

NEWS FROM



FUSION POWER ASSOCIATES

2 PROFESSIONAL DRIVE, SUITE 248 • GAITHERSBURG, MARYLAND 20760

(301) 258-0545

January 1, 1980

FUSION ADVISORY PANEL MEETS

On December 10 the Fusion Advisory Panel to the Subcommittee on Energy Research and Production of the House Committee on Science and Technology met in Washington to review the Department of Energy's timetable for fusion energy development. The Panel, chaired by Dr. Robert L. Hirsch of Exxon, listened to presentations from Ed Kintner, Mike Roberts and Frank Coffman of DOE, from Lee Berry of ORNL, and from Fusion Power Associates Board of Directors member Paul Reardon, Head of Princeton's TFTR project. Members of the Advisory Panel are Hirsch, Richard Balzhiser (EPRI), Robert Conn (U. of Wisconsin), Ersel Evans (Westinghouse), T. K. Fowler (LLL), Harold Furth (PPPL), Joseph Gavin (Grumman), John Landis (Stone and Webster), Tihiro Ohkawa (General Atomic), Robert Smith (Public Service Electric and Gas of N.J.), and Alvin Trivelpiece (SAI). Ohkawa and Trivelpiece are also members of the Fusion Power Associates Board of Directors.

In announcing the meeting, Congressman Mike McCormack, Chairman of the Subcommittee on Energy Research and Production, issued a statement saying "The technology is available today to develop magnetic fusion as a solution to continued dependence on diminishing supplies of fossil fuels". McCormack also stated "As a result of our Advisory Panel's review of the fusion program last July, I requested that the Department of Energy prepare a set of accelerated program plans. These new plans would provide for a demonstration fusion power plant in the 1990's, about two decades earlier than the current DOE plan". McCormack announced a congressional hearing of his subcommittee, which was held on December 11, saying that "The primary purpose of the hearing is to explore the prospects of achieving this (accelerated) goal". Members of McCormack's subcommittee are John Wydler (R-N.Y.), Marilyn Lloyd Bouquard (D-Tenn.), Robert Roe (D-N.J.), Edwin Forsythe (R-N.J.), Stanley Lundine (D-N.Y.), Toby Roth (R. Wisc.), Robert Young (D-Mo.), Barry M. Goldwater, Jr. (R-Ca.), Richard White (D-Tex.), Manuel Lujan (R-N.M.), Howard Wolpe (D-Mich.), Ronnie Flippo (D-Ala.), Harold Hollenbeck (R-N.J.), Nicholas Mavroules (D-Mass.), Richard Ottinger (D-N.Y.), and Beryl Anthony (D-Ark.).

SENATOR BAKER ENTERS LETTER FOR THE RECORD

At the hearing on December 11, Congressman Wydler entered into the record a letter dated December 6 which he had received from Senator Howard Baker. Baker sent a similar letter to DOE Secretary Charles Duncan. In his letter Senator Baker stated "The evidence suggests that the current program can responsibly and usefully absorb substantially increased funding. There is a virtual consensus among experts that we now know enough to program a demonstration fusion power plant by 1995, and indeed must achieve that goal if this country is to see fusion as a base station power source early in the next century. As the study prepared by DOE Under Secretary Deutch shows, an accelerated plan will actually be less expensive than the current DOE base plan to achieve a demonstration plant by the year 2010". Baker further stated "The country can no longer afford to be timid and cautious in our quest for new energy sources. In a time when we are spending \$70 billion per year for foreign oil, finely tuned academic collating of information is not adequate in the face of the deepening

crises of energy supply that threatens to engulf our society and the world in chaos". Baker added "Fusion energy will not contribute to the solution of our pressing short-term energy supply problems, but now is the time to decide that our children will not live in a world of peril because energy is running out".

ADVISORY PANEL REPORTS

At the hearing December 11, Bob Hirsch submitted the Panel's conclusions. Hirsch stated "The program had reached, and in many cases surpassed, the goals publicly set forth in past years". On that basis, he said "The Panel saw the program to be not only viable, but unusually meritorious and a source of national pride". He said "The Panel felt that the magnetic fusion energy program was without a doubt ready to proceed much more aggressively than projected by the DOE". Further, Hirsch stated that the Panel had previously recommended "that the subcommittee seriously investigate a more vigorous approach to practical fusion power" and "that the Department of Energy be requested to prepare a program plan aimed at the goal of operating a demonstration fusion power plant by the year 1995". In reviewing the plan prepared by DOE the Panel expressed its belief "that the engineering feasibility of fusion can be demonstrated before 1990 and that commercial fusion power can be demonstrated in the 1995-2000 period". Hirsch said "We continue to strongly believe that the present 2010 schedule for the demonstration of practical fusion power is unnecessarily and undesirably long".

LETTER FROM VICE PRESIDENT MONDALE'S OFFICE

In a letter dated December 3 to Fusion Power Associates President Stephen O. Dean, Vice President Mondale's Special Assistant for Domestic Policy, Eric Vaughn, stated "Magnetic fusion programs are moving along very well, in our opinion. So well, in fact, that the Department of Energy and the Office of Management and Budget think it is time to move magnetic fusion out of the pure research stage". He further stated "Inertial confinement fusion is also moving ahead at a pace considered by many to be slow by comparison to the magnetic fusion pace, but encouraging nonetheless".

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For further information contact Dr. Stephen O. Dean (301) 258-0545.

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February 1, 1980

HOUSE SCIENCE AND TECHNOLOGY COMMITTEE HEARINGS FOLLOW-UP

Following the December 10-11 hearings on fusion described in our January 1 newsletter, Congressman Mike McCormack made a series of visits to high government officials to discuss the fusion program. In the space of a few weeks, Mike visited with DOE Secretary Charles Duncan, OMB Director James McIntyre, the President's Science Advisor Frank Press, and the President's Domestic Policy Assistant Stuart Eizenstat. As a result of these visits, by early January there was, at the highest levels of government, a greater degree of awareness and interest in the fusion program than at any time in the history of fusion research. Reports of these meetings indicate that a great deal of empathy for fusion exists, although there are differences of opinion on whether a greatly accelerated fusion program should be initiated at this time. Congressman McCormack advocated an Apollo-like program aimed at a demonstration reactor by the year 2000. The Department of Energy, on the other hand, officially takes the position that the program is not yet technically ready to enter into Apollo-like mode, fearing that this might result in a premature narrowing of technical options. The OMB appears more receptive than the DOE to establishing more ambitious, nearer-term goals for fusion and to providing enhanced budgets. OMB, for example, recommended higher FY 1981 funding levels for fusion than requested by DOE. The President's Science Advisor does not appear to have an independent position yet and, consequently, supports the official DOE position. President Carter, presumably, will formulate his views in the near future.

Visions of Apollo look over the Fusion Advisory Committee at its December 10-11 meeting. Seated at the table: Joe Gavin (President, Grumman Aerospace), Bob Hirsch, Chairman (Exxon), John Landis (Senior V.P., Stone & Webster), H. K. "Bud" Hebel (President, Boeing), and Al Trivelpiece (Corporate V.P., Science Applications, Inc.). In the foreground: Paul Reardon (Princeton), Frank Coffman (DOE), Lee Berry (ORNL), Ed Kintner (Director, Office of Fusion Energy, DOE), and Len Schelle (Ebasco). In the background: Jerry Landay (CBS), Jim Williams (LASL), and Ron Kostoff (DOE).





Fusion Advisory Committee member Tihiro Ohkawa (Vice President, General Atomic) shares his views with Peter Willis (General Electric) and Len Reichle (Executive Vice President, Ebasco) at the December 10 reception.

Don Kummer (McDonnell-Douglas Astronautics Company) poses for the camera with Congressman Mike McCormack.

LETTER TO EIZENSTAT

In view of the rapidly evolving discussions of the fusion situation in the Executive Branch, Fusion Power Associates President Steve Dean sent a letter dated January 8 to Stuart Eizenstat expressing his opinions on the technical readiness of the fusion program. His letter reads as follows:

"I understand that you are in the process of discussing with the President and with Congressman Mike McCormack the question of the readiness of the fusion energy program to proceed at a more rapid pace. I wish to present my views to you on this matter.

"The Department of Energy has chosen and continues to recommend a very conservative approach to fusion development. I firmly believe that the United States could develop practical fusion energy systems in 15 years, rather than the considerably longer period envisaged by the Department of Energy. To do this would require an Apollo-style management approach, but would not require as much money as in the Apollo program. My estimate is that annual expenditures about one-fifth of the peak Apollo budgets would be needed. Yet the technical achievement and public benefits of fusion exceed that of Apollo.

"The Fusion Power Associates is a non-profit association of high technology companies which strongly believe that fusion is ready to begin the transition from scientific research to engineering development. Opinions of the Department of Energy notwithstanding, the majority of the fusion scientific community believes that an adequate scientific basis exists to proceed towards a more ambitious goal for fusion. Indeed, fusion by the year 2000 was the goal of the Administration until Secretary Schlesinger cut the program back by \$60M, relative to the budget President Ford had submitted shortly before leaving office, in early 1977. There was no scientific justification for this slowdown. In view of the very large balance of payments deficit which the U.S. experiences every year to purchase foreign oil, it seems to me that we can well afford the relatively modest increases in expenditures which would be required to create a more exciting and productive environment for fusion research and to demonstrate that the United States has not completely abandoned its historical role as world leader in high technology development."

PRESS BRIEFING

January 18 Congressman McCormack held a briefing on fusion for members of the press. Approximately 30 members of the press were in attendance. Fusion Power Associates President Steve Dean was asked to present a talk entitled "Fusion Basics" as the lead-off for this briefing. This was followed by Bob Hirsch, who presented the findings of his advisory panel, and by Frank Graham of the Atomic Industrial Forum who distributed copies of a just-released report entitled "Fusion Energy at the Cross-Roads: Role of the Private Sector". Mike McCormack then described his views of the status and promise of the fusion program and his ideas of where we should go from here. Mel Gottlieb (Princeton), Lee Berry (ORNL), and Ron Davidson (MIT) also participated in the briefing.

On January 21, McCormack sent a formal letter to the President requesting that he establish "as a national goal" the operation of a fusion electric demonstration plant before the end of the century.

NEW HIGH LEVEL REVIEW PLANNED

Ed Frieman, recently confirmed as DOE Director of Energy Research, intends to commission a new high level policy review of the magnetic fusion program. The review will update the views of the 1978 'Foster Committee'. The Committee will be chaired by S. J. Buchsbaum of Bell Laboratories. The first meeting of the Committee is scheduled for February 13. The Committee intends to make some site visits of a few days each, probably to Princeton and Livermore. Other members of the Committee are John Foster (TRW), Eugene Fubini (Fubini Consultants, Ltd.), Marshall Rosenbluth (Institute for Advanced Study), Marvin Goldberger (California Institute of Technology), James Fletcher (University of Pittsburgh), Wolfgang Panofsky (Stanford Linear Accelerator Center), Robert Conn (UCLA), and Roy Gould (California Institute of Technology).



Jerry Landay (CBS News), Ed Kintner (DOE), and Bob Hirsch (Exxon) all seemed pleased with how things are going in fusion.



Mike McCormack greets Fusion Power Associates President Steve Dean. In the background: Ersel Evans, Vice President, Westinghouse/Hanford.

EBT-P

On January 9-11 a comprehensive review of the Oak Ridge EBT program took place at DOE-Germantown. The review included the results from the existing EBT device and the proposal to build a new, large proof-of-principle experiment called EBT-P. The panel, headed by Bob Conn, reportedly gave an enthusiastic endorsement to plans to move ahead. Assuming DOE approval, ORNL intends to issue a "Request for Proposals" to industry in February.

MFTF-B Review

A major review will take place the week of January 28 of the LLL Mirror Program and the proposal to convert MFTF to a tandem configuration, called MFTF-B. No funds are contained in the DOE FY 1981 budget for MFTF-B so that approval of the project may have to involve a supplemental budget request. The review panel consists of Bill Ellis (DOE, Chairman), Lee Berry, Bob Conn, Ron Davidson, Steve Dean, Warren Quinn, Marshall Rosenbluth and Tom Stix. In preparation for the review, LLL has issued several summary reports including (1) a National Mirror Fusion Program Plan, (2) a physics survey entitled "Status of Mirror Fusion Research 1980," (3) a report entitled "Physics Basis for MFTF-B" and (4) the MFTF-B proposal.

The results of the review will be presented to the magnetic Fusion Power Coordinating Committee which meets at Livermore, February 10-12.



Jim Decker (Director, Division of Applied Plasma Physics, DOE), Mike McCormack, and Al Mense (Fusion Science Consultant on the HS&T Staff), discuss the importance of maintaining a broad fusion program with Peter Rose (President, Mathematical Sciences Northwest).

Photos in this issue by Rebecca Harrington.

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ASME HOLDS FUSION SYMPOSIUM

The American Society of Mechanical Engineers (ASME) will hold its 20th Annual Symposium in Albuquerque, New Mexico, on the subject of "Fusion Energy Production". The meeting will take place March 20-21 at the University of New Mexico, Physics Lecture Hall. The primary conference hotel is the Hilton Inn in Albuquerque. The Conference agenda will consist of invited papers on many aspects of fusion. Tours are being arranged to the Los Alamos Scientific Laboratory and to the Sandia Laboratories. Persons interested in attending the conference should contact Rodney May at (505) 264-7669.

The List of Papers is as follows:

Wednesday, March 20

Keynote Address

Stephen O. Dean, Fusion Power Associates

Laser Fusion at LLL

Alex Glass, LLL

Magnetic Fusion at LASL

Warren Quinn, LASL

Friday, March 21

Utility View of Fusion

F. Robert Scott, EPRI

Fusion Design Studies

Robert Conn, UCLA

Materials for Fusion

Walter Bauer, Sandia

Technological Aspects of Particle Beam Fusion

Don Cook, Sandia

Luncheon Speaker

Al Narath, Sandia

Kamak Fusion

Dale Meade, Princeton

Mirror Fusion

Richard Post, LLL

Environmental and Safety Aspects of Fusion

Jim Crocker, EGG (Idaho)

Particle Beam Fusion at SLA

Glenn Kuswa, Sandia

"FORTUNE" FEATURES FUSION

Fortune Magazine published a special anniversary issue February 11, 1980 to celebrate its 50th year anniversary. In the words of the editors, "This special issue is an attempt to convey the excitement of that incredible era...". The issue consists of edited reprints of 31 articles selected from almost 7000 articles which had been published in Fortune over the years. A fusion article which appeared in January 30, 1978, entitled "Shiva: The Next Step to Fusion Power" received the honor of appearing as the wrap-up article in this anniversary issue.

CONGRESSIONAL HEARINGS

Authorization hearings on the DOE FY 1981 budget submission were recently held by Mike McCormack's Subcommittee on Energy Research and Production. Government witnesses Ed Kintner (for magnetic fusion) and Duane Sewell (for inertial confinement) were heard on March 3. The Subcommittee also requested, and received on March 6, testimony from two non-governmental organizations, the Fusion Power Associates, and the Atomic Industrial Forum. Steve Dean spoke on behalf of the Associates, and Sibley Burnett of General Atomic spoke for the Forum. Copies of the prepared testimony are available directly from the witnesses or can be obtained from the Fusion Power Associates office.

FUSION BUDGETS

Budgets (in millions of dollars) for magnetic and inertial confinement fusion, as submitted with the March 3 testimony of Ed Kintner and Duane Sewell are as follows:

Magnetic

Applied Plasma Physics
 Confinement Systems
 Development and Technology
 Planning and Projects
 Program Direction
 Total Magnetic

FY 1980

FY 1981

\$ 56.2

\$ 72.5

113.8

131.3

58.6

78.8

123.9

117.9

3.13.1

\$355.6

\$403.6

Inertial

Operations
 Equipment
 Construction
 Program Direction
 Total Inertial

158.2

157.5

11.0

9.0

31.5

44.2

1.31.3

\$202.0

\$212.0

BOARD OF DIRECTORS MEETING

The Fusion Power Associates Board of Directors met February 26, 1980, at the San Diego Hilton. Among the actions which the Board took were:

- Admission of three new charter members: Burns and Roe, Inc. (designated representative, Sy Baron); Metals Division of Thermo-Electron Corp. (designated representative, Wesley Schuster), and Westinghouse Fusion Power Systems Department (designated representative, Zalman Shapiro).
- Admission, as an electric utility Affiliate, of the Long Island Lighting Company (designated representative, John Valente).
- Establishment of the new position of Technical Director. Dr. Peter J. Kortman, formerly of the McLean, Va., office of TRW has been appointed to fill this position.
- Authorization to permit individuals to subscribe to the mailings of the Associates.

ADVISORS NAMED

At a previous meeting, on October 14, 1979, in Albuquerque, New Mexico, the Board of Directors decided to seek a set of advisors consisting of managers of major U.S. fusion programs and other distinguished scientists and engineers, "to keep the Board informed on the current status and future prospects for fusion systems". The following persons have agreed to serve as advisors:

- Dr. Lee Berry, magnetic fusion program director at ORNL.
- Dr. Harry Dreicer, magnetic fusion program director at LASL.
- Dr. John Emmett, inertial fusion program director at LLL.
- Dr. T. Kenneth Fowler, magnetic fusion program director at LLL.
- Dr. Melvin Gottlieb, magnetic fusion program director at Princeton.
- Dr. Moshe Lubin, inertial fusion program director at the Univ. of Rochester.
- Dr. Roger Perkins, inertial fusion program director at LASL.
- Dr. Robert Conn, Professor of nuclear engineering at UCLA.
- Dr. Gerald Kulcinski, Professor of nuclear engineering at the Univ. of Wisconsin.

The Board held discussions with advisors Dreicer, Lubin, Perkins and Kulcinski in San Diego, February 26.

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April 1, 1980

APS SETS FUSION TALKS

The American Physical Society annual spring meeting is scheduled for April 28-May 1, 1980, at the Sheraton and Shoreham-Americana Hotels. A special symposium of the Division of Plasma Physics entitled "Advances in Controlled Fusion Research" will take place Thursday morning, May 1 in the Forum Room of the Shoreham-Americana at 9:00 A.M. This session begins with an invited paper by Fusion Power Associates President Steve Dean entitled "The Pace of Fusion Energy Development". This will be followed by invited papers given by Derek Tidman (AYCOR), Peter Politzer (MIT), Harry Dreicer (LASL), C. K. Chu (Columbia U) and Bruno Coppi (MIT). The American Institute of Physics has advised that science reporters have indicated considerable interest in the session. Consequently they have scheduled a news conference on fusion for Wednesday, April 30 at 1:30 P.M. at the Shoreham-Americana Hotel.

ETF Management Changes

DOE magnetic fusion director Ed Kintner has instituted a new management setup for the Engineering Test Facility (ETF) Programs. In a letter dated March 17, Kintner states "I have assigned the full responsibility for the development of ETF and its coordination ... to the Deputy Associate Director (John Clarke). He will be assisted by a DOE ETF Executive Committee..." Members of the Executive Committee are Frank Coffman, Anne Davies, Jim Decker, and Mike Roberts. The Committee has three functions: 1) Policy formulation for the ETF Design Center, 2) Coordination of ETF-related activities across the program, and 3) Preparation of the organizational and institutional framework for an ETF project implementation. Kintner's

letter concludes: "The Deputy Associate Director will assume programmatic direction of the ETF Design Center (at ORNL) and implement all ETF activities through appropriate OFE staff."

TEXAS TO HOST FUSION INSTITUTE

The Department of Energy has announced the selection of the University of Texas to host the newly-conceived "Institute for Fusion Studies". The Institute is to serve as an international center of excellence for fusion studies. It is expected that the Institute will attract many outstanding scientists, from many scientific disciplines, and result in a further increase in creativity and momentum to the fusion program. The Institute has already shown its ability to attract top talent. Marshall N. Rosenbluth a professor at the Institute of Advanced Study at Princeton University has been named Director of the new Institute. Rosenbluth, a member of the National Academy of Sciences, has a long history of outstanding contributions to fusion theory. The Texas proposal was selected by competitive bid from among a group of seven proposals. The University is establishing ten new faculty positions for the Institute and will provide matching funds to the DOE contribution. DOE announced that it expected to provide \$5 million over a 5-year period. The second and third runners-up in the competition were MIT and UCLA, respectively.

MIRROR PROGRAM ENDORSED

The 1980 Mirror Senior Review Panel, described in our January 1 newsletter, has completed its work and issued its report. The Panel commended LLL for "successfully responding to the challenge of finding and developing Q-enhancement ideas which potentially lead to high-Q

reactors" and "for rapidly achieving successful operation of TMX, attaining the expected physics results, and developing the thermal barrier concept." The panel recommended "that the MFTF-B proposal for rescoping MFTF into a thermal barrier tandem mirror facility in an expeditious fashion be approved and that DOE seek the required funding and project authorization." The panel further recommended "a significant strengthening of technological and scientific support efforts to address key mirror program areas, commensurate with the strong technical promise of this program to produce an attractive fusion reactor" and urged that "a significant pre-conceptual design effort on a tandem mirror next step should be initiated as soon as possible."

FPCC ENDORSES MFTF-B AND EBT-P

The magnetic Fusion Power Coordinating Committee noted "that both EBT-P and MFTF-B project proposals have undergone intensive peer reviews and have received strong technical endorsements." The FPCC stated that they considered "the performance goals of these two projects to be impressive" and concluded "that continuation of both these efforts is in the

best interest of the national fusion energy program." They endorsed both projects and recommended "that the required additional funding be sought to keep these projects as near to the proposed optimum funding schedule as possible." The total line item construction costs estimated for these facilities are \$85M for EBT-P and \$111M for MFTF-B, spread over several years.

LBL TESTS TFTR HEATERS

The Lawrence Berkeley Laboratory announced successful testing of the TFTR neutral beam heating source prototype. The test met design specs of 120 keV for one-half second. The tests ensure that the minimum energy breakeven goals of TFTR can be met with the planned four heating units, totalling 20 MW. The LBL development has been going so well that they now plan a three-fold increase in pulse time -- from one-half to one and one-half seconds. This further increases the overall performance capability of TFTR to exceed the original breakeven goal.

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Advisors: Lee Berry, Harry Dreicer, John Emmett, T. K. Fowler, Melvin Gottlieb, Moshe Lubin, Roger Perkins, Robert Conn, Gerald Kulcinski.

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April 14, 1980

Gentlemen:

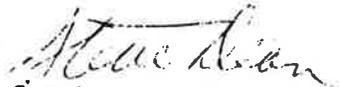
Attached is a copy of a story I prepared on request, which was published in the April 2 issue of "Review of the News," and also a story which appeared in the April 10 Washington Post.

Although our next regular newsletter is not due until May 1, I am writing at this time to make you aware of a number of important items:

- President Carter is expected to send a letter this week to Congressman Mike McCormack in which Carter will express his own strong belief in the technical promise and importance of fusion as a future energy resource. Because of his efforts to balance the budget, Carter will stop short of endorsing McCormack's call for an increased expenditure at this time, instead emphasizing the favored treatment fusion received this year relative to many other programs. The letter is in response to a letter McCormack sent Carter in January urging Carter to establish a national goal of operating a fusion demonstration reactor by the end of the century. Carter's response has taken two months to prepare because of extensive review with OMB, DOE and the Office of Science and Technology Policy. The President's science advisor, Dr. Frank Press, sent Carter a memo recommending that he respond to McCormack by strongly endorsing fusion research and development.
- A three-day seminar entitled "Fusion Energy: Can We Have It? When?" is being held at MIT on Thursday-Saturday, May 8-10. The seminar is designed primarily for business executives. Speakers include Dave Rose, Larry Lidsky, Ron Parker, Norm Rasmussen and Mujid Kazimi of MIT; Gerry Kulcinski of the University of Wisconsin; Noel Amheard of EPRI, and Mike Roberts of DOE. I have accepted an invitation to participate in the seminar and to be involved in a panel discussion on the last day. Persons interested in attending should contact Professor Kuzimi on (617) 253-4206.
- DOE's Fusion Review Committee (Buchsbaum Committee) will hold its fourth and "final" formal meeting April 27-28 in Washington. The subject of this session is expected to be primarily ETF policy and preparation for writing a report during May.
- The American Institute of Physics has scheduled a press conference April 30 at 1:30 P.M. in the Shoreham-Americana Hotel in Washington. The subject of the press conference is my invited paper entitled "The Pace of Fusion Energy Development."
- The Subcommittee on Energy Research and Production of the House Science and Technology Committee has voted to add \$45.5M to the original FY 1981 presidential budget request for magnetic fusion. The breakdown provides \$22M in additional operating funds to the Development and Technology Division

for engineering development in magnets, heaters, components, etc.; \$9M for MFTF-B at Lawrence Livermore Laboratory, \$10.5 for the design of the Engineering Test Facility; \$3M for the Fusion Materials Irradiation Test Facility at Hanford and \$2M for TFTR diagnostic development. There was a \$1M reduction in General Plant Projects. The committee also rejected the recent revised fusion budget of President Carter which called for an \$8M reduction in magnetic fusion and added the \$45.5M to the original Presidential FY 81 request of \$404M. The markup must now be passed by the full House Science and Technology Committee and, before becoming law, must also pass the House Appropriations Committee, the Senate Energy Committee, and the Senate Appropriations Committee.

- The Subcommittee on Energy Research and Production also passed a resolution establishing a civilian component of the inertial fusion program which is primarily authorized by the House Armed Services Committee. The Subcommittee added \$10M to the Presidential request and designated the money for heavy ion fusion. No cutbacks in inertial fusion were proposed in President Carter's recent revised budget.
- I have provided advice and encouragement to Business Publishers, Inc. to establish a regular independent newsletter on fusion. The charter issue has just been issued under the title "Fusion Power Report". Charter subscribers will receive the monthly at a special rate of \$67 per year; regular price is \$97 per year. If you are interested in seeing a copy of the charter issue, contact David Chaffee, editor, at (301) 587-6300 or write to Fusion Power Report, P.O. Box 1067, Silver Spring, MD, 20910.
- A provocative article entitled "The Economics of Fusion Research" by George A. Hazelrigg, Jr., of ECON, Inc. appears in the April issue of Fusion Magazine. The study, funded by DOE, addresses the difficult question of how to apply cost-benefit analysis to long-range programs like fusion. Hazelrigg points out that in applying cost-benefit analysis to a research project such as TFTR, the "value" of the project is the value of the information it produces and not the value of the end product, i.e., electricity. Also this value must be compared to the cost of the project not to the cost of the entire R&D program. The information obtained permits decisions to be made not only on continuing R&D but also on use patterns and pricing strategies for oil. Using a simplified example in which the information from TFTR allows one to decide whether or not to continue the tokamak as a developmental path to fusion and the potential impact of fusion success on the optimum pricing and use pattern for oil consumption, Hazelrigg concludes that the "value" of the TFTR information is \$188 billion dollars.


Stephen O. Dean
President

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Affiliates: Long Island Lighting Company; Pennsylvania Power and Light Company



Top Scientists Urge Development Of **FUSION**

by Stephen O. Dean, Ph.D.

■ **THE DAY** when fusion, the energy process of the Sun and stars, can be used for practical purposes on Earth may come sooner than most people think. A bipartisan group of Congressmen has introduced a bill called "The Fusion Energy Research, Development and Demonstration Act of 1980" (H.R. 6308). Initially co-sponsored by 37 members of the House Science and

Technology Committee, the number of co-sponsors has now risen to over 100. The bill would speed fusion development by 15-20 years over present Department of Energy schedules and would establish a demonstration plant commercially to produce electricity through fusion by the end of the century as a priority national objective.

The congressional initiative reflects

a growing frustration among fusion scientists concerned by the Department of Energy policy that would postpone initiation of the first fusion engineering test reactor until 1984. Various fusion advisory groups have urged an immediate start for such a facility. These include the D.O.E.'s Fusion Power Coordinating Committee and the Fusion Advisory Committee to the House Science and Technology Committee. In response to mounting pressure, the Department of Energy has decided to conduct a new assessment.

Dr. Solomon J. Buchsbaum, a vice president of Bell Laboratories, is chairing this review, which is scheduled for completion in May. Meanwhile, Congressman Mike McCormack (D.-Washington) has been seeking co-sponsorship for H.R. 6308 from the entire membership of the House. On the Senate side, Minority Leader Howard Baker (R.-Tennessee) has expressed strong views in a letter to Energy Secretary Charles Duncan. Senator Baker said: "There is a virtual consensus among experts that we now know enough to program a demonstration fusion power plant by 1995."

The author of this article is president of Fusion Power Associates, an industry-based non-profit organization formed to assist in the development of fusion as an environmentally attractive energy option. He is a former Director of the Magnetic Confinement Systems Division of the U.S. Department of Energy.

An Energy Miracle

Fusion is the process of joining two hydrogen nuclei together to form helium. The development and use of fusion as the world's primary source of large-scale process heat and electricity would lead to the removal of a principal source of world tension: the unequal geographic distribution of primary fuels. The fuel for fusion, you see, is abundantly available from water. One gallon of water contains fusion fuel with an energy content equivalent to 300 gallons of gasoline. In fact, fusion fuel releases a million times more energy than burning a comparable weight of coal or oil and eight times more energy than the nuclear fission of a comparable weight of uranium.

Only very small amounts of fusion fuel are required to make very large amounts of energy. The fusion core of a power plant putting out 1,000 megawatts of electricity would contain only about one pound of heavy hydrogen. The fuel would not be in solid or liquid form but rather in the form of a very dilute low-density gas. The gas (called a "plasma") has a density about 100,000 times less than the density of ordinary air. This plasma has an extremely high temperature, but because the density is so low the heat content of the fusion plasma is not sufficient to melt the container. The temperature required is similar to that of the Sun, somewhat in excess of 50 million degrees.

Although such temperatures seem awesome to the average person, scientists now routinely produce them in

laboratory-sized fusion experiments. In mid-1978, for example, scientists at Princeton University's Plasma Physics Laboratory produced temperatures of 70 million degrees at the densities required for fusion and sustained the fusion reaction for a time only 100-fold short of what is required for a commercial power plant. At the Massachusetts Institute of Technology (M.I.T.), plasmas at 20 million degrees have at even higher densities been sustained for a time which is only 10 times less than required. Further major advances, perhaps the entire 10-fold improvement required, are expected at M.I.T. this year.

The experiments at M.I.T. and Princeton were performed in a "magnetic bottle" called a "tokamak" which keeps the plasma away from the solid walls of the chamber. Although contact with the chamber walls does not melt them, it does cool the plasma and reduce the temperatures to values too low to sustain fusion. Experiments now under way involve using magnetic forces in sophisticated ways to keep the plasma from touching the chamber walls.

There are many different types of "magnetic bottles," but the tokamak has so far been the most effective. Recently another type of bottle called the "magnetic mirror" has been showing promise. This concept, pioneered by the University of California's Lawrence Livermore Laboratory, produces routinely even higher temperatures than tokamaks. Mirror machines have reached up to 230 million degrees.

Scientists believe that sufficient knowledge has been gained to begin designing fusion reactors with the necessary plasma insulation or confinement to keep the plasma from cooling by touching the walls. New experiments are under construction both at Princeton and Livermore which would by the mid-1980s demonstrate all the necessary plasma conditions for start-up on a commercial fusion reactor. The confidence of the scientists that these experiments will be successful is very high. It is this high confidence that is behind the call in Congress to accelerate engineering development for the power plants themselves.

Time To Move Ahead

Fusion systems involve high technology requiring sophisticated and reliable components. But to a considerable extent the early test versions of much of this equipment have already been invented. For power plants, however, larger components must be built and tested. These components will require a higher degree of reliability and less maintenance than is necessary for experimentation.

Until high reliability, low cost, equipment is developed for fusion systems, fusion will not be able to compete effectively with existing fossil-fuel plants. The cost of fuel is only one element in the economics of power plants. The cost of power handling equipment for a 1,000 megawatt electrical generating plant is still more important. Thus, even though fusion fuel is less expensive than fossil or

nuclear fission fuels, it is essential that the power-plant materials, construction, and maintenance costs be competitive also.

Fusion development has until now been almost entirely the purview of research scientists. Engineering talent must be brought to bear in fusion if commercial applications are to result. It is differences of opinion about when and how to begin the transition in emphasis from scientific research to engineering development that are at the heart of the current debate.

Congressman McCormack and many others want to begin engineering development now, but Department of Energy policy postpones this transition until the mid-1980s. McCormack offers the prospect of a commercial demonstration in the 1995-2000 time-frame, whereas the Department of Energy projects its demonstration in the 2010-2015 period. The range of dates results from different assumptions about budget levels. McCormack's 1995 date requires budget levels of about one billion dollars a year, whereas the Department of Energy assumes budgets about half that amount — approximately the same rate of expenditures as at present.

Bear in mind that the industrial skills required for fusion engineering development exist today in the nuclear industry, the aerospace industry, the heavy electrical equipment industry, and the computer industry. These groups are poised, interested, and ready to enter into fusion development. They are not sure, however,

whether the government intends to enlist their help, or whether it means to continue its present practice of carrying out the work almost entirely in universities and national laboratories. One of the purposes of the Fusion Energy Research Development and Demonstration Act of 1980 is to make a clear commitment to involve industry in the development of a commercial fusion reactor.

At the same time a broad base of scientific research must be maintained, even while engineering development in industry is beginning, so that fusion concepts may continue to evolve from improved scientific understanding. What we want, after all, is an energy source which not only has cheap inexhaustible fuel, but also one with sound economic, environmental, and social characteristics.

It is likely that there are a variety of paths, other than the tokamak and magnetic mirror, to a successful commercial fusion system. Even at this early stage of development, several possibilities are emerging. One is to set off "micro-explosions" by irradiating tiny solid hydrogen fuel pellets with lasers or beams of particles from accelerators. This approach is called "inertial confinement" because the fusion conditions are maintained only during the time before the pellet blows apart. This time is set by the inertia of the pellet. Experiments in this area are encouraging, but still about 10,000 times short of achieving "breakeven" conditions — the condition where as much fusion energy is released as is required to initiate the reaction. There are also several different fusion reactions (i.e., different fuel cycles), some of which result in significant reductions in radioactive materials to be handled and increases in power-plant efficiency.

The Safety Factor

The fission reactor accident at Three Mile Island has caused an increased public awareness of hazards of radioactivity. Although a majority of the scientific and technical community is of the opinion that fission products and fuels can be safely handled, segments of the public remain skeptical. Government policy uncertainties on questions like licensing procedures and radioactive waste storage have contributed to the confusion. It is legitimate and important then to ask the question: How does fusion differ from fission with respect to reactor safety and radioactivity?

Many people ask if an accident similar to Three Mile Island could occur in a fusion reactor. The answer is no. In the core of a nuclear fission reactor, heat from fission reactions is generated in solid fuel rods. A continual flow of coolant must pass over these rods to remove the heat; otherwise, the temperature of the rods will continue to rise, melting will occur, and radioactivity might escape into the control system. Such a circumstance could not occur in a fusion reactor since the core is a gas and thus not susceptible to melting. The energy generated by fusion reactions is trans-

ported freely out of the core by fast-moving neutrons and converted to heat in an outer region (called a "blanket") which surrounds the core. Since no fusion reactions are occurring in the "blanket" (the heat is deposited by the slowing down of neutrons emitted from the core), cooling of this outer region is an inherently less critical and difficult task than cooling the core of a fission reactor.

There are two kinds of radioactive materials in a fusion reactor. The first is tritium, which is one of the fuels used in combination with non-radioactive deuterium to generate fusion energy. The second appears in some of the reactor structural materials, which become radioactive when they absorb neutrons created by the fusion process.

Tritium is one of the least hazardous of radioactive materials. It is commonly used as a light source in digital watches. In its radioactive decay, a tritium nucleus emits a beta particle (i.e., an electron) which has so little energy that it cannot even penetrate the outer layer of the skin. Tritium is hazardous if it enters the body, but the residency time of tritium in the body is only about 10 days. Tritium mixes easily and quickly with air or water. Consequently, enormous dilutions are quickly and easily accomplished. Thus, even massive tritium releases from a reactor accident would result in extremely small doses of radiation to the public.

The parallel hazard from a nuclear fission reactor accident is the possible release of radioactive fission products such as cesium and iodine. With these elements dilution is difficult. Furthermore, there is a strong tendency for cesium and iodine to become bound in soil, to be taken up in plants, to enter the food chain, and to be concentrated in the body. This is not the case with tritium. Although there will be substantial amounts of tritium at the reactor site, only a fraction of it (about one pound) will be in active use at any one time.

In both fusion and fission reactors, engineering design makes it unlikely that large amounts of radioactive materials will be released. The Three Mile Island accident demonstrates that only minute quantities of radioactivity will escape even in a major accident. Even so, fusion would be safer.

The second kind of radioactivity present in fusion reactors is that induced in the structural materials of the reactor when neutrons from the fusion reaction are absorbed. This form of radioactivity occurs in metallic components. Since metals are not generally volatile, they are relatively easy to keep out of the environment in the case of accident. Furthermore, the total amount of such radioactivity can be greatly reduced by proper selection of construction materials.

The practical measure of dangers of radioactivity in both fission and fusion reactors is called the Biological Hazard Potential (B.H.P.). This is the volume of air or water which would be required to dilute the radioactivity in question down to the Maximum Per-

missible Concentration (M.P.C.) permitted by government regulations. Calculations of the B.H.P. show that the most difficult and hazardous materials in a fission reactor are radioactive iodine and plutonium. The tritium in a fusion reactor has a biological hazard potential which is *one million times* less than iodine in a fission reactor and 100,000 times less than that of plutonium. There are a large number of candidates such as vanadium and stainless steel which could be used as structural materials of a fusion reactor. Their biological hazard potentials are hundreds to hundreds of thousands of times less than radioactive iodine and plutonium.

So Let's Get Moving

Little wonder that there is growing support from both the scientific community and the Congress for setting a nearer goal for achieving practical benefits from fusion. Senator Baker has said: "As the study prepared by D.O.E. Under Secretary Deutch shows, an accelerated plan will actually be less expensive than the current D.O.E. base plan to achieve a demonstration plant by the year 2010." Baker added, "The country can no longer afford to be timid and cautious in our quest for new energy sources. In a time when we are spending \$70 billion per year for foreign oil, finely tuned academic collating of information is not adequate in the face of the deepening crises of energy supply that threatens to engulf our society and the world in chaos." ■ ■

Scientists on Path to Major Energy Breakthrough—Fusion

By Thomas O'Toole

Washington Post Staff Writer

PRINCETON, N.J.—Under a bright red tent behind concrete walls four stories high stands the start of the industrialized world's hopes for a future of limitless energy.

Inside the tent, concrete is being poured, floors laid and cables installed to carry power to what is called the Tokomak Fusion Test Reactor. This is the machine that is expected to demonstrate that the fury of the hydrogen bomb can be tamed and tapped for its energy. It is halfway to completion.

Fusion involves the joining of light elements under such terrific force that they release massive amounts of heat. The main fuels for fusion are deuterium and tritium, heavy isotopes of hydrogen, which can be extracted in abundance from seawater.

Nuclear power plants now operate on the principle of fission, or splitting apart of atoms.

"We are on a schedule that will allow us to demonstrate the scientific feasibility of fusion in 1983," Dr. Melvin B. Gottlieb, director of Princeton University's Plasma Physics Laboratory, said in an interview, "We know it's going to work. We have every confidence that we will do it."

Demonstrating the feasibility of fusion means matching the temperature of the sun inside a machine. That temperature—100 million degrees—must be sustained for at least one second, magic numbers scientists have talked about reaching for 30 years.

It also means a fusion reaction rate that pumps more energy out of the fusion machine than is being pumped in that loses less heat through the walls of the machine than is being trapped inside.

"What we're striving for is an energy breakeven point," Gottlieb said. "That's where we'll be able to say we've done it, we've achieved fusion."

By the time the Princeton machine is ready to operate in 1981, the Department of Energy will have spent \$284 million to build it. That will be on top of more than \$2 billion spent on fusion research since 1951. Reflecting growing confidence in the program, DOE is asking for \$403.6 million for fusion research in fiscal 1981, \$30 mil-

lion of it for the Princeton Tokomak Fusion Test Reactor.

"The rapid technical developments in fusion research in the last two years suggest a new evaluation of the program is now appropriate," Dr. Nelson D. Pewitt, deputy director of the Office of Energy Research, told a Senate subcommittee recently. "That such a review is appropriate is testimony to the progress made in the fusion program."

If fusion is demonstrated in 1983, as Gottlieb is convinced it will, some scientists think that commercial electricity can be produced from fusion before the end of the century. An accelerated program to do so would cost at least \$20 billion.

The way the fusion program is conceived now, the Department of Energy does not expect to operate the first commercial fusion reactor until 2005, and the second one 10 years after that. Sticking to this timetable would cost an estimated \$14 billion.

Under this schedule, a network of fusion electric plants would be in place in the United States in 2025. If the United States decides to speed up fusion development and spend the

extra dollars, fusion electricity might be commercial 10 to 15 years sooner.

The commercial development of fusion would bring a swift halt to at least that part of the energy crisis that involves burning oil, coal or uranium to generate electricity.

The breakthrough that inspired such confidence came on July 4, 1978, when a machine called the Princeton Large Torus, half the size of the Tokomak test reactor, reached a temperature of 60 million degrees and held it for one-twentieth of a second.

Since then, scientists at Princeton and at Tennessee's Oak Ridge National Laboratory, Massachusetts Institute of Technology and General Atomic Research have made steady progress in fusion research.

Oak Ridge scientists have demonstrated they can ignite more deuterium gas in a confined space than was theoretically thought possible. While this may seem like a small step, a doubling of the density of the gas means a quadrupling of the power output. Any time that is done, scientists move closer to what Gottlieb calls "energy break-even."

Oak Ridge scientists also have created larger and more powerful devices

called neutral beam machines, which are the heaters that raise the temperature of the deuterium fuel to more than 50 million degrees. At that temperature, the gas becomes a plasma whose electrons have been stripped away.

Supplementing the more potent neutral beam machines will be radio frequency heaters, which are being tested at the Princeton Large Torus. One advantage of radio frequency heating is its lower cost. Another advantage is that it heats the gas to a plasma in a way that results in less heat loss. Together with bigger neutral beam devices, the radio frequency heaters promise to raise the temperatures of the gas in the Tokomak reactor to the hoped-for 100 million degrees.

Nothing will produce higher fusion temperatures better than the Tokomak itself.

"To get to higher temperatures and longer confinement times, what you have to do is build a bigger device," Gottlieb said. "It's a fact of nature."

Gottlieb said the Princeton Tokomak (Russian for doughnut-shaped machine) will start up in late 1981, reaching full power sometime in

1983. He said he sees no technical obstacle anywhere ahead that will stop the machine from extracting 100 million-degree temperatures from a fusion reaction for pulses of one second or longer.

"It's gone so well that everybody's telling us we built a machine that's too conservative," Gottlieb said. "Now they're all saying we should have taken a bigger risk and built a bigger machine."

Fusion wasn't always so promising. When Dr. John M. Deutch left MIT three years ago to become undersecretary of energy, his first assignment from then-Energy Secretary James R. Schlesinger was to cut \$200 million from the fusion budget that year.

"We looked into it very carefully and I remember briefing Jim [Schlesinger] and saying, 'You can't do it,'" Deutch recalled in an interview. "I said, 'There is a real possibility that will become a serious candidate for electric power generation in the next century.'"

"I'm convinced that feasibility will be proven," said Deutch, who has resigned to return to teaching chemistry at MIT. "I'm confident it will happen at Princeton in the next three years."



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PRESIDENT CARTER ENDORSES FUSION POWER

In a letter dated April 22, 1980, to Representative Mike McCormack, President Carter states "The Administration is committed to the fusion option." Carter said, "I am aware of the promise that fusion energy holds for long range, relatively clean, and inexhaustible energy. I strongly support the development of a technology that offers such hope for meeting future energy needs."

THE WHITE HOUSE

WASHINGTON

April 22, 1980

Dear Mr. Chairman:

Thank you for your interesting and provocative letter urging the acceleration of magnetic fusion energy development.

I am aware of the promise that fusion energy holds for long range, relatively clean, and inexhaustible energy. I strongly support the development of a technology that offers such hope for meeting future energy needs.

The Department of Energy, the Office of Management and Budget, and the Office of Science and Technology Policy are assessing the recent scientific advances in the program to determine the best course for the future. Their effort should be completed by June of 1980. It will enable us to design an orderly and aggressive approach to the challenge.

I applaud your foresight and bipartisan leadership on this issue and welcome this opportunity for us to work together. The Administration is committed to the fusion option. I would urge that, upon completion of our examination, we strive jointly to make this option a reality.

Sincerely,

The Honorable Mike McCormack
Chairman
Subcommittee on Energy Research
and Production
Committee on Science and Technology
U.S. House of Representatives
Washington, D.C. 20515

DOE FUSION REVIEW UPDATE

The DOE Fusion Review Committee (Buchsbaum Committee) met on April 27-28 in Washington. On April 27 they discussed the issues associated with starting a fusion engineering test facility (ETF) with DOE fusion head, Ed Kintner. On April 28 they met with Fusion Power Associates President Steve Dean. Kintner emphasized his belief that the timing was right to commit to this facility now. In addition to being technically ready to proceed, Kintner noted the consensus of the U.S. and world fusion communities, Congressman McCormack's activities, our national energy crisis and the potential impact of the review committee on DOE planning. Kintner proposed the establishment of an ETF Project Office in DOE, and the issuance of "requests for proposals" for conceptual design in October 1980, for selection of a management organization in April 1981, followed by the selection of a managing organization in April 1982 and the initiation of Title I engineering in October 1982.

In his presentation Steve Dean described the nature and purposes of the Fusion Power Associates and the policy recommendations recently adopted by the Board of Directors. Specifically the Board had recommended that the following policies be adopted:

- Establish as a national goal the operation of a fusion energy demonstration plant by the year 2000.
- Accelerate the present national effort over the next few years and maintain that effort at the level required to meet the national goal.
- Encourage and promote the full participation of industry in the planning, research and development as well as engineering and operating phases of the national fusion program.
- Commit immediately to a program leading to construction and operation of a fusion engineering test facility based upon the tokamak concept.
- Continue to support concepts which show promise for practical commercial fusion systems and rapidly develop the most promising.
- Strengthen those aspects of inertial confinement fusion dealing with civilian applications.
- Commit to the engineering development of the technology required to meet facility operation schedules.
- Strengthen and encourage fusion-related programs in universities to ensure an adequate supply of engineers and physicists with knowledge in this field.
- Continue international cooperation on fusion research for the ultimate benefit of mankind.

Dean also expressed his "personal opinions on ETF." He told the Committee he believed:

- An ETF should be initiated now by,
 - expanding the conceptual design effort,
 - establishing management procedures for evolving design goals, bringing the project to completion, site selection and contractor selection,
 - requesting "Title I" funding for detailed engineering design, preparation of cost estimates and initiation of design-independent facilities.
- ETF should be a tokamak whose primary purpose is to extend the level of accomplishment in fusion beyond the performance expected from TFTR, as measured by Q , $n\tau$, pulse duration, beta, duty cycle, total fusion energy released.
- ETF, in addition to its detailed engineering and physics goals, should have one or more goals which can be clearly perceived by the public as a step toward practical fusion power.

On May 2, Buchsbaum made a progress report to the DOE Energy Research Advisory Board (ERAB). He noted that his committee did not yet have a draft report and had decided to schedule an additional meeting May 23 to receive public comment. He promised ERAB that his report would not be finalized until after ERAB had reviewed the final draft at its next meeting in August. Buchsbaum gave a tutorial briefing on fusion to the ERAB, stated that great scientific progress had occurred on a broad scientific front in the past two years and commended the fusion program management. He said that he found widespread support for an ETF in the fusion community as a whole and not just among the tokamak community. He said, however, that neither the exact statement of purpose and goals of ETF nor its design parameters had yet been finalized.

LASL DIRECTOR ENDORSES FUSION BILL

Senator Pete Domenici (D-NM) has released a letter he received from Los Alamos Scientific Laboratory Director Don Kerr. Commenting on H.R. 6308, the National Fusion Energy Research, Development and Demonstration Act of 1980 sponsored by 156 representatives, Kerr states, "My colleagues and I at the Los Alamos Scientific Laboratory believe the

proposed step is a wise one, justified by impressive technical achievements during the past several years, and urgently required by the political, economic, and social problems with which the energy crisis threatens the United States."

The complete text of Kerr's letter to Senator Domenici follows.

"Dear Pete:

"Congressman McCormack has introduced a bill in the House which would significantly increase funding for the development of magnetic fusion into a commercially attractive source of energy. This bill would enable the country to pursue this development on a high priority basis and establish as a national goal the construction and successful operation of a magnetic fusion electric generation demonstration plant before the end of this century. In the estimation of experts from the national laboratories, industry, government and the universities this goal could be achieved on this time scale, and this would provide the country with the basis for commercializing this energy source. The country could then look back at this historic legislation and recognize it as an act of political vision on the part of Congress.

"My colleagues and I at the Los Alamos Scientific Laboratory believe the proposed step is a wise one, justified by impressive technical achievements during the past several years, and urgently required by the political, economic, and social problems with which the energy crisis threatens the United States. Our belief is based on the long term Los Alamos involvement with the nuclear fusion process, which includes the first achievement of fusion energy release in thermonuclear weapons and the first observation of controlled thermonuclear reactions in hot laboratory gases. During the past 30 years LASL participated with the other national laboratories in the development of that branch of science, plasma physics, which deals with the production, heating and stable confinement of very hot gases. This work contributed in an important way to the recent successes in the magnetic fusion program that will allow the United States to demonstrate the scientific feasibility of magnetic fusion with the Tokamak confinement approach in a device (TFTR) now under construction. Our long-term involvement also contributed to the development of several other important confinement concepts. These, known as advanced fusion concepts, are now in the research stage, and are being studied so that ultimately it will be possible to demonstrate the most practical fusion reactor.

"The magnetic fusion program is presently pursuing a broad scientific program, and is also developing some of the technologies it requires. What is lacking is the essential engineering phase that will integrate and test the science and technology from a practical standpoint, especially in the areas of environmental safety, maintenance, and everyday operating experience. The possibility of accumulating such experience and demonstrating a practical fusion reactor by the end of this century is primarily precluded by the present funding level rather than by the technological and scientific obstacles that remain. The necessary test facilities ordinarily involve years between inception and operation, and if utilized in a purely sequential fashion would delay the ultimate achievement of magnetic fusion quite far into the 21st century. To reduce this period we need to embark upon the various required research and development projects in a series-parallel approach that utilizes technical information and the resources in government and industry in the most effective way. For example, the next major developmental step in the program, a Fusion Engineering Test Facility (ETF), should be authorized for construction now so that the program's present momentum can be maintained and possibly increased without incurring costly delays. This facility would primarily utilize the Tokamak confinement approach to test integrated technologies and gain operating experience, but it will also provide some experience that is applicable to the advanced fusion concepts when these have matured scientifically to the point where they can be tested in their ETF. To be sure, this aggressive approach involves risks, but these risks are justified by the challenge which faces our country.

"The Los Alamos Scientific Laboratory currently has an important role in the national magnetic fusion energy program. Work is already under way in our laboratory on several engineering support projects that will provide the proposed ETF with some of the key technology it requires. Among these are the Tritium System Test Assembly and the Superconducting Magnetic Energy Storage and Transfer programs. LASL's unique expertise in many technology areas could be utilized to enhance our involvement with the ETF. Moreover, LASL has the important assignment of developing and testing several advanced fusion concepts that could make major improvements in the commercial reactor systems ultimately placed into operation. We believe that a significant increase in funding for the magnetic fusion program can and must go hand-in-hand with enhanced support for advanced fusion concept research and development. LASL could increase its overall contribution to the magnetic fusion energy program if the Congress and the Executive Branch assigns national priority to it.

"The Lab and I stand ready to provide you and your staff with additional information about the status of the national fusion program and our own contribution to it.

Sincerely yours,

(signed)

Donald M. Kerr
Director"

MEETINGS

The biannual IAEA Conference on Plasma Physics and Controlled Fusion Research will be held in Brussels July 1-10. This is the major international conference on fusion. Papers have been selected competitively by an international committee. Attendance is limited. Those desiring to attend should contact Jack Kane at DOE (301) 353-3378.

There will be a Workshop on Plasma Confinement on Open Magnetic Field Lines at the International Centre for Theoretical Physics in Trieste, Italy from July 14-18. Persons wishing to present papers or attend should contact Brendan McNamara at LLL (415) 422-9821.

The Annual Meeting of the APS Division of Plasma Physics will be held November 10-14 in San Diego. An important part of this meeting is the selection of invited papers. In the past very few unsolicited suggestions have been received for invited papers although many complaints on the selection are usually received afterwards. If you have suggestions for topics and speakers please contact Nick Krall, Vice-Chairman, Division of Plasma Physics or a member of the Program Committee. Nick's number is (714) 453-6580.

Fusion Power Associates is a non-profit organization recently formed to assist in the development of fusion as an environmentally attractive energy option. Membership is open to all public and private organizations which share the Associates' goals and are admitted to membership by the Board of Directors. For further information, contact Dr. Stephen O. Dean, (301) 258-0545.

Members of the Fusion Power Associates: Aydin Energy Division; BDM Corporation; Burns and Roe, Inc.; Ebasco Services; General Atomic Company; Gilbert/Commonwealth; ILC Technology, Inc.; JAYCOR; RMS Fusion, Inc.; Mathematical Sciences Northwest, Inc.; McDonnell-Douglas Astronautics Company; Quadrex Corporation; Science Applications, Inc.; Metals Division, Thermo-Electron Corp.; Universal Voltronics Corp.; and Westinghouse Fusion Power Systems Dept. Affiliates: the Long Island Lighting Company, and Pennsylvania Power and Light Company.

Board of Directors: Stephen O. Dean, Chairman; Henry J. Comberg, Vice Chairman; Donald L. Kummer, Secretary; Bernard J. Eastlund, Treasurer; Ronald C. Davidson, Nicholas A. Krall, Sherman Naymark, Tihiro Ohkawa, Paul Reardon, Leonard F. P. Reichle, Peter B. Rose, Glen Sorenson, Alvin W. Trivelpiece, James M. Williams, Gerold Yonas, Donald P. Zeifang. Ruth A. Watkins is Assistant Secretary-Treasurer. Peter Kortman is Technical Director.



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NEW MEMBER AND AFFILIATE

Stone and Webster Engineering Corporation (Boston, Massachusetts) has become the seventeenth member of Fusion Power Associates. John W. Landis, Senior Vice President, is the designated representative.

Dow Chemical Company (Midland, Michigan) has become our third affiliate. William J. Sauber, Project Manager, Corporate Staff, is their designated representative.

We welcome their participation.

NUCLEAR ENERGY SYMPOSIUM, JULY 22

The National Energy Resources Organization (NERO) is sponsoring a Nuclear Energy Symposium, July 22, in Room 2167 of the Rayburn House Office Building in Washington from 9 A.M. 'til 5 P.M. FPA President Steve Dean will speak on "Prospects for Nuclear Fusion" at 10:30 A.M. Other speakers include DOE's George Cunningham at 9:15. Cunningham will speak on "Prospects for Nuclear Energy over the Next Twenty Years". Representative Mike McCormack will speak at 9:45 A.M. on "Congressional Views in Support of Nuclear Energy", and Wallace Behnke, Executive Vice President, Commonwealth Edison, will speak at 11:00 A.M. on "The Need of Electric Utilities for the Nuclear Option". For further information, contact Sheryl P. Rutledge at (202) 624-6783.

FUSION BUDGET

The House of Representatives overruled its Appropriations Committee by approving \$394.1M for magnetic fusion in FY 1981. This was \$20.8M higher than the \$373.3M mark recommended by Appropriations. The Appropriations mark for inertial fusion of \$209.65M was accepted by the House. This was above the \$192.2M submitted by the President but below the \$213.65M authorized by the House Armed Services Committee. Senate action is not expected until some time in late July or August.

FUSION BILL GAINS SPONSORS

Senator Paul Tsongas (D-MA), a member of the Senate Energy Committee, has requested that a bill similar to H.R. 6308 be prepared for submission in the Senate. H.R. 6308, the "National Fusion Energy Research, Development, and Demonstration Act of 1980," has gained three new co-sponsors in the House, bringing the total number of co-sponsors to 156. The new sponsors are Marc Marks (R-PA), Dan Marriott (R-UT) and Edward Stack (D-FL).

NEW UNIVERSITY FUSION ASSOCIATION FORMED

Scientists from universities throughout the country have banded together to form a "University Fusion Association". The purpose of the organization is "to promote the continued participation of university research groups in the fusion program; to enhance the broad-based support for fusion, both in plasma physics and engineering, through contacts with various segments of our society; to improve communications between university personnel and other parts of the fusion community; to provide information on fusion policy to its general membership, and to promote the involvement of the academic community in policy decisions made in the fusion program".

The Association has over 100 individual members at this time. An executive committee has been elected consisting of the following members: F. F. Chen (UCLA); H. R. Griem (U. MD); R. N. Sudan (Cornell); J. L. Shohet (U. WI); H. Grad (NYU); R. A. Gross (Columbia U.); G. H. Miley (U. IL); F. L. Ribe (U. WA); B. Coppi (MIT); K. W. Gentle (U. TX); N. Hershkowitz (U. IA); A. Simon (U. Rochester).

Interested university fusion personnel should contact a member of the executive committee or Ms. Joyce Oliver, 308 Upson Hall, Cornell University, Ithaca, NY, 14853.

The Fusion Advisory Panel to the House Science and Technology Committee met in Washington May 19-20 and received testimony from several organizations, including DOE, ORNL, AIF and Fusion Power Associates. In a report transmitted to Mike McCormack on June 17, the Panel reaffirmed its previous endorsements of the readiness of the program for engineering development. In addition, the panel recommended that McCormack make the following two formal requests to the Department of Energy.

- "That DOE provide a clear, concise, and brief statement of the purposes of the engineering test facility;
- "That DOE immediately perform an in-depth study of organizational options for managing the ETF project and that that study include major inputs from the existing fusion community and, very importantly, from qualified industrial organizations."

The Panel stated that "It is the Panel's view that the primary problems facing expeditious development of fusion power are not at present technological; they are institutional" and further commented that "that means that the rate of development of fusion power is now primarily in the hands of the Congress and the President, not in the hands of the technologists."

BUCHSBAUM COMMITTEE EXCERPTS

The Fusion Review Committee of the DOE Energy Research Advisory Board (ERAB) issued its anxiously-awaited report on June 23, with the cautionary note that it should be considered as a "draft ERAB report" until reviewed by ERAB at its next meeting in August. Here are some excerpts from the report:

- "The magnetic fusion program can, and should, embark on the next logical phase towards its goal of achieving economic feasibility of magnetic fusion. To this end a broad program of engineering experimentation and analysis should be undertaken under the aegis of a Center for Fusion Engineering (CFE)."
- "The Panel ... has misgivings about the ETF as it was presented to us. We find it too ambitious." "Rather, the program we advocate should center around a more modest Tokamak-based Fusion Engineering Device (FED)."

- "The U.S. mirror program should proceed with the ... tandem mirror facility (M^B) as a proof-of-principle experiment for open confinement systems.

- "... in addition to the large engineering device discussed earlier, the DOE should plan and implement a coherent, comprehensive advanced Tokamak program."

- "Work on the Elmo Bumpy Torus (EBT) ... should be strengthened, with effort aimed at clarifying some near-term key physics questions. The EBT-P construction should wait for additional confirming results of work in progress and proposed herein, especially an exploration of the possibilities of more modest experiments."

- "Work on alternate concepts ... should continue commensurate with new discoveries in physics." "The DOE should be highly discriminating in advancing existing alternate concepts much beyond their present scopes."

- "The DOE should support a strong research program on fuel cycles (and their required containment systems) other than deuterium, tritium, since reactors based on such cycles would have major advantages in the long run."

- "Although the Panel did not examine magnetic fusion in the context of the overall balance of DOE programs, we believe that this large increase is justified. This next step in the fusion program is both sound and timely. The U.S. should determine as soon as is programmatically feasible whether or not fusion is a viable option, that is, whether or not fusion reactors can compete favorably with alternate energy sources from economic, environmental, safety standpoints. Such knowledge would have a profound influence on U.S. energy policy."

The Review was established in February 1980 at the request of Dr. Edward A. Frieman, DOE Director of Energy Research. In his charge to ERAB, Frieman stated that "the terms of reference" for the study should be to: "Review and evaluate the progress, status, plans and prospects for magnetic fusion, with the "dominant concern" to be the "judicious choice of the next major step to be taken in proceeding from the current generation of experimental devices toward demonstration of economic fusion power."



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HOUSE PASSES FUSION BILL

By a vote of 365-7, the House of Representatives has passed H.R. 6308, the "Fusion Energy Research, Development and Demonstration Act of 1980." The bill, cosponsored by 160 members led by Rep. Mike McCormack, declares it "to be the policy of the United States" to operate a fusion demonstration plant "before the end of the twentieth century."

SENATE FUSION BILL GAINS SPONSORS

A bill similar to H.R. 6308 was introduced into the Senate by Sen. Paul Tsongas as S. 2926. That bill now has 16 cosponsors: Tsongas (D-MA), Howard Baker (R-TN), Bradley (D-NJ), Dale Bumpers (D-AR), Frank Church (D-ID), Robert Dole (R-KS), Pete Domenici (R-NM), Barry Goldwater (R-AZ), Sam Hayakawa (R-CA), Walter Huddleston (D-KY), Paul Laxalt (R-NV), Spark Matsunaga (D-HI), Daniel Moynihan (D-NY), Jim Sasser (D-TN), Adlai Stevenson (D-IL), Harrison Williams (D-NJ). Fusion Power Associates was one of several groups invited to testify at public hearings on July 28 and August 5. Subcommittee action on the bill is expected on September 10.

ERAB ACCEPTS BUCHSBAUM REPORT

On August 19, the DOE Energy Research Advisory Board (ERAB) unanimously endorsed the report of its Fusion Review Committee (Buchsbaum Committee). The Board authorized transmittal of the report to DOE Secretary Charles Duncan. The report urges DOE to institute "a broad program of engineering experimentation and analysis ... under the aegis of a Center for Fusion Engineering." The engineering program would center around the construction of a Fusion Engineering Device and would, in ERAB's view, require a doubling of the fusion program in 5-7 years.

MAJOR PARTIES ENDORSE FUSION

Both Democratic and Republican Party Platforms contain planks indicating their continued support for research on fusion. The Democratic plank reads: "A greater share of federal funds should be committed to basic research and must be devoted to the development of renewable energy resources and fusion research and development. The Democratic Party vigorously supports substantial funding for the construction of an engineering test facility for fusion technology. Fusion energy is a safe, clean alternative source of energy which can be used to generate electricity efficiently." The Republican plank reads: "We also believe the government must continue supporting productive research to speed the development of renewable energy technology, including solar energy, geothermal, wind, nuclear fusion, alcohol synthesis and biomass to provide the next generation of energy sources."

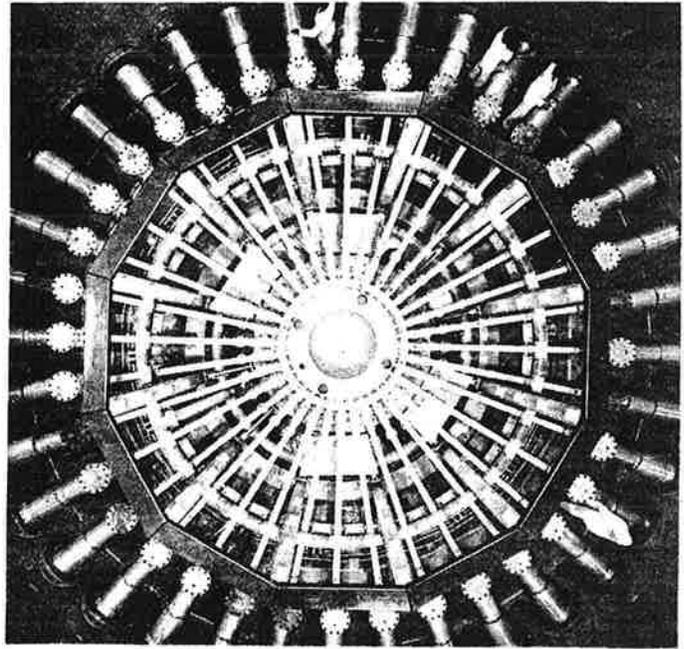
NEW AFFILIATE JOINS

Northern States Power Company of Minneapolis, Minnesota, has become the third electric utility to affiliate with Fusion Power Associates. Leslie C. Weber is their designated representative. We welcome their participation.

SANDIA PARTICLE BEAM FACILITY STARTUP

Dr. Gerold Yonas, Director of Pulsed Energy Programs at Sandia Laboratories and a member of the FPA Board of Directors, has announced the completion and initial startup of the 36-module Particle Beam Fusion Accelerator (PBFA-I). Designed for nominal operations at 1000 kilojoules and 30 trillion watts, the device has already operated at 840 kilojoules and 20 trillion watts in a 40 nanosecond pulse. "We expect no major problems in bringing the machine up to its nominal operating level,"

Yonas said. PBFA-I is the first machine designed to test the principles of the new fusion concept called "ion beam fusion" in which a beam of light ions is used to implode a small pellet containing fusion fuel. Compared to the more common inertial confinement fusion approach which uses high energy lasers, ion beam fusion has the advantage that the required megajoule levels of energy are achievable more cheaply and with higher efficiency and less technical complexity. Focussing of the ions onto the pellet is more difficult, however, and it is in this area that the primary research effort will be dedicated at Sandia over the next few years. If tests on targets are successful, Yonas plans to upgrade the facility to 72-modules in 1984.



PBFA-I

UNIVERSITY FUSION ASSOCIATION ELECTS OFFICERS

The newly-formed University Fusion Association has elected Ravi Sudan of Cornell University to be its first chairman. Fred Ribe of the University of Washington was elected Vice-Chairman and George Miley of the University of Illinois was elected Secretary-Treasurer. The group has nominated Bob Gross of Columbia University to represent them on the DOE Fusion Power Coordinating Committee. The group has also formed an Executive Committee with terms as follows: 3 Years: F. F. Chen (UCLA), H. R. Griem (U. MD), J. L. Shohet (U. Wisc.), R. N. Sudan (Cornell); 2 Years: H. Grad (NYU), R. A. Gross (Columbia), G. H. Miley (Ill), F. L. Ribe (U. WA); 1 Year: B. Coppi (MIT), K. W. Gentle, (U. TX), N. Hershkowitz (U. IA), A. Simon (U. Rochester).

the June, July, and August 1980 issues. The September issue will look at fusion policy and planning.

APS PROTESTS GOVERNMENT INTERFERENCE

Herman Feshbach, President of the American Physical Society, has written letters to the Secretaries of State and Commerce protesting recent government actions to restrict the exchange of scientific information with foreign scientists. Three specific cases cited were the Commerce Department's requirement that foreign scientists attending an international conference sponsored in the U.S. by the American Vacuum Society sign a secrecy pledge; a directive by DOE imposing "total surveillance" on communications between U.S. scientists working on DOE contracts and their Soviet counterparts; and State Department denial of visas to Soviet Bloc scientists invited to attend international conferences in the U.S. (Several invited Soviet scientists were denied visas to attend the Inertial Confinement Topical Conference in San Diego in February.)

NUCLEAR NEWS FUSION SERIES

Nuclear News, the monthly of the American Nuclear Society, is featuring a four-part series on "Fusion in the United States". Written by Associate Editor E. Michael Blake, the first three articles appeared in

Members of Fusion Power Associates: Aydin Energy Division; BDM Corporation; Burns and Roe, Inc.; Ebasco Services; General Atomic Company; Gilbert/Commonwealth; ILC Technology, Inc.; JAYCOR; RMS Fusion, Inc.; Mathematical Sciences Northwest, Inc.; McDonnell-Douglas Astronautics Company; Quadrex Corporation; Science Applications, Inc.; Stone and Webster Engineering Corp.; Metals Division, Thermo-Electron Corp.; Universal-Voltronics Corp.; and Westinghouse Fusion Power Systems Department. *Affiliates:* Dow Chemical Company, Long Island Lighting Company, Northern States Power Company, and Pennsylvania Power and Light Company.

Board of Directors: Stephen O. Dean, Chairman; Henry J. Gomberg, Vice Chairman; Donald L. Kummer, Secretary; Bernard J. Eastlund, Treasurer; Ronald C. Davidson, Nicholas A. Krall, Sherman Naymark, Tihiro Ohkawa, Paul Reardon, Leonard F. P. Reichle, Peter H. Rose, Glen Sorenson, Alvin W. Trivelpiece, James M. Williams, Gerold Yonas, Donald P. Zeifang. Ruth Watkins is Assistant Secretary-Treasurer. Peter Kortman is Technical Director.

NEWS FROM



FUSION POWER ASSOCIATES

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FOR IMMEDIATE RELEASE
October 1, 1980

PRESIDENT AND CONGRESS MANDATE FUSION ENERGY DEVELOPMENT

President Carter is signing legislation mandating a rapidly accelerating, highly mission-oriented, fusion energy program. The legislation easily passed both houses of Congress with strong bipartisan support.

Dr. Stephen O. Dean, President of Fusion Power Associates, a non-profit, public benefit corporation, called the action "The most important piece of energy legislation yet passed by Congress. Fusion has the potential to provide the world with a safe, environmentally-acceptable primary energy source, and its development will remove a principal source of world tension: the unequal geographical distribution of conventional fuels," Dean said.

The new Law calls for a doubling of the almost \$400 million now being spent on fusion energy development by the Department of Energy. The Law states, "The Secretary (of Energy) shall initiate design activities on a fusion engineering device using the best available confinement concept to ensure operation of such a device at the earliest practicable time, but not later than the year 1990." The DOE's Energy Research Advisory Board has estimated the cost of such a device to be about \$1 billion.

The Law further states "The Secretary shall initiate at the earliest practical time each activity which he deems necessary to achieve the national goal for operation of a commercial demonstration plant at the turn of the twenty-first century."

To implement the needed engineering development, the Law directs the Secretary of Energy to develop a plan for the creation of a national fusion engineering center in order to save "cost and time ... relative to the cost and schedule currently projected for the program." Previous DOE schedules, established in 1978, aimed at a demonstration plant in 2015.

During the past few years, scientists have demonstrated the high temperatures required for fusion and have evolved the scientific principles necessary for designing larger, power-producing devices. "We are now standing on the threshold of controlling Nature's most fundamental and powerful energy process," Dean said.

For further information contact:
Dr. Stephen O. Dean
Dr. Peter J. Kortman
301-258-0545



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PRESIDENT SIGNS FUSION BILL

On October 7, President Carter signed the "Magnetic Fusion Engineering Act of 1980". The new law makes it national policy to initiate the engineering phase of fusion development with the expressed goal of operating a fusion demonstration plant "at the turn of the twenty-first century". The law, which also calls for the operation of a "fusion engineering device" by 1990, was due largely to the efforts of Congressman Mike McCormack (D-WA), and Senator Paul Tsongas (D-MA).

NEW MEMBER AND AFFILIATES

TRW, Inc. of Redondo Beach, CA, has become the eighteenth member of Fusion Power Associates. Corporate liaison between TRW and FPA will be provided by Pete Staudhammer, Don Arnush, and Arthur F. Grant.

Bendix Corporation of Southfield, MI, and Ralph M. Parsons Co., Pasadena, CA, have become our fifth and sixth Affiliates. A. B. Van Rennes, Corporate Director, External R&D, will represent Bendix, and Roy E. Gaunt, Vice President, will represent Ralph M. Parsons Co.

We welcome their participation.

FPA SCHEDULES SYMPOSIA AND ANNUAL MEETING

Fusion Power Associates will sponsor symposia on November 13 in San Diego and on November 20 in Washington, D. C. The San Diego symposium on the "Status of Fusion R&D" will feature DOE speakers led by Ed Kintner, head of the DOE magnetic fusion program, and Rick Schriever, Deputy Director of the DOE inertial fusion program.

The November 20 symposium in Washington will feature "The Role of Industry in Fusion Research". Mike McCormack will be the keynote speaker. November 20 will also be the occasion of our first annual meeting.

RADIO

Steve Dean discussed fusion energy development on three radio talk shows recently. The programs took place on September 26 on KAYO in Seattle, on October 5 on WIYY in Baltimore, and, also on October 5, on WIFE in Indianapolis. Station and audience response was positive.

On September 3, station WIPX in New York City editorialized on fusion, endorsing the fusion legislation moving through Congress. The editorial stated in part: "The aspect we find most heartening is that, at last, we are taking our future into our own hands, and by our own intelligence and ingenuity, beginning to work our way out of the energy problem by--how obvious it sounds--producing more energy".

SENATE ACTION ON FUSION BILL

In addition to the 16 Senators listed in our September newsletter, the following 8 Senators became co-sponsors before the legislation was passed by voice vote in the Senate on September 23. The 8 Senators are Alan Cranston (D-CA), John Danforth (R-MO), Jake Garn (R-UT), Ernest Hollings (D-SC), Jacob Javits (R-NY), James McClure (R-ID), Claiborne Pell (D-RI), and Alan Simpson (R-WY). The Senate version of the bill was then passed by the House on September 24 and sent to the President for signature.

FUSION ARTICLES

An article entitled "Prospects for Inertial Confinement Fusion" by FPA President Steve Dean will appear in the November issue of Optical Spectra magazine.

OMNI magazine expects to devote most of its January issue to fusion. The magazine is expected on the news stands in early December.

An excellent article appeared in the October 6 Barron's by Roscoe Born. Fusion Power Associates has begun to receive inquiries from the investment community as a result of the article.

MEMBER NEWS

McDonnell Douglas Astronautics Company has won the subcontract from ORNL to design, fabricate and install the Elmo Bumpy Torus Proof of Principle experiment. This award is estimated to be worth \$70-100M over the next 5 years. The EBT concept is what DOE calls the "next most promising magnetic concept after tokamaks and magnetic mirrors." The device will be built at a MDAC-owned site in the city of Oak Ridge, and operated by MDAC for ORNL. The EBT-S device, currently in operation at ORNL is providing data pertinent to EBT-P design.

Mathematical Sciences Northwest, Inc. has offered its first commercial product: a repetitively-pulsed ultraviolet laser having applications in laser photochemistry, semiconductor processing, atmospheric monitoring and as a driver for tunable dye lasers in the visible spectra region. The product called "EXCI-LITE"™ provides an output energy of 5-10 mJ per pulse at wavelengths of 193, 248, 308, and 353 nm. The pulse duration is about 5 nsec, yielding a peak power of 1-2 megawatts. The units sell for \$17,500.

Universal Voltronics is building the new Doublet III neutral beam power supplies recently authorized as part of the joint US-Japanese fusion program at General Atomic Company. The contract valued at \$7,537,943 is to be completed by October 15, 1981. UVC is also working on power supplies for the Antares inertial fusion program at LASL and for RF heating on the Tandem Mirror Experiment at LLNL.

ANS MEETING

The American Nuclear Society is meeting in Washington, D. C. the week of November 17 at the Sheraton Washington. Of special interest is a session "Fusion for the 1980's--The Breakeven Decade" on Tuesday afternoon November 18. Featured speakers are John Emmett (LLNL), Mel Gottlieb (PPPL), Dick Post (LLNL), Charlie Baker (ANL), Klaus Zwilsky (DOE) and Fred Ribe (U. of Washington).

FPCC MEETINGS

The magnetic Fusion Power Coordinating Committee met in Germantown on Sept. 23-25. The primary topic of discussion at the meeting was planning for the Fusion Engineering Device. Also, there were discussions of the advanced tokamak program and summary presentations from each of the major laboratories. The next meeting of the FPCC will take place in ORNL on December 8-10 where the primary focus will be on the Oak Ridge program.

ICRH HEATING DEMONSTRATION

Up to 1 MW at 25 MHz of Ion Cyclotron Resonance Heating (ICRH) has been supplied to the PLT plasma. Using 600 kW at a pulse length of 100 ms-200 ms, the ion temperature was raised from less than 1 keV to greater than 2.5 keV. This is a very significant demonstration of ICRH for bulk plasma heating in tokamaks.

FUSION SAFETY PLAN

A Fusion Safety Program Plan, dated September 1980, has been prepared by the Idaho National Engineering Laboratory (INEL) which is managed by EG&G. The document identifies the primary issues in fusion safety and presents a plan whereby those issues can be addressed. INEL has lead-lab responsibility for safety in the magnetic fusion energy program. A copy of the plan can be obtained from INEL by writing James G. Crocker, Manager of Safety, INEL, P.O. Box 1625, Idaho Falls, ID, 83401.

Members of Fusion Power Associates: Aydin Energy Division; BDM Corporation; Burns and Roe, Inc.; Ebasco Services; General Atomic Company; Gilbert/Commonwealth; ILC Technology, Inc.; JAYCOR; KMS Fusion, Inc.; Mathematical Sciences Northwest, Inc.; McDonnell Douglas Astronautics Company; Quadrex Corporation; Science Applications, Inc.; Stone and Webster Engineering Corp.; Metals Division, Thermo-Electron Corp.; TRW, Inc.; Universal-Voltronics Corp.; and Westinghouse Fusion Power Systems Department. Affiliates: Bendix Corporation, Dow Chemical Company, Long Island Lighting Company, Northern States Power Company, Pennsylvania Power and Light Company, and Ralph M. Parsons Co.



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FIRST ANNUAL MEETING

Fusion Power Associates held its first annual meeting of members and affiliates on November 20 in Washington, D. C. Highlights of the meeting included:

- o Breakfast with Senator Paul Tsongas. Senator Tsongas described his views on getting all segments of our society working together towards constructive action to meet national and international energy needs, and exchanged views with representatives of our member and affiliate organizations.
- o Announcement of the selection of Senator Tsongas, Congressman McCormack, Robert L. Pirsich, and Solomon J. Buchsbaum to receive Fusion Power Associates Leadership Awards for 1980.
- o A decision to interact with DOE on its review of inertial fusion and its procedures for setting up a (magnetic) Center for Fusion Engineering.
- o A magnificent luncheon at the Regency Club.
- o A well-attended public symposium on "The Role of Industry in Fusion Development". Congressman McCormack, the keynote speaker, told the audience that "the formation of Fusion Power Associates and the involvement of industry now are essential elements in the coming engineering development phase which will lead to fusion power".
- o A reception, also attended by members of the recently established Technical Management Board which is overseeing the design of the (magnetic) Fusion Engineering Device (FED).

NEW MEMBERS AND AFFILIATES

EDS Nuclear, Inc. of San Francisco, CA, has become the nineteenth member of Fusion Power Associates. L. W. Cooley, Senior Vice President, will represent the corporation.

Maxwell Corporation, San Diego, CA, has become the twentieth member of Fusion Power Associates. As a result, the Associates has achieved a doubling of membership over the original ten members who initially joined the association one year ago. Dr. Alan C. Kolb, Chairman and CEO of Maxwell will represent the company. (While Superintendent of the Plasma Physics Division of the U.S. Naval Research Laboratory, Dr. Kolb was instrumental in bringing FPA President Steve Dean into the field of laser fusion as an experimental physicist back in 1968!)

The Tri-City Nuclear Industrial Council of Pasco, Richland, and Kennewick, Washington, a non-profit corporation dedicated to the development of Hanford, WA, as a nuclear energy center, has become the seventh affiliate of Fusion Power Associates. Glenn C. Lee, Secretary of the Council, will represent the company.

Northeast Utilities Service Company of Hartford, CT, and the Institut de Recherche de l'Hydro-Quebec (IREQ), Varennes, Quebec, Canada, have become the eight and ninth affiliates of Fusion Power Associates. IREQ also becomes our first foreign affiliate. Sidney H. Law, (Director - Research) will represent Northeast. Claude Richard (Directeur, Production et Conservation de L'Energie) will represent IREQ.

We welcome our new members and affiliates to participation in Fusion Power Associates.

PRESIDENT SIGNS FUSION ACT

The President signed the Magnetic Fusion Energy Engineering Act of 1980 into law on October 7. In signing the bill, the President issued the following statement:

"I have today signed H.R. 6308, the 'Magnetic Fusion Energy Engineering Act of 1980', a bill authorizing a magnetic fusion research, development, and demonstration program within the Department of Energy. The bill establishes as a national goal the successful operation of a magnetic fusion demonstration plant in the United States by the year 2000. To date, the scientific results of magnetic fusion experiments have been highly encouraging and there exists considerable confidence that a controlled fusion reaction can be achieved. Congressman McCormack and Senators Church, Tsongas, Baker and Domenici are to be commended for their foresight and efforts in obtaining the enactment of H.R. 6308.

"Fusion power offers the potential for a limitless energy source with manageable environmental effects, and H.R. 6308 represents a bipartisan effort to develop fusion as a viable energy supply option for the United States. Today, our Nation is the undisputed leader in developing this advanced technology. This bill represents a reasonable approach to the broad advancement of fusion research and technology, and it is with pleasure that I sign this bill into law."

FPCC TO MEET AT ORNL

The magnetic Fusion Power Coordinating Committee will meet December 9-11 at Oak Ridge National Laboratory. For information, contact Ed Kintner at DOE.

FURTH NAMED HEAD OF PPPL

Harold P. Furth, long recognized internationally as one of the most creative fusion scientists in the world, has been named Director of the Princeton University Plasma Physics Laboratory, the largest fusion research center in the world. He succeeds Melvin B. Gottlieb who will retire January 1, 1981. Furth, who was instrumental in the initiation of the Tokamak Fusion Test Reactor (TFTR) now under construction at PPPL, came to Princeton in 1967 from the Lawrence Livermore Laboratory. He received his Ph.D. in 1960 from Harvard.

RECENT ARTICLES

Articles on fusion appear in the November 24 issue of Forbes and in the December issue of Discover. The January 1981 issue of OMNI will also feature fusion stories.

UPCOMING SHORT COURSE

The University of New Mexico will sponsor an intensive short course in Inertial Confinement Fusion, June 14-19, 1981. The course fee is \$525 for those who register by February 1, 1981; and \$575 thereafter. For further information contact Dr. Gary W. Cooper, Department of Chemical and Nuclear Engineering, University of New Mexico, Albuquerque, NM, 87131.

FY 1982 FUSION BUDGETS

As one of his last official acts, President Carter will recommend FY 1982 funding levels for federal programs to Congress and to the incoming administration. The budget levels will not be finalized until late December. As of this writing, it appears likely that Carter will recommend \$506M for magnetic fusion (compared to \$394M in FY 1981) and \$209M for inertial fusion (compared to \$204M in FY 1981).

Members of Fusion Power Associates: Aydin Energy Division; BDM Corporation; Burns and Roe, Inc.; Ebasco Services; EDS Nuclear, Inc.; General Atomic Company; Gilbert/Commonwealth; ILC Technology, Inc.; JAYCOR; KMS Fusion, Inc.; Mathematical Sciences Northwest, Inc.; Maxwell Corporation; McDonnell-Douglas Astronautics Company; Quadrex Corporation; Science Applications, Inc.; Stone and Webster Engineering Corp; Metals Division, Thermo-Electron Corp.; TRW, Inc.; Universal-Voltronics Corp.; and Westinghouse Fusion Power Systems Department.

Affiliates: Bendix Corporation; Dow Chemical Company; Institut de Recherche de Hydro Quebec (Canada); Long Island Lighting Company; Northeast Utilities Service Company; Northern States Power Company; Pennsylvania Power and Light Company; and Tri-City Nuclear Industrial Council.