"Document Control"

TYPE: ACTION DOCUMENT NUMBER: 9200020
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

****

FROM: FINERTY, Michael P.

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 12/20/91

SUBJECT: HE REQUESTS ASSISTANCE IN OBTAINING COMPUTERS TO CONTINUE HIS RESEARCH, AND HE WANTS RECOGNITION FOR THE PROJECTS HE HAS OUTLINED IN HIS LETTER.

****

DIRECTORATE ASSIGNED: PHYSICAL SCIENCES

STAFF ASSIGNED:

ACTION REQUIRED: AS NECESSARY

STAFF ACTION: No action needed. 1/7/92 I agree 1/15

****

SENDER'S DUE DATE:

OSTP DUE DATE: 01/20/92 STAFF DUE DATE

DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

PHONE: EXT:

REMARKS:

OSTP RECEIVED: 01/06/92 DEPT RECEIVED:

FILE: P-PHYSICAL SCIENCES

CENTRAL FILES: MATERIALS - General

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01a. Letter	To: Allan Bromley From: Michael Finerty Re: Request for assistance [personal information redacted] (4 pp.)	12/20/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Materials [1991]

Date Closed:	3/30/2010	**OA/ID Number:**	62044-012
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
(b)(6) Release would constitute a clearly unwarranted invasion of personal privacy [(b)(6) of the FOIA]
(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01b. Letter	To: VA Regional Office From: Michael Finerty Re: Request for assistance [personal information redacted] (4 pp.)	12/20/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Materials [1991]

Date Closed:	3/30/2010	**OA/ID Number:**	62044-012
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

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Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01c. Letter	To: Ed Pastor From: Michael Finerty Re: Request for assistance [personal information redacted] (2 pp.)	12/20/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Materials [1991]

Date Closed:	3/30/2010	**OA/ID Number:**	62044-012
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
AR Case #:		**MR Case #:**	
AR Disposition:		**MR Disposition:**	
AR Disposition Date:		**MR Disposition Date:**	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
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(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
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Michael Palmer Finerty
2970 E 5th St
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FINERTY, MICHAEL PALMER, retired educator; b. N.Y.C., Oct. 5, 1943; s. John Frederic and Catherine (Palmer) F.; m. Meganne Wiseman, Nov. 27, 1982 (div. 1988); 1 child, Jennifer Etta. BA in Math., U. Ariz., 1965, MA, 1974. English tchr. U. Ariz., Tucson, 1969, grad. libr. asst., 1974; math. tchr. Phoenix Indian High Sch., 1983-84; physics tchr. Am. Sch. Found., Guadalajara, Mexico, 1988; cons. Vol. health educator Amistad Found., Palo Alto, Calif., 1990-91. With U.S. Army, 1966-68. Recipient Amistad Found. grant Sierra of Jalisco, 1989-90. Mem. AAAS, Tucson Amateur Astronomers Assn., Internat. Dark Sky Assn. Republican. Roman Catholic. Achievements include design of tuned linear accelerator, 1986; design of fractional wavelength tuned linear accelerator, 1989; design of spectrochromatic imaging device, 1975; extended range of calculators and showed it to be useful extension. Home: 2970 E 5th St Tucson AZ 85716 (602) 795-0464
Office: APDO # 210, Zapopan, PC 45101 Mexico

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Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01d. Form	VA Form 21-0517 [personal information redacted] (2 pp.)	12/25/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Materials [1991]

Date Closed:	3/30/2010	**OA/ID Number:**	62044-012
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
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AR Disposition:		**MR Disposition:**	
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"Document Control"

TYPE: ACTION
DOCUMENT NUMBER: 9124802
ORIGINATOR: 02
STATUS I
DIRECTORATE STATUS

****

FROM: NIELSEN, Don: MIDWATCH INC.

TO: DR. D.A. BROMLEY

DATE OF CORRESPONDENCE: 11/15/91

SUBJECT: RE:THE DEVELOPMENT OF AN ENGINE MODIFICATION TO REDUCE EMISSIONS AND IMPROVE ENGINE EFFICIENCY. WOULD LIKE TO PROVIDE MORE INFORMATION FOR DR. BROMLEY IF HE SO DESIRES.

****

DIRECTORATE ASSIGNED: PHYSICAL SCIENCES

STAFF ASSIGNED: Jim Ling (as of 2/2/92)

ACTION REQUIRED: DIRECT REPLY

STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: 12/02/91

STAFF DUE DATE

DATE COMPLETED:

DATE COMPLETED/DEPT: 11/13/92

****

COPIES TO: INDUSTRIAL
D. Allan Bromley

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WHITE HOUSE TRACKING #:

CONTACT PERSON:

PHONE:

EXT:

REMARKS:

OSTP RECEIVED: 11/18/91

DEPT RECEIVED:

FILE: P-PHYSICAL SCIENCES

CENTRAL FILES:

MIDWATCH, Inc.
Consulting Services
Don Nielsen, President
PO Box 357, Flint Hill, Va. 22627

Nov. 15, 1991

Dr. D. Allan Bromley,
Science Advisor to the President,
Washington, D.C.

Dear Dr. Bromley,

A small business in Atlanta, the ENTEC Corporation, has invented and patented an engineering modification to the internal combustion engine which, in the view of a number of respected engineering concerns, offers the potential for revolutionary improvement in engine emission control, operating efficiency and fuel versatility.

This invention has culminated in the Entec Cycle Engine, a brief technical summary of which is appended. We are anxious to put this information in your hands for your review since we feel that the development of this engine, if credited in part to the foresight of the administration, might provide the President with a valuable domestic plank in his re-election platform.

As indicated in the attached technical summary, the Entec Cycle Engine offers a significant reduction in air pollution, longer engine life through lower operating temperatures and the versatility of operation on a variety of alternative fuels. Equally important, the technology can be made available through a relatively inexpensive modification to the thousands of deisel engines in trucks and busses already on the road with poor emission control.

The Entec Corporation is seeking private capital to enable the production of prototypes, and to complete the testing and computer modelling we feel is needed before production can begin. While government funding would, of course, be welcomed, we recognize the difficulties in obtaining such funding in the current environment, and would be pleased if, at this stage, we can obtain recognition, advice and--to the extent appropriate--endorsement by government offices most concerned. We have contacted several of these offices, notably in the Departments of Energy, Transportation and Defense, and have been encouraged to continue our efforts.

We will, of course continue to explore avenues of possible support within the Executive Branch and we also have obtained offers of support from within the Congress. Our purpose in contacting you, however, is to express our interest in working with your office for two reasons: first, to obtain your advice and assistance on how best to proceed to develop government support and, second, to offer information on this truly startling technological advance to add emphasis and substance to the President's positions on concern for both the environment and for technical growth.

We have extensive additional data attesting to the technical soundness and environmental value of the Entec Cycle Engine, and we would be pleased to provide it for your review or, preferably, to give it to you as part of a briefing or meeting on our technology.

I am a retired Navy Officer, working with the Entec Corp, to assist them in establishing contact with the appropriate offices in the federal government. I live in Northern Virginia, and I am available to provide you with additional information, or to arrange for follow up meetings with Entec officials. I am at your service at your first convenience.

Thank you very much for your time and interest.

Sincerely,

Don Nielsen
MIDWATCH, Inc.
Phone or Fax: (703) 675-1379

Attachment:
"The Entec Cycle Engine" information brief

THE ENTEC CYCLE ENGINE

Information Brief

Summary of the Proposed Concept

The concept is of a multi-cylinder reciprocating internal combustion engine operating in a new working cycle having inherently much higher thermal efficiencies than those of either the Otto or the Diesel cycles. This working cycle is characterized by a greatly extended expansion process, by extreme charge turbulence in the combustion chamber, by much higher compression for gasoline operation and by dramatic power density increases.

This concept further provides for multi-fuel operation with similar efficiencies with a wide range of fuels, including the volatility range from Diesel oil to high-test gasoline and the octane range from zero to that of the best aviation fuels. In addition, the extra burning time of the extended expansion process coupled with a cool, more turbulent charge will lessen polluting emissions.

The means are as follows: Atmospheric air is received and compressed in an auxiliary compressor and then expressed into a high pressure manifold-reservoir. The entire air charge is intercooled and aftercooled so that combustion starts at 250 degrees F. providing charge densities greater than that of a four-stroke or two-stroke engine of the same displacement. The engine can also be highly supercharged.

The manifold supplies two-stroke cylinders. These cylinders have normal combustion chambers which receive, near the end of its scavenging stroke, a cool, highly compressed, high velocity charge along with the fuel, then ignites the charge, for the power stroke. The manifold contains a volume sufficient to prevent an appreciable overall pressure drop when a charge is received by a cylinder. (Expansion always begins at maximum compression.)

A cool charge and greater flame velocity means that the initial combustion reaction is cooler, peak pressures and temperatures are much lower, and the end gas is also cooler. This results in knock-free operation in the gasoline mode to a 14:1 compression ratio without detonation, regardless of the octane rating of the fuel. In addition NOx, CO, CO_2 and unburned HC emissions are greatly reduced. With diesel fuel particulate matter is also greatly reduced.

The higher compression and greater charge densities assures a power-to-weight ratio greater than that of conventional Otto or Diesel cycle engines. (The cylinders are "ideal" two-stroke cylinders since scavenging is by positive displacement and there is no loss of air charge or fuel in the scavenging process.) Fuel economy is achieved by an extended expansion process and by more complete combustion, and by the greater efficiency inherent in higher compression.

The technical details of the Entec cycle engine are fully explained in the accompanying technical presentation.

Expected Impact on Military Operations

This engine will have great positive impact upon military tactical craft and combat vehicles. Because of the greater expansion and cooler exhaust temperatures, reliability and maintainability of engine component parts will be greatly increased. Less rejected heat should permit elimination of the liquid cooling system for less sensitiveness to conventional cooling system damage and extreme environmental conditions.

Fuel economy improvements translate into increased vehicle range which, with the multi-fuel capabilities, provide greatly reduced logistic concerns.

Increased power over current engines will result in a reduction in both weight and volume for the same horsepower level for improved vehicle response and reduced armor cover requirements.

Technical Feasibility and High Risk Areas

There are no special barriers to quantity production, neither in production methods nor in tooling. The technology is current and every component is already present in existing engines. Conversions to the Entec cycle requires changes only in the cylinder head, valve drive train, and in the manifold air distributor.

These engines can be built on present assembly lines and indeed can be retrofitted to any existing engine. The latter feature is important where large expensive engines are concerned.

Expected Availability Date

A prototype can be designed, fabricated and tested in a period of 13 months.

Quantity production could begin within two years of the decision to adopt the concept. Retrofitting existing engines could be begun in a like time framework.

Estimated Cost and Basis for Estimate

The cost of fabricating and testing prototypes would be approximately $10,000,000 based on proposals received from Battelle Columbus Labs, Detroit Diesel Corporation, Georgia Institute of Technology and Ricardo Consulting Engineers.

Concerning quantity production, a rough judgement of relative cost can be made on a cost-per-pound of manufactured product. On this basis, production cost of the water cooled Entec cycle engine would appear to be less than that of

current engines, since power plant weight would be less than conventional powerplants for the same power output.

Cost of the air cooled version is expected to be even less than its watercooled counterpart since waterpump, radiator, seals, hoses and costly water jackets would be eliminated.

4902

FAX TRANSMISSION

COVER SHEET

* * *

TO: Office of Science & Technology Policy

FOR: Ms MARIAN NIOA

FAX NR.: (202) 395-3261

DATE: 15 Nov 1991

* * * *

FROM: Don Nielsen, MIDWATCH, Inc.

FAX NR.: (703) 675-1379

NR of PAGES (including this one): 6

MESSAGE: Ms NIOA - Attached letter is pursuant to our conversation earlier this week, I hope DR BROMLEY finds it useful and am prepared to provide additional information as needed. Thanks for your assistance — Don Nielsen

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

January 13, 1992

Dear Mr. Nielsen:

This is a follow-up to your telephone conversation on January 6 with Dr. Ling of our office. As he indicated to you, our recommendation is that you contact the Army Tank Automotive Command concerning the Entec Cycle Engine. The Army is in a position to evaluate the technical aspects of the engine and give you a more detailed response.

Sincerely,

J. Douglas Beason
Senior Policy Analyst

Mr. Don Nielsen
President
MIDWATCH, Inc.
P.O. Box 357
Flint Hill, VA 22627

"CORRESPONDENCE TRACKING"

TYPE: ACTION DOCUMENT NUMBER: 9120970

****

FROM: KNOTEK, Michael L.: BATTELLE

TO: DR. BROMLEY

DATE OF CORRESPONDENCE: 04/01/91

SUBJECT: REQUEST TO DISCUSS DR. KNOTEK'S TESTIMONY BEFORE THE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY 03/19/91 ON THE NEED FOR ADVANCES IN MATERIALS SCIENCE.

****

ASSIGNED TO: Perry Lindstrom

ACTION REQUIRED: FOR DAB SIGNATURE

****

SENDER'S DUE DATE: OSTP DUE DATE: 04/17/91

DATE COMPLETED: 4/8/91

****

COPIES TO: D. Allan Bromley
Dr. Phillips

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

REMARKS:

DATE RECEIVED: 04/03/91 FILE: MATERIALS

Battelle
Pacific Northwest Laboratories
Battelle Boulevard
P.O. Box 999
Richland, Washington 99352
Telephone (509) 375-2272
Fax No: 509/375-6844

April 1, 1991

Dr. D. Allan Bromley
Science Advisor to the President
Office of Science and Technology Policy
Old Executive Office Building
17th Street and Pennsylvania Avenue NW
Washington, DC 20506

Dear Dr. ~~Bromley~~ Allan;

I was recently asked to testify before the House Space Science and Technology Committee on the need for advances in Materials Sciences. Here at the Pacific Northwest Laboratory we are focussing our work on the needs of the nations Environmental Restoration and Waste Management effort, and it was my goal to impress on the committee the critical need for advances in many Materials Sciences areas to support this effort. I feel that it is important that you are aware of these needs, because a timely investment by the nation could yield many $billions in benefits, as well as a distinct competitive advantage. I would hope that this national need will be an important driver for your initiative on Materials Science. I enclose my testimony and hope that I can have the opportunity to discuss these matters with you sometime at your convenience.

Sincerely yours,

Michael L. Knotek
Deputy Director

MLK:par

Enclosure

Testimony of

DR. MICHAEL L. KNOTEK

Senior Science Director

Pacific Northwest Laboratory

Before the

Committee on Science, Space, and Technology

Subcommittee on Energy

United States House of Representatives

Washington, D.C.

March 19, 1991

Madam Chairman and Members of the Subcommittee, it is a pleasure to be here today on behalf of the Pacific Northwest Laboratory, which is managed for the Department of Energy by Battelle Memorial Institute. Your invitation to testify asked that I provide my views on the importance of materials science as it relates to national needs and the missions of the Department of Energy.

I believe it would be impossible for me to overstate the importance of the role materials science now plays, and will continue to play, in meeting the needs of our nation and fulfilling the missions of the Department of Energy. The connection is simple. Our society, our quality of life, and our economic development depend on technology, and the development of technology depends on materials.

Background

As pointed out in the 1989 National Research Council report, Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials, "Without new materials and their efficient production, our world of modern devices, machines, computers, automobiles, aircraft, communication equipment, and structural products could not exist." This observation is echoed in the recent Materials Research Society publication, A National Agenda for Materials Sciences and Engineering: Implementing the MS&E Report, which states, "Virtually all new technologies are driven by advances in materials, and the future competitiveness of the U.S. depends on our relative ability to adapt these new technologies to the needs of our society."

Both the National Research Council report and the Materials Society publication note that while support for materials science and engineering in other countries has increased, U.S. federal nondefense and industry support for materials research and development, particularly long-range research, has declined. To remedy this situation, the Council report recommended a national program, including strong efforts in the four basic elements of materials science and engineering; synthesis and processing; structure and composition;

properties; and performance. The Pacific Northwest Laboratory strongly agrees with this recommendation.

The Department of Energy and its predecessor agencies have had a longstanding role in materials research in the United States. Starting with the Manhattan Project and continuing with AEC and ERDA, the evolution of several laboratories, including new scientific facilities, can be traced directly to this support for materials research. The Department can be proud of its accomplishments in the development of new materials and processes. However, as the aforementioned reports pointed out, many opportunities that relate to materials are not being exploited by the DOE and other federal agencies. Much needs to be done for a variety of important applications.

Materials Research Needs and Environmental Challenges

One of the most important contributions materials science programs funded by the Department of Energy can make is to provide the tools and techniques we need to restore the environment and clean up hazardous, toxic, and radioactive wastes. The Department has published its Five-Year Plan for Environmental Restoration/Waste Management, and identified the problems at each of its sites. The Department has also separately identified the research needs to develop innovative new technologies for environmental remediation.

Few aspects of environmental restoration can be reasonably and economically accomplished without advances in materials science. Simply stated, we need new materials that can serve as sensors to detect and monitor subsurface contaminants or characterize the components of mixed waste; new membrane and ion exchange materials to assist waste treatment and separation; and new and well-understood containment and barrier materials to immobilize and stabilize waste over very long periods of time.

These environmentally related problems have pushed materials science into new areas that require detailed, molecular-level understanding of very complex systems. For example, it is much easier to design a sensor to detect the presence of a contaminant during the processing of a semiconductor chip in

a well-controlled environment than it is to develop a sensor to detect a similar contaminant groundwater system where we have little direct control.

Similarly, to create verifiable models that can accurately predict the lifetime of barrier and containment materials, we must have a detailed mechanistic understanding of the interactions of a material with its environment. Environmentally related materials science may appear less glamorous than the creation of a new high-temperature superconductor, but the long-term impact on our society and quality of life may be much greater.

The Department has begun to address these questions in a focused matter through the Basic Energy Sciences budget. Funds have been included for research support and capital equipment to create a Molecular Science Research Center at the Pacific Northwest Laboratory. The Materials and Interfaces Research Program, which is a key component of the Molecular Sciences Research Center at PNL, is aimed at understanding these problems.

This research program is generating the information we need to design and synthesize advanced materials to analyze and separate mixed chemical and hazardous wastes, to provide long-term storage of hazardous materials, and to develop chemical sensors for environmental monitoring of various organic and inorganic species. The program includes provisions for supporting facilities that will enable scientists to synthesize new materials, as well as advanced instrumentation to study their structural, mechanical, electronic, and chemical properties.

In September 1990, PNL hosted a workshop to explore materials and interfaces research needs related to environmental concerns. The workshop was attended by more than 50 scientists representing materials science, physics, surface and interface science, chemistry, chemical engineering, and earth and environmental sciences. About half the participants were from PNL; the remainder were from national laboratories, universities, and research organizations throughout the United States. The workshop identified four major challenges or issues related to environmental cleanup, waste storage,

and restoration that are directly dependent on materials science--both basic and applied.

1. **We must be able to detect and characterize hazardous waste.** Detection and characterization require, among other things, the development of selective sensors that function in complex environments.

2. **We must minimize the amount of waste that must be treated as hazardous, so we can reduce cleanup costs an disposal volume.** Waste minimization requires the development of separations membranes, ion exchange or selective sorption materials, and catalysts for waste destruction.

3. **We must encapsulate hazardous waste for permanent disposal.** Effective containment requires materials that have low and predictable reaction rates with their environment; are stable to radiation effects; and are compatible with each other if multiple containment is required. To ensure that containment materials possess these properties, we must expand our fundamental understanding of phase stability and alteration and reaction mechanisms.

4. **We must be able to predict the transport of hazardous waste from contaminated areas as well as potential disposal sites.** To ensure accurate predictions, models must account for many factors, including sorption and/or desorption on mineral surfaces and colloid formation and transport. These models can only be developed through molecular-level research of mineral surface interactions with various hazardous waste constituents and with colloids as well as stability fields for colloids.

Based on these materials science challenges and issues, the workshop participants identified three important research areas that DOE should address: interface structure and chemistry, materials and interface stability, and materials synthesis. The **interface structure and chemistry** research area includes two related, but somewhat distinct, objectives. One is to expand our knowledge of the surface structure and chemistry of oxides, minerals, clays, and other environmentally relevant materials with the ultimate goal of achieving a level of understanding that equals current

knowledge of metals and semiconductors. The other is to develop more detailed information about what happens at solid-liquid interfaces and how various contaminants affect interface properties.

Many of the basic interface structure and chemistry studies will involve idealized model systems; however, the ultimate success of this research effort will depend upon the relationship between the idealized models and real-world systems, which generally are much more complex. For example, the program must include examinations of typical complications introduced by the addition of components to the system under study as well as studies of real materials in relation to the model systems.

Two examples of technologies that must rely on an understanding of materials and interface stability are waste containment barriers and advanced sensors for remote operation in hostile environments. Containment and barrier materials may alter with time as a result of radiation, thermal gradients, or reactions with the environment. We must be able to predict such alterations and potential changes in material properties. Furthermore, sensors may involve integrated circuit-based technology that is unsuitable for operation in harsh, complex environments.

Research in this area must address the stability of composite materials designed to have specific optical, electronic, or chemical properties and the interfaces and reaction layers that form as a result of environmental interactions. Studies should range from the examination of simplified model interfaces to real-time, in-situ characterization of buried interfaces.

The materials synthesis research effort must involve the creation of model surfaces and interfaces for detailed examination as well as the formation or synthesis of new materials with specific properties. We need model surfaces and interfaces to improve our molecular-level understanding of the surface structure and chemistry of environmentally relevant materials such as oxides, clays, and minerals. These models will enable researchers to compare theoretical calculations with experimental measurements, which can be obtained most readily from well-characterized, often single-crystal, surfaces.

We also need materials with new or improved properties because some environmentally related requirements cannot be met easily by existing materials. This is especially true in the containment areas as well as some sensor areas. Natural hard tissue materials are of special interest because they develop unusual properties from rather normal starting materials. Biomimetric systems that imitate nature offer the potential for protective ceramic coatings and unique sensor properties as well as the formation of natural ceramic materials within the geologic environment to serve as stable barriers or containment materials for hazardous waste.

The Environmental and Molecular Sciences Laboratory

The materials science programs conducted by DOE will be substantially upgraded when several new scientific facilities are completed. The Advanced Photon Source at Lawrence Berkeley Laboratory, the Advanced Light Source at Argonne National Laboratory, the Advanced Neutron Source at Oak Ridge National Laboratory, and the Environmental and Molecular Sciences Laboratory at the Pacific Northwest Laboratory will provide researchers throughout the United States with new and unique capabilities for materials research.

The Environmental and Molecular Sciences Laboratory will provide one-of-a-kind capabilities to researchers for materials research for a variety of applications relating to environmental restoration. EMSL will be a focal point for molecular-level research in the United States, and will provide industry with the information to accelerate the development of cost-effective technologies for environmental remediation challenges facing DOE, other federal agencies, and the private sector. (Attached to my testimony is project summary which provides more detail on EMSL.)

One of the reviews conducted on the EMSL proposal characterized the materials science challenges associated with environmental restoration and the role of EMSL as follows: "The intellectual challenge of the EMSL's mission is staggering, however the practical payoff of success in this mission is immense on the level of, or perhaps beyond, that of the Manhattan Project."

Summary

Materials science has given us new metals, ceramics, and composites with extraordinary properties designed for specific applications. Materials science has produced innovative concepts that enable us to improve and tailor existing materials to meet new or unique requirements. And, materials science has provided benefits and applications that affect every aspect of our society and economy.

Materials science also has the potential for making vital contributions to the solution of environmental restoration and waste management problems faced by the DOE and the nation. The four challenges described here are universal. The task of surmounting these challenges is formidable but not beyond our capabilities, providing we establish clear targets and empower the scientific community to achieve them. Despite today's constrained budgets, the long-term payoff from an enhanced materials science program should be substantial. I urge the Committee to weigh that option.

User Fees at DOE/BES User Facilities

I thought it appropriate, given my past experience as Chairman of the National Synchrotron Light Source, to comment on the charging of User Fees at the DOE/BEST user facilities. The ground rules at these facilities are that all capabilities are available to the entire community of scientists--be they from academia, industry, or the government's own institutions.

It is important, however, to realize that a typical "experiment" contains elements from many sources, all contributed for the common welfare of the community of users and stationed permanently at the facility. While the core instrument, such as the reactor or synchrotron, is provided by the DOE, the actual experimental apparatus that makes the experiment a reality will contain elements of capital equipment, technical support manpower, operating systems, supporting experiments away from the facility, and data analysis and administrative support from a large number of institutions bridging every possible funding and disciplinary boundary.

The concept of "ownership" of such capability is not at all clear. Since each user now provides its "in-kind" support gratis to the community, this entire concept will have to be revised if the DOE seeks cost recovery for its part. Indeed, this whole phenomenon of interinstitutional support and collaboration, which has been one of the great successes to come out of the National User Facility concept, could be damaged if we do not carefully weigh the value of material and intellectual contributions from all sources in establishing support policy.

References

1. National Research Council. 1989. Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials. National Academy Press, Washington, D.C.

2. Materials Research Society. 1991. A National Agenda in Materials Science and Engineering: Implementing the MS&E Report. Materials Research Society, Pittsburgh, Pennsylvania.

ENVIRONMENTAL AND MOLECULAR SCIENCES LABORATORY

Project Summary

NEEDS AND GOALS

The United States has embarked on an environmental restoration effort that dwarfs any scientific enterprise this country has ever launched. Estimated cost for cleanup of Department of Energy production sites alone is equivalent to a number of superconducting supercolliders, several space stations, or another trip to the moon. The unresolved scientific problems of this effort are as complex as any this nation has ever faced, yet they are critical to our quality of life and economic competitiveness. Research and innovation are the only ways to assure restoration and protection of our environment by reducing cost, uncertainty, and risk.

The Environmental and Molecular Sciences Laboratory (EMSL) will capitalize on today's revolution in experimental and theoretical molecular sciences to meet DOE's environmental commitments and to create a science base for other DOE and national needs. Its research will be multidisciplinary, spanning physics, chemistry, materials science, biology, geology, hydrology, mathematics, computer science, and the environmental sciences. Worldwide there is no adequate model for the effort required. DOE needs a project scaled to encompass critical masses in all necessary fields and a programmatic setting containing practical problems that focus the research.

To meet DOE's need, the EMSL will have as its cornerstones:

fundamental research in underlying chemical, materials, biological, computational, and environmental sciences.

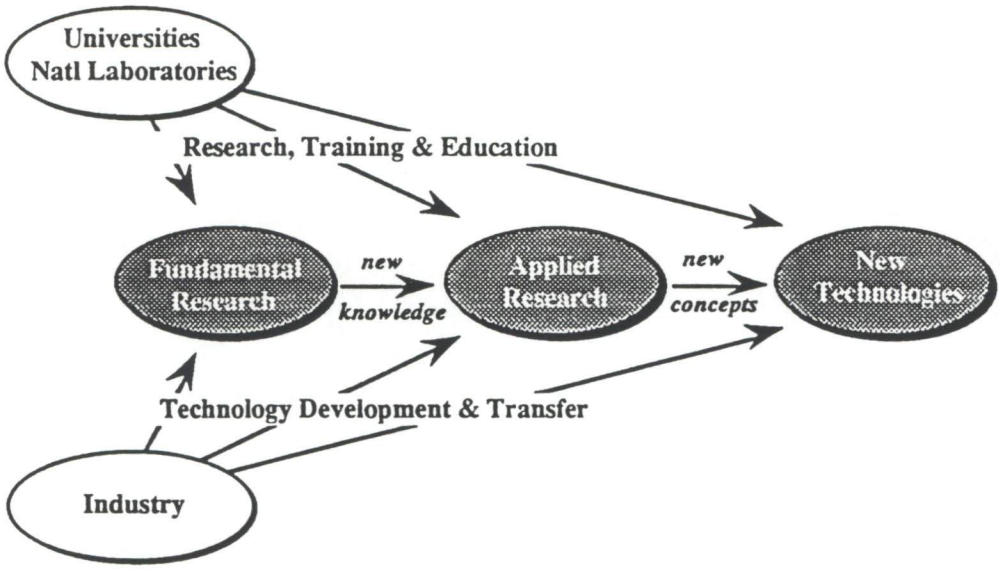
applied research that focuses fundamental knowledge on specific problems.

research, education, and training opportunities for the entire scientific and technical community, which will use the facility.

rapid transfer of technology by involvement of industry.

PROGRAMS AND FACILITIES OF THE EMSL

The EMSL project will develop the requisite interdisciplinary research programs, forefront research equipment, and supporting facilities to meet these demanding



EMSL Focuses Multisite Collaborations on Research and Technology Needs in Environmental Restoration and Waste Management

scientific challenges posed by DOE's environmental initiative. The EMSL will house 300 core and visiting scientists with world-class instrumentation and computational resources in a 200,000 square foot facility. The $220-million investment includes design and development costs for beyond state-of-the-art instrumentation; construction of the building; acquisition, installation and commissioning of the instrumentation; initial operations; and all associated management costs. When complete the EMSL's annual research programs and operations budget will be roughly $60 million.

Research supported by the Offices of Environmental Management (EM) and Energy Research (ER) is organized into six programs.

The **Chemical Structure & Dynamics** program will study chemical kinetics and reaction dynamics of terrestrial and atmospheric processes and the chemistry of complex waste forms and waste storage media using new laser systems, new surface mapping techniques, and molecular clusters that mimic adsorbate/surface interactions. The program will generate new knowledge for geochemical modeling of contaminated soils, for understanding the behavior of wastes in interim storage, for developing novel approaches to remediation, and for evaluating proposed treatment methods.

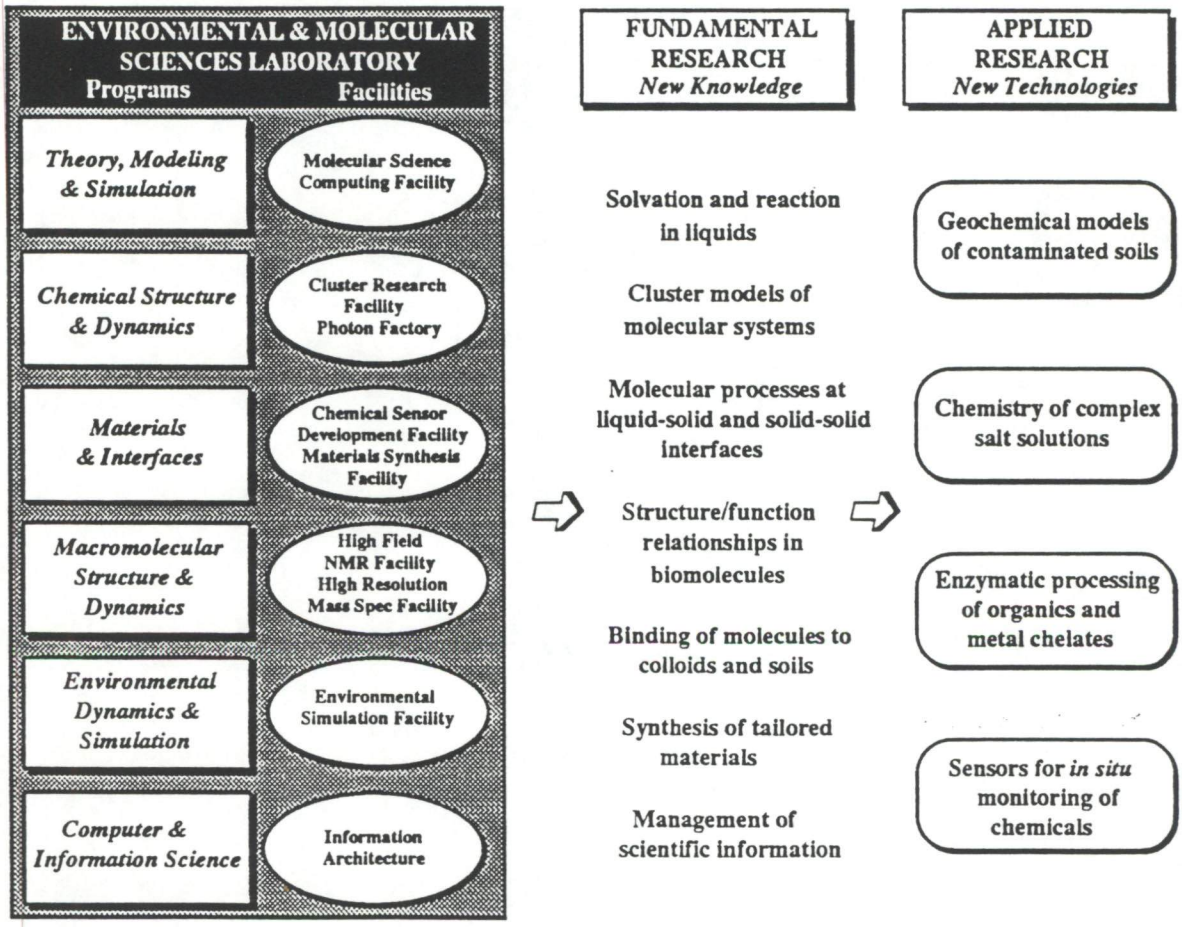
The **Environmental Dynamics & Simulation** program will establish a molecular-level understanding of the bonding forces and speciation of chemicals in colloidal suspensions and of chemicals sorbed on soils. A multidisciplinary approach will use controlled environmental chambers that simulate real-world conditions. New experimental results and theoretical analyses will provide

detailed descriptions of chemical reactions in complex mixtures and at solid-liquid interfaces. Resulting models will predict the fate and transport of contaminant species and provide a scientific basis for remediation schemes.

The **Macromolecular Structure & Dynamics** program will determine biomolecular structure/function relationships for processes that control the biological transformation of contaminants and the health effects of toxic substances. The world's first 1000-megahertz nuclear magnetic resonance (NMR) system and advanced mass spectrometers will be used for structural analysis of key enzymes and genetic material to enhance the use of natural systems for bioremediation, to guide the rational design of new systems having specific activity, and to establish a molecular basis for health risk assessment.

The **Theory, Modeling & Simulation** program will develop detailed molecular level descriptions of the chemical, physical, and biological processes in natural and contaminated systems. This research will use the full spectrum of computational techniques and one of the world's most powerful computer

EMSL Programs, Facilities and Research Activities



systems to model chemical and physical properties of wastes and contaminant interaction with soils and groundwater. This program will produce knowledge needed to predict waste form behavior, suggest new remediation strategies, and support predictions of long-term consequences of proposed ER/WM activities.

The **Materials and Interfaces** program will generate information to support the design and synthesis of advanced materials for the analysis and separation of mixed chemical waste, the long-term storage of concentrated hazardous materials, and the development of chemical sensors for environmental monitoring of a wide variety of organic and inorganic species. Supporting this program will be facilities to synthesize novel materials and instrumentation to study their structural, mechanical, electronic, and chemical properties.

The **Computer & Information Sciences** program will develop new approaches to handle vast amounts of data and perform calculations for complex natural systems. The EMSL will contain a high-performance computing facility and ancillary computing laboratories, as well as high-speed data acquisition systems for all of the major research instruments. An information system will be developed to speed communications of fundamental research results to applications areas.

The EMSL will be a **Collaborative Research Facility.** It will attract hundreds of academic, industrial, and government scientists and students each year. These visitors will collaborate with the in-house staff to develop new levels of understanding and permanent solutions to the nation's environmental problems. **Education and training** programs will motivate external collaborators to continue this research at their home institutions. **Technology transfer** will be achieved by involving industrial and academic partners in the development of frontier research capabilities and the integration of new knowledge and concepts into critical technologies.

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

April 17, 1991

Dear Dr. Knotek:

Thank you for your letter of April 1, 1991, transmitting a copy of your testimony before the House Science, Space, and Technology Committee's Energy Subcommittee. I read it with interest.

Environmental needs will undoubtedly be an area of focus in any materials initiative. As a matter of fact, this area was recently identified in a summary report of the regional meetings held to implement the report "Materials Science and Engineering for the 1990's" of the National Research Council.

Should you require additional information on technology issued, please feel free to contact my Associate Director of Industrial Technology, Dr. William D. Phillips at (202)456-7740 or Dr. Huber, who is acting Executive Director of the National Critical Materials Council, at (202)395-7200.

Sincerely,

D. Allan Bromley
Director

Dr. Michael L. Knotek
Deputy Director
Battelle
Pacific Northwest Laboratories
Battelle Boulevard
P.O. Box 999
Richland, WA 99352

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9120714

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FROM: APPLETON, Bill: OAK RIDGE NATIONAL LABORATORY

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 03/07/91

SUBJECT: A THANK YOU FOR PRESENTING THE KEYNOTE ADDRESS TO THE SSSC FORUM.

****

ASSIGNED TO:

ACTION REQUIRED:

****

SENDER'S DUE DATE: OSTP DUE DATE:

DATE COMPLETED:

****

COPIES TO: D. Allan Bromley
Steve Olson
Dr. Phillips

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

REMARKS:

DATE RECEIVED: 03/11/91 FILE: THANK YOU

OAK RIDGE NATIONAL LABORATORY
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FOR THE U. S. DEPARTMENT OF ENERGY

BILL R. APPLETON
ASSOCIATE DIRECTOR
FOR PHYSICAL SCIENCES AND ADVANCED MATERIALS

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March 7, 199

Dr. D. Allan Bromley
Assistant to the President for
Science and Technology
1600 Pennsylvania Avenue
Washington, D.C. 20500

Dear Allan:

On behalf of the Solid State Sciences Committee (SSSC) of the National Research
please accept our thanks for presenting the keynote address to the SSSC Forum.

Your endorsement of the regional meetings on materials science and engineering (M
and the encouragement given at the forum to the resulting report *A National Agenda in Materials Science and Engineering* have been a strong beneficial catalysts in unifying the field of MS&E. This unity has led to a new high level of cooperation among the industry, university, and government laboratories involved in this field. This was exemplified by the entire regional meeting process as well as the joint sponsorship by eight major materials societies of the Washington Materials Forum, which was organized this year in conjunction with the SSSC Forum.

I am convinced that this new spirit of cooperation alone will result in a much more effective leveraging of our national resources in MS&E and a resulting improvement in our competitive posture. If in addition, as recommended in the national agenda report, we can establish a strategic, goal-oriented planning process in MS&E and focus incremental funds onto problems of national significance, I think we have the opportunity to institutionalize a lasting improvement in the way we do materials R&D in the future. Thank you again for supporting our efforts in MS&E and for your presentation to the SSSC Forum.

Sincerely,

Bill R. Appleton

Bill Appleton
Chairman, SSSC

BRA:dmw

cc: D. C. Shapero
File–RC