office of Policy Development covering energy policy matters.

Pat Collins has been named Under Secretary of DOE where he will concentrate on conservation and renewable energy technologies. He was previously Vice President of Political Affairs at the National Association of Home Builders.



Dr. Robert R. Borchers, newly-appointed Associate Director for Computations, LLNL.

## INESCO READIES PUBLIC OFFERING

INESCO, the San Diego-based company founded by Robert W. Bussard has issued a preliminary prospectus dated September 14 indicating its intention to make a public stock offering. Copies of the preliminary prospectus can be obtained from D. H. Blair and Co., Inc., 44 Wall Street, 19th Floor, New York, New York, 10005, (202) 757-0066. The document states that "the company's cumulative net loss since inception (in 1976) has been \$16,010,503 through June 30, 1983" and indicates that "the company's staff has been reduced by approximately 30 people since April 1983" and that "the company is now operating at a monthly expenditure level of approximately \$300,000." The company plans a three-phased program consisting of (1) design and component testing (through 1986), (2) demonstration of fusion ignition and controlled burn (1986-1989) and (3) "commercial exploitation of fusion power" ("commencing between approximately 1989 and 1994").

## LIDSKY SLAMS FUSION PROGRAM

MIT professor of nuclear engineering Larry Lidsky, in the cover story of the October issue of Technology Review, proclaims "Even if the fusion program produces a reactor, no one will want it." Lidsky bases his conclusions primarily on his belief that the low power density of fusion reactors compared to fission reactors will make fusion non-competitive. He also believes fusion reactors will be too complex. Lidsky poses the question "Given all of fusion's liabilities, why are we working so hard on it.?" Lidsky says "the only real hope for fusion is to take the long view ignored in the fission program" and consequently he advocates research on neutron-free fusion fuel cycles.

In a letter to the editor of Technology Review, FPA president Steve Dean states that "the fusion scientific and engineering community has been and is concerned about the problems he raises but does not share his conclusion that the problems are unsolvable." "Indeed," Dean says, "there are many studies showing that fusion economics, though only dimly perceived now, are within the uncertainties of projections for fusion, fission and other power sources of the next century." According to an associated press story in the October 3 Boston Globe, "Lidsky is adamant. 'In my opinion,' he said, 'it is a dead end as far as producing power.'"

A rebuttal prepared by Dan Cohn of MIT will appear in a forthcoming issue of Technology Review.

## FPA SURVEY

We recently solicited the views of our members and affiliates on how we are doing and on suggestions for improvements. Over 100 persons responded. Over 90% of those responding rated our "overall performance in promoting fusion energy development" and the "quality of our publications" as "good" to "excellent." By a 2-1 margin they found our newsletter to be our "most useful service." They indicated their belief that our "most important activities" were interacting with the Congress and working with the media. In answer to the question "Do you think we are too critical of government?", over 90% said "no." Our respondents saw our "strengths" to be good contacts and the ability to provide an independent perspective. They saw our primary weakness to

be our "small size" and insufficient breadth in our membership. The principal suggestion for improvement was to engage in a larger number of educational activities aimed at a broader audience. We are seriously reviewing all your comments and suggestions in detail and sincerely appreciate your help.

## ROCHESTER SEEKS LASER USERS

The National Laser Users Facility (NLUF), located at the University of Rochester's Laboratory for Laser Energetics, is available for user experiments on high energy density studies and associated applications. Proposals requesting allocation of facility time should be submitted by April 1, 1984 to Thomas C. Bristow, Manager, NLUF, Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, NY, 14623.

The facility has accommodated 30 user experiments since 1979 in areas such as spectroscopy of highly-ionized atoms, laboratory astrophysics, pulsed x-ray diffraction and fusion. Opportunities are also available in shock wave studies, pulsed neutron applications and fundamental physics of matter. Tom Bristow, (716) 275-2074, can give you further details.

## MEETINGS AND COURSES

December 5-9, Short Course on "Laser System Design." University of Wisconsin. Contact Donald E. Baxa (608) 262-6381.

December 5-9, Tenth Symposium on Fusion Engineering, IEEE, Philadelphia, PA. Contact Constance Hopkins, PPPL, (609) 683-2468.

January 23-27, International Symposium on Heavy Ion Accelerators and Applications to ICF. Tokyo. Contact T. Katayama, Inst. for Nuclear Studies, Univ. of Tokyo, Tanashi, Tokyo, 188, Japan.

February 9-10, Magnetic Fusion Advisory Committee meets at GA Technologies, Inc., San Diego. Contact John Cowles, DOE (301) 353-3598.

February 26-29, AIF Conference on "The Role of Industry in Fusion Power." Washington, D. C. Contact Frank Graham (202) 654-9260.





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## ALCATOR ACHIEVES LAWSON PRODUCT

In a famous 1957 paper, British physicist John Lawson showed that regardless of how high a temperature was achieved, net energy from fusion reactions could only occur if the product of the plasma density and its confinement time exceeded a certain minimum value, which he calculated to be  $6 \times 10^{13} \text{cm}^{-3} \text{sec}$  (This value is usually rounded off to  $10^{14}$  in the popular literature). Now, 26 years later, scientists at the Massachusetts Institute of Technology, using a tokamak device called Alcator C, have become the first group to successfully achieve and surpass this value (popularly known as the Lawson product). This truly historical event marks the accomplishment of an important and essential demonstration on the path to practical fusion power. Our congratulations to Ron Parker, leader of the Alcator Group and to the many supporting scientists, engineers, technicians and supporting staff, including Martin Greenwald, Dave Gwinn and Steve Wolfe, key contributors to the experimental work.

The actual value achieved for the  $n\tau$  product was about  $8 \times 10^{13} \text{cm}^{-3} \text{sec}$ , about two times the previous record set by the Frascati tokamak in Italy a few years ago.

The Alcator achievement takes its place alongside another major historical event in tokamak devices: the surpassing of the minimum temperature required for ignition and self-sustained fusion burn, achieved in the PLT tokamak at Princeton in 1978. The stage is now set for the demonstration of energy breakeven (the simultaneous accomplishment of temperature and Lawson product in the same device). This demonstration is projected to occur around 1986 in the Tokamak Fusion Test Reactor (TFTR) now in initial operation at Princeton.



Dr. Ronald R. Parker of MIT, leader of the Alcator group that just achieved the Lawson Product.

## DOE RANKS LLNL & PPPL AS TOP FUSION LABS

The Office of Fusion Energy, DOE, has issued a performance ranking of its eight largest fusion contractors. Lawrence Livermore National Laboratory is ranked first, with the Princeton Plasma Physics Laboratory a close second. Both were given the top ranking of "Excellent/Superior."

MIT and Los Alamos were tied for third and fourth place, with Argonne National Laboratory listed fifth. These three were rated "Excellent." The other contractors were ranked in the following order: ORNL, LBL, GA Technologies and the University of Texas. None of the contractors were viewed as unsatisfactory. A letter from OFE director John F. Clarke states "It is our collective judgment that this listing represents the rank ordering of the laboratories to the best of our abilities."

## CONN HEADS NEW FUSION JOURNAL

North Holland Publishing Company has begun publishing a new international fusion journal entitled "Nuclear Engineering and Design/Fusion." R. W. (Bob) Conn of UCLA is principal editor. There are no page charges to authors or institutions. If you would like subscription or manuscript information, contact Bob at UCLA, 6291 Boelter Hall, Los Angeles, CA, 90024.

## ROCHESTER SETS NEW ULTRAVIOLET LASER RECORD

By frequency-tripling six beams of the 1 micron wavelength, 24-beam OMEGA Nd:Glass laser, scientists at the University of Rochester have successfully operated at a wavelength of approximately one-third micron. During its first series of tests, OMEGA produced 388 Joules at 0.351 microns in a pulse lasting 0.6 nanoseconds. This is the highest energy, uniform irradiation laser available at this frequency in the world today. Target irradiation experiments performed with ultraviolet irradiation from OMEGA show considerably increased absorption and considerably reduced levels of hot electron preheat. These results increase the probability that the short-wavelength, direct-drive approach to laser fusion will succeed. Rochester plans systematic conversion of additional beams, pending DOE approval which they expect to receive in the near future. OMEGA is part of the National Laser Users Facility at the Laboratory for Laser Energetics of the University of Rochester.

## COHN REBUTS LIDSKY

In an article to be published in a forthcoming issue of Technology Review, Dan Cohn, head of the Fusion Systems Division at the MIT Plasma Fusion Center takes on fusion critic Larry Lidsky (see our November newsletter). Cohn opens his rebuttal by quoting Samuel Johnson, who said, "Every man has a right to utter what he thinks truth and every other man has a right to knock him down for it." According to Cohn, "Lidsky's excessive pessimism about neutron-producing reactors is in a sense a mirror image of the unrestrained optimism he attributes to the fusion program." Cohn says Lidsky's "unbalanced assessment" stems from having considered the issues "in an unnecessarily negative way". Lidsky shows a clear

**ERRATUM:** The phone number given in our last newsletter for for D. H. Blair and Co. for requesting a copy of the INESCO prospectus was incorrect. The correct number is (212) 747-0066.



Sponsors of the University of Rochester fusion program visit the laboratory. (l. to r.) Gen. William Hoover (DOE), Dr. Robert McCrory (LLE), Mr. Mark Vehay (LLE), Maj. Charles Whited (DOE), Mr. Sid Law (Northeast Utilities), Dr. John Soures (LLE), and Dr. Jack Wilson, The Standard Oil Co. (Ohio).

preference for a future based on fission reactors. However, as Cohn notes, "a hundred years after shutdown the biological hazard potential of the radioactive waste (from a fusion reactor) would be more than a million times lower than that generated in a comparable fission plant." Cohn does not expect public opposition to fusion reactors compared to fission reactors where "opposition to the transportation and storage of radioactive waste has increased; and recently fission plants have been threatened with shutdown because of public concern about evacuation in the event of a worst case accident."

On Lidsky's argument that fusion reactors will be too complex to be reliable, Cohn notes that "present civilian aircraft are far more complex than aircraft of forty years ago but are more reliable." Cohn addresses each of Lidsky's major criticisms and notes that "Lidsky downplays the wide range of (fusion) reactor design features and emphasizes the least attractive possibilities."