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BROOKHAVEN NATIONAL LABORATORY

TECHNOLOGY TRANSFER REPORT,

FISCAL YEAR 1986

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TECHNOLOGY TRANSFER ANNUAL REPORT - FY 1986

DIRECTOR'S OVERVIEW

In FY 1986, the Office of Research and Technology Applications (ORTA) effort was intensified. The level of scientific staff devoted directly to technology transfer was doubled. In addition to continuing the ongoing ORTA activities and maintaining our endeavors to launch an incubator facility, the ORTA has initiated two totally new activities.

One of these is directed to a transfer of accelerator technology to the semiconductor industry. The ORTA recognized that both the Germans and the Japanese had created government supported, industry/laboratory consortia aimed at developing the production technology necessary for manufacturing high-density integrated circuits in the 1990's. If the U.S. is to compete in this market, synchrotron technology, derived from three decades of DOE accelerator programs and resident at DOE laboratories, must be integrated with several other industrial technologies. In March, industry representatives attended a workshop sponsored by the NSLS and the ORTA to determine if a window of opportunity is still open vis a vis the Germans and the Japanese. The consensus of the workshop was that their lead is not insurmountable. In August, a second industry/Laboratory workshop was sponsored by the NSLS and the ORTA at which strawman designs were presented and reviewed. This workshop recommended:

- . Establish a plan to build a prototype synchrotron as a source for a manufacturing x-ray lithography system.
- . Establish a parallel R&D plan to resolve critical technologies.
- . Distribute a small number of improved sources throughout the country.

I have asked our staff to play a leading role in making Brookhaven a center for the transfer of accelerator technology for an x-ray source that will provide sub-0.5 micron resolution for integrated circuit manufacturing.

The second new ORTA initiative is directed to public utilities in the Northeast. During the past year interactions with the public utilities was expanded. For example, the Empire State Electric Energy Research Corporation (ESEERCO) held three

(Director's Overview con't.)

technical committee meetings here at BNL in order to facilitate interactions with BNL staff on technical subject matter of interest to New York State utilities. These companies have long realized that unique capability and facilities exist at BNL and that spinoffs from many of the DOE and NRC supported programs are of direct or indirect value. Encouragement of technology transfer from Federal Laboratories to industry is now affording utilities an opportunity to access these capabilities. In keeping with technology transfer legislation passed by the 99th Congress, we are exploiting this concurrence of utility needs and our capability. The first step in a regional initiative will be a Regional Utility Seminar planned for the first week in November, 1986. In order to more effectively develop this initiative, we have established a Utility Advisory Committee. This committee is composed of high level research managers and planners from utilities in the Northeast. In general, we are pleased and flattered by the response of the utility industry, which may prove to be a model for future initiatives with other regional industries.

In general, I am pleased with the acceptance of our technology transfer programs by industry. We feel these programs are building a bridge between research at the fundamental level and the practical needs of industry. I will continue to encourage increased participation by BNL scientific and professional staff in technology transfer. This should be reinforced by the incentive provisions of the new legislation.

N. P. Samios

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Director

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A. ACCOMPLISHMENTS

1.0 Overview

Fiscal Year 1986 has been marked by a substantial increase in the activities of the Office and Research and Technology Applications. The staff has been doubled and this has resulted in a more than proportional increase in technology transfer activities. Most of the additional effort has been directed to the regional electric utility initiative, but intensive efforts have been applied to the commercialization of a compact synchrotron storage ring for x-ray lithography applications.

Other important technology transfer accomplishments have transpired. At least six laboratory technologies have been or are in the process of being transferred. Laboratory accelerator technology is being applied to study radiation effects and Laboratory reactor technology is being applied for designing space reactors for the Department of Defense. Representatives of three private sector concerns are resident at BNL and are working with our staff to commercialize specific BNL developed technologies. Like last year, Laboratory project managers have continued to be involved in DOE technology transfer activities sponsored by the DOE Solar and Renewable, Conservation, Geothermal Energy and Electric Energy Systems programs.

2.0 Technologies Transferred

2.1 Polylite - A new product, polylite, is being produced and marketed by the Reactive Polymer Division of Reichhold Chemicals, Inc. Four different formulations are marketed, tailored to particular user requirements. The following quotation is from the manufacturer's sales literature:

"...Reichhold's PolyLite resins in polymer concrete overlays offer low permeability to corrosive sub-

(Accomplishments Cont'd.)

stances, high skid-resistance and excellent bonding to the concrete substrate. Equally important, polymer concrete overlays with Reichhold's PolyLite resins, can be applied in stages during off-peak traffic periods to minimize motorist inconvenience and traffic-control cost."

2.2 Quazite - Formation of this Houston company was reported in the FY 1983 report. They claim to be the largest U.S. manufacturer of polymer materials with annual sales of \$40 to \$50 million for concrete in precast structural pieces, including sinks, bathtubs, electrical utility boxes and manhole covers. Other producers include PC Construction Company and AR Lite Co. both of Detroit and Aco-Drain Co. of Cleveland.

2.3 Hybrid Triple Preamplifier - The REL Labs Model RL-789 hybrid preamplifier is a marked improvement over their model RL-721 single hybrid preamplifier that won a 1985 IR-100 award. The new hybrid preamplifier embodies three separate preamplifiers in one hybrid assembly, about the same size as the earlier version, and it exhibits superior performance. The new type hybrid triple preamplifier (HTP) has won a 1986 IR-100 award. Its list price is \$65.10.

The HTP has been specially developed for use with silicon position sensitive detectors that are critical for high energy physics experiments. The HTP is used to amplify small amounts of charge produced by the interaction of radiation in the detector and must exhibit extremely low noise to achieve the required sensitivity. The input elements of the HTP are optimized to produce the low noise capability. The HTP is marketed by REL Labs for \$65.10 in small quantities which allows experimenters to consider using many such devices in their experiments.

(Accomplishments Cont'd.)

3.0 Emerging Technologies

Previous annual reports have not included technologies that are in the early stage of development but look promising. Since the Laboratory publishes those of its findings that are not done under proprietary research agreements, and the mechanism for exclusive licenses is exercised in a relatively limited number of instances, most of these technologies are implemented without the need for further direct Laboratory participation. Several nascent technologies that are likely to proceed along this path toward commercialization are described.

3.1 Photon Activation Therapy - Phase I clinical trials at Ohio State University have been initiated in collaboration with BNL scientists involving the administration of ^{145}Sm to human patients. This technology is directed to curing the lethal brain tumor glioblastoma multiform, as well as other forms of cancer. The drug is produced by irradiating Samarium (Sm), which is in short supply, in the High Flux Beam Reactor and producing Sm seeds. A number of drug companies have shown interest in producing the Sm seeds once the clinical effectiveness has been satisfactorily demonstrated.

3.2 In-Situ Cleaning of Vacuum System Surfaces - This invention has a narrow market but is of great value within specialized applications. The inventor cleaned four years of accumulated monochromatic C contamination in a weekend. Previously the beam line would have had to be disassembled, the monochromator cleaned and the line reassembled. This traditional process disables the beam line for several weeks. The new cleaning process is performed in-situ, requiring only a small piece of equipment constructed from off the shelf hardware. Part

(Accomplishments Cont'd.)

of the trick of making it work under operating conditions is to achieve the proper operating parameters.

This product is almost certain to be commercialized. Many hardware designers may be able to reproduce the equipment and with sufficient experimentation may yield the proper operating parameters. However, if the Laboratory had the power to license this process, an improved design could be generated under license and the inventor's knowledge of proper implementation would provide a considerable competitive edge to the licensee. Obviously getting a better product to market sooner is of economic value and accelerates market acceptance and growth.

3.3 Public Domain Spinoff - The Injury Prevention and Analysis Group at BNL is undertaking a path-breaking epidemiological study on occupational injuries for DOE. They are collecting, storing and analyzing injury data for all DOE facilities based on a probability sample of all reported injury cases. This has not been done for any collection of different facilities across geographical locations and occupational and industrial classifications using uniform standard definitions for the nature, cause, type and severity of injuries.

Important as the study is in its own right, a significant spinoff has been the development of the capability to store, manage and analyze massive quantities of data in personal computers. The methods and techniques developed for data storage and analysis are, in effect, a new technology. This technological advance permits the use of decentralized personal computers instead of large centralized data processing systems in large data systems with complex processing. These techniques make it possible to maintain and process large data bases without

(Accomplishments Cont'd.)

the dependence and inconvenience of centralized mainframe computers. Widespread application of the techniques should result in increased productivity and decreased costs.

This spinoff technology is in the process of being transferred to community, public, private and veterans' hospitals in the bi-county Long Island area. The published results of this application will be in the public domain and will demonstrate the availability of the method and techniques. The result of this transfer will be that many users will be able to manage large data bases and perform lower cost analyses, without dependence upon an external central processor.

3.4 Spinoff Technologies - Facility Energy Services of Parsippany, NJ offers boiler selection procedures to reduce fuel use by central boiler plants. The procedure collects process boiler operating data including part-load performance of each boiler as a function of outside temperature. It then combines these data with fuel use records and weather data to determine the overall plant efficiency in terms of MMBtu per degree-day. A microcomputer is used to model the boiler or boiler combination that is most efficient for each outside temperature. These data, that are not normally available to operators, permits them to continually choose the most efficient boilers as load varies. Boiler optimization studies have been performed for several plants and fuel savings range from 9 to 15 percent. This procedure arose from work supported by DOE at BNL in the mid-1970s on optimization of small residential boilers. The transfer was effectuated by the employment of a BNL participant in the program by Facility Energy Services.

(Accomplishments Cont'd.)

4.0 Collaborative Research

4.1 Sodium Iodide Crystal Processing - This program was initiated as part of the Laboratory Technology Exchange Program. A prototype has been built and tested and it works. A piece of equipment is now being built that will be used for scanning the crystals. Sometime in the Fall the device will be ready to use in a production environment.

4.2 Medical Imaging Device - This activity is one of the projects funded by the Laboratory Technology Exchange Program. During FY 1986 the initial performance of the system was tested. Initial tests did not appear promising but improved performance was obtained by replacing large scintillators with thinner ones. Available collimators, developed for other purposes, have been used but are sub optimum in performance. The next step in the project is to acquire and test a fiber optic minifier that should permit the design and use of better collimators. The validity of the approach should be established within the next six months.

4.3 Dike for Liquified Natural Gas - An insulating polymer concrete formulation has been created for Brooklyn Union Gas to use as a containment device for liquified natural gas storage. The formulation is now the property of Brooklyn Union Gas. They intend to market it to other users who need such a material.

4.4 Environmental Risk Assessment - This transfer activity is quite unusual. It consists of a combination of technologies available in two Brookhaven organizations that an industrial concern has found useful in their facility planning process. The Probability Risk Assessment (PRA) techniques developed for the Nuclear Regulatory Commission have been used in combination with the risk assessment techniques developed for DOE's Office of

(Accomplishments Cont'd.)

Conservation and Renewable Energy to assist the Atlantic Richfield Corporation in designing a new photovoltaic manufacturing facility. The work is being performed in collaboration with ARCO's environmental personnel at BNL. The potential for this approach both in designing plants and facilities and for satisfying regulatory authorities that the plant designs meet occupational health and environmental concerns is significant.

4.5 Electric Energy Transmission - The Laboratory has provided guest appointments to two staff members of Underground Systems Incorporated, an electric utility consulting firm. The purpose of these appointments is to provide a mechanism for transfer of some of the technology developed by BNL's superconducting transmission program. The two innovative aspects, (forced cooling and insulation) that will be addressed by Underground Systems have not been implemented in commercial installations. Utilities do not have a history of experience in their use and are reluctant to commit themselves to a system with which they lack familiarity born of practice. Underground Systems is strategically positioned to credibly introduce these innovations in a way that will increase industry's understanding of the system and the comfort factor associated with installation and operation. The experience and reputation of Underground Systems will provide assurance to the user community that the system is reliable and can be maintained in a way that will sustain a satisfactory service lifetime.

5.0 Success Story

In 1978 a Brookhaven spinoff, International Resources Group (IRG) was formed. IRG incorporated the following year and has been expanding ever since. Its sales increased from \$472,000 in

(Accomplishments Cont'd.)

1980 to \$3,145,000 in 1984, an increase of 566 percent, over 60 percent annually compounded. This growth rate was sufficient for Inc Magazine, in its December, 1985 issue, to identify IRG as one of America's 500 fastest growing companies. IRG is a stock company with the stock held by the President, the Chairman, two venture capital groups and its employees.

IRG is an international consulting firm primarily engaged in energy analysis but also in the areas of agroforestry, agriculture and health planning. In addition to the Main office in East Setauket, NY, it has offices in New York City, Washington, D.C., London, Nairobi (Kenya), Abidjan (Ivory Coast), and Khartoum (Sudan).

6.0 ORTA Initiatives

This year the ORTA started two new initiatives. One of these is to identify possible transfers to regional utilities. The second is to assure that x-ray synchrotron technology will be available to American industry if they choose to enter into the gigabit integrated circuit manufacturing competition in the 1990's. The ORTA continued its efforts to bring a mini-incubator into being on the Laboratory site and made a special effort to alert Laboratory staff of the SBIR competitions and awards.

6.1 Northeast Electric Utility Initiative - This initiative grew out of discussions with the Consolidated Edison Company and the Public Service Company of New Jersey in the Fall of 1985. The utility staff recognized capabilities were resident at Brookhaven that did not exist on their own staffs and were not available from the private sector on an independent, convenient, and timely basis and at a reasonable charge. A proposal has been

(Accomplishments Cont'd.)

prepared to establish an Office of Utility Research and Industrial Support (OURIS), associated with the ORTA, that would specifically address the transfer of Laboratory developed technology and make available unique capabilities to electric utility and associated industrial beneficiaries. The proposal describing the basis for and functions of the OURIS is included in Appendix A.

Encouraged by the initial interactions between ORTA staff and utility personnel, utility interest has continued to grow and numerous technical areas of interest have been identified. Means have been established with the Empire State Electric Energy Research Corporation (ESEERCO, a collection of eight New York State utilities), Consolidated Edison of N.Y. and the Public Service Electric and Gas Company of New Jersey for quick response by BNL staff to problems faced by the utilities. Such interactions will be expanded to other utilities in the Northeast region.

Because of the growth of technical involvement with the utility industry, the BNL Directorate feels that advice, guidance and technical direction for these initiatives should be shared with high levels within the utility managements. Toward this end, a Utility Advisory Committee has been established and supported by the research managements of six eastern utilities and a consortium of New York State utilities. This Utility Advisory Committee will meet regularly and advise the BNL Directorate and the ORTA on matters concerning interactions with the utility industry.

6.1.1 Specific BNL Utility Technical Interactions - BNL's Office of Research and Technology Applications (ORTA) has

(Accomplishments Cont'd.)

established an Office of Utility Research and Industrial Support (OURIS) for the express purpose of more effective technology transfer to the utility industry. A management plan for the overall effort is given in Appendix A. In this regard, ORTA staff have been involved in a number of arrangements with individual utility companies in which unique facilities or capability resident at BNL are made available to utility R&D staffs. Additional arrangements have also resulted from actions by BNL staff. Examples of some such interactions encouraged by the OURIS follow:

RECENT UTILITY TECHNICAL INTERACTIONS

1. Technical assistance in coal characterization and combustion.
2. Coal ash correlations and development of predictive models.
3. Microbial digestion of coal tar waste.
4. A new concept for direct current storage and distribution.
5. Design of a drop tube furnace for coal characterization.
6. Nuclear reactor pump seals: Failure analysis.
7. Gas turbine longevity study.
8. Fluorocarbon leak detection: Application to oil-filled transmission lines.
9. "O" ring failure analysis.
10. Nuclear safety analysis.
11. Nuclear accident simulation.
12. Synthetic tape power cables.
13. Quick response by BNL technical staff.
14. Discussion on materials problems and related BNL capability.
15. PRA technology transfer/training.
16. Field test of condensing heat exchange systems.
17. Environmental chemistry/sampling.

6.1.2 Specific BNL Utility Staff Interactions - A Regional Utility Seminar will be held at BNL on November 5-6, 1986. Approximately seventy-five utility companies have been invited to participate.

(Accomplishments Cont'd.)

Over the past year, several utilities have participated in meetings sponsored by the ORTA. A list of these companies follows. This list does not include BNL interactions with the Electric Power Research Institute (EPRI) and the Gas Research Institute (GRI) where various projects have been underway for several years.

UTILITY COMPANIES INTERACTING WITH BNL

Bonneville Power Administration
Brooklyn Union Gas Company
Consolidated Edison of N.Y.
Empire State Electric Energy Research Corporation
Florida Power & Light Company
Jersey Central Power & Light Company
Long Island Lighting Company
New York Gas Group
New York Power Authority
Niagara Mohawk Power Corporation
North East Utilities
Philadelphia Electric Company
Public Service Electric and Gas of N.J.
Toledo Edison Company

The list of meeting dates presented below provide some notion about the level of interaction between the ORTA and utility companies. It does not include meetings by individual BNL staff acting independently of the ORTA.

LIST OF SOME KEY UTILITY MEETING DATES

Mar 12, 1985 - Initial meeting with Con Edison R&D staff to lay groundwork for summer meeting with ESEERCO Fossil Committee.

Apr 2, 1985 - Meeting with PSE&G R&D staff concerning interest in coal utilization.

(Accomplishments Cont'd.)

- Apr 12, 1985 - Meeting with B&R R&D staff to discuss possible efforts relating to utility plant longevity.
- May 13, 1985 - Meeting with B&R staff concerning joint utility interactions.
- May 22, 1985 - Follow-up meeting with R&D staff of B&R.
- Jun 28, 1985 - Meeting with Con Edison R&D staff regarding ESEERCO Fossil Committee meeting to be held at BNL.
- Aug 15, 1985 - Visit to ESEERCO in NY to meet with staff.
- Sep 19, 1985 - Meeting with ESEERCO Fossil Committee at BNL and presentations by BNL staff.
- Oct 29, 1985 - Meeting with PSE&G staff at BNL on stress corrosion cracking problems at company power plants.
- Oct 31, 1985 - Meeting with Con Edison staff and BNL staff on problems of utility plant longevity.
- Dec 16, 1985 - Meeting at PASNY concerning BNL programs relevant to utility needs and problems.
- Feb 13, 1986 - Meeting at Con Edison to discuss gas turbine longevity program and BNL capability to lend support.
- Apr 7, 1986 - Meeting between BNL and PSE&G staffs in Newark concerning coal characterization.
- Apr 15, 1986 - Meeting with Jersey Central Power & Light (JCPL) staffs at BNL and BNL staff presentations.
- Apr 25, 1986 - Meeting between BNL staff and ConEdison staff in New York City to discuss gas turbine longevity program and prospective BNL role.
- May 12, 1986 - First meeting of the BNL Utility Advisory Committee.
- May 28, 1986 - Meeting with Con Edison in New York City on gas turbine longevity efforts.

(Accomplishments Cont'd.)

- Jun 17, 1986 - Meeting with chairman and staff person of the ESEERCO Conservation Task Force and review of BNL programs by BNL staff as initial screening meeting for full task force meeting in September.
- Jun 18, 1986 - Meeting between BNL and PSE&G staffs on direct current energy storage and initiation of proposed joint efforts.
- Jun 26, 1986 - BNL staff attended Conference at New York State Power Pool Office on reliability of New York State electric grid, a proposed project.
- Jul 8, 1986 - Meeting of ESEERCO Electric Energy Systems and Equipment Committee and presentations by BNL staff.
- Jul 9, 1986 - Meeting with PSE&G staff and BNL staff at BNL concerning nuclear plant longevity.
- Jul 10, 1986 - Meeting between BNL staff and JCPL in Morristown offices on materials problems faced by the utility.
- Jul 28, 1986 - Meeting at ESEERCO offices in New York City with Utility Organizing Committee concerning plans for November 5-6, 1986 Regional Utility Seminar to be held at BNL.
- Sep 10, 1986 - Planning meeting at ESEERCO for Regional Utility Seminar at BNL.
- Sep 29, 1986 - Briefing of PASNY Vice President for R&D on BNL utility related programs at BNL.

6.2 Compact Synchrotron Light Source Initiative - This initiative is directed to transferring a small synchrotron x-ray ring to the industrial sector to be used as the radiation source for the manufacture of multi-megabit to gigabit chips in the 1990's. This section presents a brief chronology of the acti-

(Accomplishments Cont'd.)

vity. This effort is indebted to Mr. Norman Kreisman of the Office of Laboratory Management in the Office of Energy Research for his steadfast and encouraging support and assistance.

In the Summer and Fall of 1985, several semiconductor companies were approached and asked if they had interest in synchrotron radiation as a radiation source for x-ray lithography. It was pointed out to them that IBM had an experimental beam line at the National Synchrotron Light Source and that they were also welcome to perform experiments at the NSLS. Their answer was yes, they had some interest, but because of financial difficulties could not afford to do it at this time. As it turned out we asked the wrong question. We should have asked them if they would be customers for a production facility based upon a synchrotron x-ray source and as we discovered at our March workshop the answer would have been yes.

In December 1985, internal problems on the German sponsored effort (government support of a consortium composed of a government laboratory, semiconductor equipment vendors and semiconductor manufacturers), indicated that despite almost three years of effort, it did not appear that they held a lead in synchrotron technology. We talked with Oxford Superconducting Corporation about the possibility of their initiating a U.S. effort relying on the synchrotron technology base that existed at the Laboratory.

About the same time the massiveness of the Japanese MITI sponsored program became evident and it was clear that if the U.S. was going to play a role in the high density chip business in the mid-1990's, action had to be taken immediately - perhaps we were already too late.

(Accomplishments Cont'd.)

This led the ORTA and the National Synchrotron Light Source (NSLS) to invite a broad spectrum of American semiconductor equipment manufacturers and semiconductor producers to a workshop at Brookhaven in March 1986. The primary purpose for this workshop was to make U.S. industry aware of the accelerator technology base that existed at Brookhaven and other DOE Laboratories, as well as to inform them that it was ready and available for transfer for commercial applications. A collateral objective was to raise the question, "If industry takes advantage of this technology base can we overcome the lead of our foreign competitors?" The conclusions were:

1. Successful (technical and timely) development is possible, if there is cooperation within the semiconductor industry and between industry and national laboratories.
2. A commitment by Government is required to initiate and facilitate this cooperation, coupled with a long-term industry commitment for the related R&D in production processes.
3. A plan of action that clearly defines the respective roles of government and industry is required.

Semiconductor equipment manufacturers were invited to a meeting at Brookhaven in May. At this meeting it was agreed that BNL would prepare two straw man designs for a July (later changed to August) meeting.

The theme of the August meeting is reflected in the remarks made to those assembled by Dr. Bruce Merrifield, Assistant Secretary of Commerce for Productivity, Technology and Innovation. Dr. Merrifield said that financial and national security are the stakes in the international race for supremacy in the high density semiconductor industry. He pointed out that to stay ahead of the competition, notably from Japan and West Germany, the U.S. must remove anti-trust barriers so as not to hinder

(Accomplishments Cont'd.)

cooperative ventures among equipment manufacturers and chip producers. Dr. Merifield pledged to lead the fight within government to protect those entering into cooperative ventures.

The workshop, held on August 25-27 at BNL, brought together over seventy people representing 23 semiconductor equipment manufacturing companies, 11 semiconductor manufacturers and users and 5 national laboratories. Their joint task was to review three straw man designs for x-ray synchrotron accelerators. Synchrotron accelerators are now recognized as the most promising source for manufacturing the next generation of low-cost, high-density chips. Two designs were prepared by Brookhaven's National Synchrotron Light Source, the third by the Brobeck Corporation. The agreed upon design parameters that emerged from this workshop will be used to generate rough costs, schedules and critical resources that will be required to build a prototype. Such a prototype is needed before industry will have the necessary information to build a synchrotron factory. However, before the prototype effort can be launched a substantial financial commitment will have to be made by industry and/or government.

R&D costs for the synchrotron R&D and its portion of the capital cost of a production facility is only about one-sixth of the total. Six other technologies, each of which is characterized by greater R&D risk than the synchrotron must be integrated to make it all work. Already the Japanese and the Germans have assembled teams of equipment manufacturers, producers and national laboratory people and given them government support to acquire the technology.

Ideally, U.S. industry would take the technology developed by DOE and carry out the program itself. Unfortunately, even if

(Accomplishments Cont'd.)

industry could set up the cooperative arrangements that would be needed, it does not have the funds to support the development engineering. Most of the players in this industry have been showing negative earnings for the past few quarters. Even if industry had the financial resources, the nature of the American industrial structure - the culture of competition and anti-trust - precludes this kind of voluntary consortium.

Another option is to select a prime contractor who would carry out the integration by managing a large number of sub-contractors. This is the way much defense procurement takes place and might be a path for x-ray lithography, particularly if funded by the Department of Defense. A danger is that this approach while succeeding in providing the technology may not be sensitive to costs, and the U.S. will not be competitive on the multi-billion dollar, international, semiconductor market.

Is there another route to government involvement that would not corrupt the decision process and cost consciousness of a free enterprise effort? If we find such a model and it proves workable, we will have made a major breakthrough in maintaining American entrants in the international high technology sweepstakes.

The recommendations of the workshop were as follows:

Premise

1. There are several technologies necessary to establish a viable X-ray lithography capability to manufacture 0.25 micron IC (integrated circuit) devices.
2. Industry can develop all but one of these critical technologies. The one technology that would be difficult for industry to develop is the synchrotron X-ray source which can be an integral part of a manufacturing X-ray lithography system.

(Accomplishments Cont'd.)

It is the desire of industry to implement a program based on this premise:

1. Establish a plan to build, at the earliest possible date, a cost competitive synchrotron which can be the source for a manufacturing X-ray lithography system. The machine should be located within an IC Processing Center so that the associated process technologies required for manufacturing can be developed.
2. Establish a parallel research and development plan on critical technologies which can improve the cost effectiveness of the synchrotron source. These include:
 - a. superconducting magnets
 - b. low energy injection options.
3. Distribute a small number of second generation prototype synchrotron sources to other IC manufacturing centers to expedite the commercialization of the synchrotron sources as well as the other processing technologies.

Plans are being formulated by the ORTA and the NSLS for a workshop to generate costs and schedules. Concurrently, the ORTA is working with Laboratory management, interested semiconductor equipment manufacturers and government agencies to identify an effective means of continuing the effort that has been launched.

The following semiconductor manufacturers have visited BNL in connection with the Compact Synchrotron. Most have attended both workshops.

AT&T Bell Laboratories
Texas Instruments
National Semiconductor

IBM
Hewlett Packard
Intel Corporation

The following equipment manufacturers have participated in either or both workshops. Some of these also produce and/or use integrated circuits.

3M Corporation
Baker Manufacturing
McDonnell Douglas

Oxford Superconducting
Martin Marietta Aerospace
Micronix

(Accomplishments Cont'd.)

Varian Associates
Perkin Elmer
Intermagetics General
General Dynamics
Grumman Electronic Systems

Comark Communications
Brobeck Corporation
Horizon Technology
Westinghouse
Spire Corporation

Accelerator Laboratories who have participated include:

Fermi Laboratory
Stanford Synchrotron
Radiation Laboratory

Lawrence Berkeley Laboratory
Cornell
Univ. of Wisconsin

Four Minneapolis based integrated circuit users, Digital Equipment Corp., Control Data Corp., CRAY and Minneapolis Honeywell were represented by University of Minnesota faculty.

6.3 Incubator Facility - The BNL incubator that has appeared in the FY1985 and FY1986 Institutional Plans has moved a step closer to commencing operation. The Plan for this facility and the proposed prototype license agreement between the user and Associated Universities Incorporated appears as Appendixes B and C.

The Medical Department has made space available for a small incubator that will house at least two, perhaps three, start-ups. This space comprises the large animal building which is located behind the Medical Building. It is a separate building, has its own parking lot, and can be independently locked by the users. It should be possible to partition the building so that each user has privately secured areas.

The facility can be activated as soon as the proper approvals are received. Over the past year we have had three prospective users. At the present time we have one prospective user.

(Accomplishments Cont'd.)

6.4 Small Business Innovation Research - In FY 1985, the ORTA acquainted a selected set of innovative Laboratory Staff with the availability and requirements of the Small Business Innovative Research (SBIR) Program and New York State programs that supplement the SBIR. The staff brought the SBIR to the attention of seven potential applicants that were assisted by the ORTA. As a result the decision was made in FY 1986, to acquaint all of the scientific and professional staff with the program. This has elicited inquiries from over twenty staff persons, some with respect to themselves, others for non-laboratory individuals.

6.5. Awards - Two IR-100 awards were awarded to Laboratory staff in FY 1986. One of these was for the Hybrid Triple Amplifier discussed in section 2.3 and the second for the improved red blood cell kit discussed in the FY 1985 annual report.

Two Laboratory staff members were recognized as Engineers of the Year by the Long Island Chapters of the National Engineering Associations. These awards were made in connection with National Engineers Week and was the second year in succession that the Laboratory was so honored.

One Laboratory Staff member received an award from the Federal Laboratory Consortium for his contribution to technology transfer during the past year. This is the second year that the Laboratory has received such an award.

Two Brookhaven scientists were honored by the National Society of Professional Engineers. The Design D Dipole Magnet designed by Brookhaven in collaboration with Lawrence Berkeley and Fermi Laboratories was selected as one of the ten outstanding

(Accomplishments Cont'd.)

engineering achievements of 1985. This design was selected for further research and development for the proposed Superconducting Super Collider (SSC). If built, the SSC will be the largest and highest energy accelerator in the world, thus providing further insight into particle physics. Within the SSC, the Brookhaven/Berkeley/Fermilab dipole magnet would bend protons as they whiz around the accelerator close to the speed of light.

6.6 Other ORTA Activities - The ORTA has been an active participant in the Federal Laboratory Consortium. The Head of the ORTA serves as the Northeast Regional Coordinator for the FLC. In this capacity, he also is a member of the ORTA Executive Committee. This year in particular, in preparation for the expanded role for the FLC incorporated in new legislation this has been a significant function.

Within the FLC the ORTA has been instrumental in setting up and serving on the industry interaction special interest group. The ORTA has also accepted the responsibility for acting upon Region 1 requests associated with an experimental; program that has been initiated between region 6 and the NASA Technical Information Centers.

The ORTA has represented the Laboratory at The Long Island Forum for Technology (LIFT). Presentations have been made to LIFT and to a Connecticut small business R&D symposium held at Yale. The invitation was proffered by the Director of Science Park, a successful incubator in New Haven, Connecticut. Two visits have been made to Science Park and a presentation was made to the Spring meeting of the FLC by Science Park on their experiences in interacting with a Federal Laboratory. At the request of the Library of Congress the ORTA presented a paper to

(Accomplishments Cont'd.)

an Engineering Conference on Technology Applications. A presentation was made to the Director of the FAA Center at Atlantic City, NJ and Congressman Morse, the Congressman from that district about the incubator concept. The ORTA has been active in assisting the ORTA at the FAA Center with the Southern New Jersey Technology Consortium that will incorporate an incubator facility for that region.

The ORTA was a co-sponsor with the Science Museum of Long Island in the second Conference on Science and Technology "Sci-Tech 1986". The ORTA will continue its sponsorship each year. The theme of the 1986 conference was technology transfer and three BNL staff gave presentations. The two day conference held on a Friday at the Museum and on Saturday at BNL was attended by sixty-three high school science teachers who received an education credit for attending.

7.0 Other Laboratory

7.1 Reimbursed Industrial Work - BNL enters into various arrangements with nongovernmental sponsors. The most common are industrial contracts at the laboratory for fully funded research. These sometimes involve work performed exclusively by BNL staff at BNL and in other cases industry participation may consist of work done at their own facilities or by supplying staff to BNL. In 1986, BNL entered into 27 agreements with 16 private sector entities totalling over two million dollars. Table 1 shows the steady growth of this type of activity since Departmental implementation of the Stevenson-Wydler Act.

7.2 Program Activities - Technology transfer activities are central to most technical programs and are more extensive than

(Accomplishments Cont'd.)

TABLE 1
Non-Government Funded Work for Others

<u>YEAR</u>	<u>FULLY FUNDED RESEARCH</u>	
	<u>NUMBER</u>	<u>THOUSAND DOLLARS</u>
1982	6	1,171
1983	9	2,453
1984	14	2,431
1985	9	3,000
1986	16	2,200

those of the ORTA. Many of these applied programs have as their goal expanding scientific knowledge and expanding the technology base in specific areas that may be useful for exploitation by the private sector. Other applied programs are directed to environmental concerns so that the private sector may have the technology base to manufacture and utilize new products, processes and services in an environmentally acceptable manner. Laboratory environmental programs are directed to attaining satisfactory workplace environments for implementing new industrial materials, processes and products, for disposing of waste and for the eventual disposal or recycle of manufactured items. Research directed to these goals leads to new technologies for maintaining a satisfactory environment. BNL's Advanced Technology Applications Division assist the DOE Division of Electric Energy in transferring the product of their programs. Similarly BNL program staff assist DOE's Office of Solar Heat Technologies, Geothermal and Hydropower Technology Division, and Office of Energy Storage and Distribution in their transfer activities.

Of special note was a visit by sixteen Japanese scientists and engineers on a visit sponsored by the Technology Transfer Institute, a Japanese technology transfer organization with

(Accomplishments Cont'd.)

offices in many of the world's major cities including Los Angeles and New York. The subject of their visit was nuclear technology, especially waste disposal, and it was called a mission on "nuclear renaissance". The Department of Nuclear Energy acted as hosts to the Japanese visitors. Nuclear safety also was a major topic of discussion since the visit occurred after the Chernobyl nuclear incident.

7.3 Visitors, Meetings and Publications - All Brookhaven researchers, whether engaged in applied or basic research activities, publish the results of their work, attend professional meetings, symposia and workshops, and are involved in scientific collaborations. Last year the Laboratory processed about 1700 papers, 589 journal articles, 475 abstracts, 363 conference papers, 40 books or contributions to books, 130 informal reports, and 109 formal ones. The Laboratory hosted more than 220 symposia and workshops attended by at least 8600 participants. Since small meetings magnify the communications among participants, it is significant that 151 of these meetings had thirty or fewer attendees. DOE policies that encourage BNL's staff attendance at scientific meetings, not only increases the general access to knowledge, but enhances and promotes the technology transfer process.

The program activities of the Laboratory contribute to technology transfer through their guest scientist and collaborator programs. Large numbers of scientists spend extended periods of time at the Laboratory working in their host Departments with selected staff. These visitors exceeded 2000 during fiscal year 1986. The DOE Laboratory/Industry Visitor Exchange Program that will be initiated in FY 1987 will greatly assist the BNL ORTA in making arrangements for industrial visitors who may

(Accomplishments Cont'd.)

transfer technology to their parent organizations. The ORTA believes that if the program is extended to encourage industrial visitors engaged in planning, their increased familiarity with the Laboratory would lead to increased transfer. This suggestion is based upon the notion that technology transfer comes about primarily because of demand pull, that is it is the individual who has a problem and seeks a solution who initiates the transfer. To make this connection, such individuals must come from industry and be exposed to the Laboratory capabilities.

The enormous amount of interaction between Laboratory scientists and their peers is depicted in Tables 2 through 5. When it is realized that information transfer is a two way street, the role of the Laboratory in capturing information useful to the Agency's mission is clear from these data. The numbers in the tables may be somewhat overstated since there are undoubtedly some individuals who appear in more than one category. In addition research collaborators, consultants and guest appointments are sometimes carried over from previous years and

TABLE 2
VISITING AND ADVISORY COMMITTEES

DEPARTMENT/PROGRAM	UNIVERSITY	AFFILIATION	
		PRIVATE SECTOR	NON-PROFIT/ GOVERNMENT
Associated Universities	19	2	3
Applied Science	9	3	1
Biology	9	1	3
Chemistry	7		1
High Energy Physics	2	2	2
Medical	5	1	
Nuclear Energy	6		2
TOTAL	57	9	12

(Accomplishments Cont'd.)

TABLE 3
CONSULTING BY BNL STAFF

DEPARTMENT/PROGRAM	UNIVERSITY	AFFILIATION	
		PRIVATE SECTOR	NON-PROFIT/ GOVERNMENT
Accelerator	3		
Applied Mathematics	1		
Applied Science	2	8	
Biology		4	
Chemistry			
Medicine			
NSLS			
Nuclear Energy	1	7	3
Physics	2	3	
Other		6	
TOTAL	<u>9</u>	<u>28</u>	<u>3</u>

TABLE 4
CONSULTING FOR BNL

DEPARTMENT/PROGRAM	UNIVERSITY	AFFILIATION	
		PRIVATE SECTOR	NON-PROFIT/ GOVERNMENT
AGS	3	6	3
Applied Mathematics	3	1	
Applied Science	31	16	2
Biology		2	
Chemistry	1	2	1
Directors Office	20	14	1
Medical	3	16	3
NSLS	5	3	
Nuclear Energy	42	13	7
Physics	11	9	2
Reactor	8	4	
Other	2	8	
TOTAL	<u>129</u>	<u>93</u>	<u>20</u>

(Accomplishments Cont'd.)

TABLE 5
VISITORS WITH APPOINTMENTS

DEPARTMENT	AFFILIATION				GUESTS/ COLLABORATORS
	SUMMER SALARIED	SUMMER STUDENTS	SEMESTER STUDENTS	STUDENT ASSISTANT	
Applied Math	3	1			1
Applied Science	2	11	4	1	79
Biology	3	5		1	115
Chemistry	3	1			103
High Energy Physics	1				288
Instrumentation	3	3			3
Medical	2	12		1	237
NSLS	11	31	2	4	79
NSLS Users					343
Nuclear Energy	6	3			28
Physics	15	9		2	212
Other		11		6	8
TOTAL	<u>49</u>	<u>57</u>	<u>6</u>	<u>15</u>	<u>1496</u>

all those listed may not have actually visited the Laboratory during the past fiscal year.

7.4 Patents and Licensing - Over the past six years, 75 patents have been issued to DOE covering inventions made by Brookhaven scientists and engineers. Five of these were issued in FY 1986. At the moment 28 patent applications filed by BNL on behalf of DOE are pending. The invention disclosure activity and the patent activity of BNL is shown in Table 6.

DOE granted four patent waivers to Associated Universities, Inc. (AUI) during fiscal year 1986. The BNL Patent Office is negotiating licensing arrangements on these four inventions with industrial concerns interested in commercializing these inventions.

(Accomplishments Cont'd.)

TABLE 6
BNL PATENT OFFICE ACTIVITY

<u>FISCAL</u> <u>YEAR</u>	<u>NO. OF RECORDS OF</u> <u>INVENTION RECEIVED</u>	<u>NO. OF PATENT</u> <u>APPLICATIONS FILED</u>	<u>PATENTS</u> <u>ISSUED</u>
1980	37	16	
1981	47	13	10
1982	53	19	13
1983	44	23	9
1984	40	26	18
1985	36	17	20
1986	29	11	5

It is now expected that the AUI/DOE prime contract will be modified by December, 1986 to implement the new patent law, P.L. 98-620. The provisions of the modified prime contract will give AUI the option to take title to all inventions made at Brookhaven from the date of the passage of P.L. 98-620 forward. AUI has already identified ten new inventions that they will retain title to and include in their licensing program.

The BNL Patent Office will continue to file and prosecute patent applications on BNL inventions on behalf of DOE for those BNL origin inventions owned by DOE. In addition, under the amended prime contract, it will perform all patent and licensing functions on behalf of AUI for those inventions to which AUI takes title. The licensing activity will also include negotiations for support of development work on licensed inventions at BNL.

7.5 Educational Programs - BNL conducts an extensive educational program designed to draw upon the scientific quality of the staff and facilities to improve science education and to

(Accomplishments Cont'd.)

increase student appreciation of science as a career. This program includes:

- o Summer Student Program: Summer research appointments for selected juniors and seniors
- o Brookhaven Semester Program: One semester research appointments for selected undergraduates from historically black colleges
- o High School Teachers Course: Graduate level courses for Long Island science and mathematics teachers
- o Health Physics Training Program: Summer experience for health physics graduate students
- o Summer Research Apprenticeships: Summer experience for minority high school students
- o NSLS/HFBR Faculty and Student Support: Support for university people whose sources of research funds are limited
- o Sabbatical Leave: Partial support for college/university faculty on sabbatical leave
- o Summer Research Participation: Research opportunities for high school teachers at BNL and other participating institutions for three consecutive summers
- o Saturday Morning Science: One semester course for advanced high school students in modern physics or chemistry
- o Science Exploration: A series of single Saturday morning sessions for students in grades 7 and 8
- o Elementary School Science Fair: An annual science competition for students in grades K through 6.

Currently under development is a program to make the Laboratory available to student-faculty research teams from

(Accomplishments Cont'd.)

small, undergraduate colleges with historically strong science programs but few research opportunities.

The Secretary of Energy asked the 50 State Governors and the Governor of Puerto Rico and the Mayor of the District of Columbia to select a student who shows promise in chemistry, physics, engineering or biology to attend a two week honors research program at Brookhaven. This group was in residence at the Laboratory during the period July 4 to 15 and performed research on the National Synchrotron Light Source, the worlds brightest source of x-ray and ultraviolet radiation. This program is part of a Department of Energy program designed to support the development of scientific and technical talent in energy-related areas. In his letter of invitation to the Governors, Secretary Herrington noted that, "The department's support for these two summer programs is one way to assure that bright young students receive the best preparation possible for their future careers." This is an outstanding example of inter-generational technology transfer.

Monitoring of personnel records shows that BNL supplies an important educational service that results in a significant low level technology transfer to the local community. During the past year, fourteen members of the Laboratory security forces left. Of these eleven resigned to take law enforcement related jobs. Three took jobs with the Southampton Town Police, and three joined the New York City Police Department, Two joined the Sheriff's Department and one became a juvenile case worker in the New York State Correction System. The remaining two became members of the Suffolk County Police Department. Since almost all of the BNL security force have not had prior law enforcement experience when they are hired, it is clear that the formal and

(Accomplishments Cont'd.)

on-the-job training provided by the Laboratory results in considerable technology transfer to the nearby jurisdictions.

8.0 Quantifying Technology Transfer

It is tempting to attempt to quantify the impact of technology transfer by measures such as the numbers of new companies formed, jobs created, value of product produced, or volume of sales. This type of measurement may be quite misleading. First, many transfers are in the form of improved process technology that results in lower production costs through a reduction in the labor requirements. The direct effects of this type of technology transfer will be to reduce the number of jobs. A second type of transfer is often in the form of a substitute or replacement product of higher quality and lower cost. Although the direct effects on employment may be positive, sales of the product displaced will fall and jobs will be lost. The net effect may be a decrease in employment if those displaced exceed those hired. This may be the outcome if fewer people are required to produce the cheaper new product than the more expensive old one.

The true value of technology transfer is in its contribution to increasing productivity which will permit greater output with the same effort, thereby raising the quality of life. Unfortunately, although productivity increases can be measured, it is impossible to distinguish the contribution of technology transfer from that of other contributing factors. It is probably fairly safe to say that as population increases and the given stock of raw materials becomes even scarcer on a per capita basis, virtually all economic progress (output per person-hour) depends on

(Accomplishments Cont'd.)

technological change which in turn is dependent upon the transfer of new technologies.

B ORTA

1.0 ORTA CONTACT

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Office of Research and Technology Applications
Brookhaven National Laboratory, Building 475
Upton, New York 11973
Telephone (516) 282-2103, FTS 666-2103

2.0 Placement of ORTA Within Laboratory Management Structure

The Head of the Office of Research and Technology Applications (ORTA) reports directly to the Laboratory Associate Director for Applied Programs. The diagram on page 34 depicts a modified organization chart of the Laboratory highlighting the organizational location of the ORTA and depicting the makeup of the Technology Transfer Coordinating Committee - close to the programmatic efforts of the Laboratory. This organizational location provides the ORTA with direct access to the Laboratory Director, Deputy Director and Associate Directors. Direct support for the ORTA is provided by the Laboratory Patent Attorney.

Figure 1 on page 34, depicts the interaction of the ORTA with the research activities of the Laboratory. The Head of the ORTA chairs the Technology Transfer Coordinating Committee. This Committee is composed of one or more senior members from each of the Laboratory's Research Departments and Independent Divisions, the Laboratory Patent Counsel and representatives from Personnel and Public Relations. This Committee assists the ORTA in identifying research areas for applications assessments and for providing guidance and assistance in developing ORTA policies. They also play an important role in this research oriented Laboratory in increasing the awareness of the Scientific Staff of the importance of applications. This highly visible ORTA has

(B. ORTA con't.)

FIGURE 1

Organizational Location of the ORTA
and the Technology Transfer Coordinating Committee

(B. ORTA con't.)

been established by the Laboratory in response to the Stevenson-Wydler legislation and the DOE Order implementing it.

The ORTA will continue to focus on organizational structure and management procedures necessary to effectively implement its P.L. 96-480 mandated duties, especially in technology assessment. We intend to concentrate on the fundamental aspects of the technology transfer process so as to bring to bear the full capabilities of BNL staff, facilities and management to fulfill this important and critical mission for DOE.

3.0 General Description of Technology Transfer Process

The Department Representatives and the Patent Attorney review current Laboratory programs and identify candidates. These are then screened by an internal review panel and application assessments are prepared for selected technologies. These are subjected to evaluation by external reviews and industry contacts. When the recommendations are positive, the process passes to the outreach phase where pertinent information on the "product" is provided to the DOE Technical Information Center for eventual dissemination by the National Technical Information Center. Specific user groups are targeted and information on the "product" provided to these groups and to appropriate technology brokers.

Finally, in the transfer and assistance phase, the ORTA and other involved parties at Brookhaven respond to requests regarding transfer of the technology. The structure of this phase varies depending on the specific nature of the "product" involved and whether it is patented, copyrighted, otherwise protected or generally unprotected (or unprotectable). If proprietary

(B. ORTA con't.)

information is involved and the product is protected, negotiations will be established between the DOE patent counsel and the potential "user" group. As needed, and subject to resource - constraints, the ORTA provides further information on the "product" and provides technical assistance in developing or refining the product for use and in design and evaluation programs. Further, if the "user" group seeks enhanced assistance in developing spin-off applications, the ORTA provides appropriate support.

C ESTIMATE OF LABORATORY EFFORT

The Office of Research and Technology Applications (ORTA) is staffed by two full time staff members who receive line support from legal and administrative personnel and operating support from the Research Department.

Office of Research and Technology Applications Resource Projections (\$ in Thousands B/A - Personnel in FTE)

	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990
<hr/>					
Funding					
ORTA	\$ 400	\$ 400	\$ 400	\$ 400	\$ 400
Other ¹	<u>2800</u>	<u>2800</u>	<u>2800</u>	<u>2800</u>	<u>2800</u>
Total	\$ 3200	\$ 3200	\$ 3200	\$ 3200	\$ 3200
<hr/>					
Staffing					
Professional Staff ²					
ORTA	4	4	4	4	4
Other	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>	<u>2</u>
Total	6	6	6	6	6

¹Includes 25% of NSLS operating budget since 25-28% of beam line facilities are used for industrial researchers. Also includes \$100.00 in operating funds for the fraction of the Nuclear Data Center used by industrial consumers.

²Includes 1 FTE manager, 2 FTE's in Director's Office support and department representative activities and 1 FTE for consulting performed for industrial firms by BNL staff listed as Other.

D APPLICATION ASSESSMENT RECORDS

Vapor Tagging With Perfluorinated Compounds.

Palladium-109 Labeled Lymphocytes - A New Agent For Lymphoid Ablation Therapy.

Technique For Detecting Gaseous Impurities in Silane, Germane, and Other Semiconductor Process Gases. Low Cost Thin Polymer Film Solar Collectors.

Ocular Radioactivity Monitor.

Non-Intrusive Measurement of D_2O/H_2O Mole Percent of Heavy Water in Drums.

Multi-Mode Computer Interface for Data Acquisition for Nuclear Medicine Imaging Devices.

Reliable and Intense Polarized Ion Source for Particle Accelerators.

U. S. Department of Energy Application Assessment Record

bnl

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory

BROOKHAVEN NATIONAL LABORATORY2. ^{Title}
Vapor Tagging with Perfluorinated Compounds

3. Date (Initial and Revisions)

March 21, 1984

4. Contact

William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973
(516) 282-2103 Commercial - 666-2103 - FTS

5. Number DOE/BNL-19

6. Patent # 4,256,038

License Status

Available for exclusive or non-exclusive licensing

7. Categories

500000 - Environmental Sciences, Atmosphere, 5002000 - Chemicals Monitoring
and Transport

8. Technology Description (What Problem Does It Solve and How).

This technology was developed for the Bureau of Alcohol, Tobacco and Firearms of the U.S. Treasury Department, for detecting blasting caps in suitcases, in meeting rooms, in aircraft, and in buildings. It consists of a taggant, that is rare in the natural ambient backgrounds, and a detector that can detect minute quantities of the taggant. The taggant is easy and inexpensive to apply to elastomers. Sensors can be custom built for about \$15,000. Suitcase screening tests were successful in detecting the taggant's presence in 2-3 seconds at concentrations that simulated tagging done two years earlier.

9. Descriptors tracer techniques, instrumentation, radiation instrumentation, detection, measuring instruments, electron-capture detectors, gas analysis, monitors, monitoring, chromatography, security, surveillance, safeguards, physical protection, crime detection, explosives and losses.

10. Why is this better than existing technology? This technology can be used to improve property security. It might be used on containers of high enriched uranium or plutonium to prevent unauthorized removal of such material. It might also be used in any other situation where high valued property (tools, electronic equipment, drugs) are handled, but will require that the employees go through a monitor upon exiting from the plant.

11. Stage of development The taggant and detector have been invented and patented. The cost of the detector should be substantially lower if produced in quantity. An application must be identified before anyone will consider commercially producing the sensors.

12. Potential uses and spinoffs

Theft is a major problem for American commercial and industrial firms. This technology could decrease theft of major items.

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-- Do Not Use For Classified or Proprietary Information --

13. Descriptive Literature Availability and Author

Dietz, et al.

Author(s) _____
Title _____
Detection of Perfluorinated Taggants in Electric Blasting Caps by
Electron Capture Monitors

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No BNL 25050

Availability _____

Cost _____ 14 Package No _____

Presented at the New Concepts Symposium and Workshop on Detection and
Identification of Explosives, Reston, Virginia - 10/30, 10/31 and 11/1/78.

Senum, et al.

Vapor Tagging of Electric Blasting Caps with Perfluorinated Compound

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No BNL 25051

Availability _____

Cost _____ 14 Package No _____

Presented at the New Concepts Symposium and Workshop on Detection and
Identification of Explosives, Reston, Virginia - 10/30, 10/31 and 11/1/78.

Dietz, et al.

Evaluation of Detection of Tagged Blasting Caps Utilizing the U.S. Customs
Service Automated Baggage Examiner and the Brookhaven Continuous Electron
Capture Monitors

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No BNL 25051

Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Operated by Associated Universities, Inc., for the United States Department of Energy

VAPOR TAGGING WITH PERFLUORINATED COMPOUNDS

DUE/BNL-19

THIS TECHNOLOGY WAS DEVELOPED FOR THE BUREAU OF ALCOHOL, TOBACCO AND FIREARMS OF THE U.S. TREASURY DEPARTMENT, FOR DETECTING BLASTING CAPS IN SUITCASES, IN MEETING ROOMS, IN AIRCRAFT, AND IN BUILDINGS. IT CONSISTS OF A TAGGANT, THAT IS RARE IN THE NATURAL AMBIENT BACKGROUNDS, AND A DETECTOR THAT CAN DETECT MINUTE QUANTITIES OF THE TAGGANT. THE TAGGANT IS EASY AND INEXPENSIVE TO APPLY TO ELASTOMERS. SENSORS CAN BE CUSTOM BUILT FOR ABOUT \$15,000. SUITCASE SCREENING TESTS WERE SUCCESSFUL IN DETECTING THE TAGGANT'S PRESENCE IN 2-3 SECONDS AT CONCENTRATIONS THAT SIMULATED TAGGING DONE TWO YEARS EARLIER

STAGE OF DEVELOPMENT

THE TAGGANT AND DETECTOR HAVE BEEN INVENTED AND PATENTED. THE COST OF THE DETECTOR SHOULD BE SUBSTANTIALLY LOWER IF PRODUCED IN QUANTITY. AN APPLICATION MUST BE IDENTIFIED BEFORE ANYONE WILL CONSIDER COMMERCIALY PRODUCING THE SENSORS.

APPLICATIONS

THIS TECHNOLOGY CAN BE USED TO IMPROVE PROPERTY SECURITY. IT MIGHT BE USED ON CONTAINERS OF HIGH ENRICHED URANIUM OR PLUTONIUM TO PREVENT UNAUTHORIZED REMOVAL OF SUCH MATERIAL. IT MIGHT ALSO BE USED IN ANY OTHER SITUATION WHERE HIGH VALUED PROPERTY (TOOLS, ELECTRONIC EQUIPMENT, DRUGS) ARE HANDLED, BUT WILL REQUIRE THAT THE EMPLOYEES GO THROUGH A MONITOR UPON EXITING FROM THE PLANT.

PATENT STATUS

PATENT #4,256,038 - AVAILABLE FOR EXCLUSIVE OR NON-EXCLUSIVE LICENSING.

PUBLICATIONS

DIETZ ET AL., DETECTION OF PERFLUORINATED TAGGANTS IN ELECTRIC BLASTING CAPS BY ELECTRON CAPTURE MONITORS

BNL 25050 - PRESENTED AT THE NEW CONCEPTS SYMPOSIUM AND WORKSHOP ON DETECTION AND IDENTIFICATION OF EXPLOSIVES, RESTON, VIRGINIA - 10/30, 10/31 AND 11/1/78.

SENUM ET AL., VAPOR TAGGING OF ELECTRIC BLASTING CAPS WITH PERFLUORINATED COMPOUND BNL 25051 - PRESENTED AT THE NEW CONCEPTS SYMPOSIUM AND WORKSHOP ON DETECTION AND IDENTIFICATION OF EXPLOSIVES, RESTON, VIRGINIA - 10/30, 10/31 AND 11/1/78.

DIETZ ET AL., EVALUATION OF DETECTION OF TAGGED BLASTING CAPS UTILIZING THE U.S. CUSTOMS SERVICE AUTOMATED BAGGAGE EXAMINER AND THE BROOKHAVEN CONTINUOUS ELECTRON CAPTURE MONITORS. BNL 24959.

ADDITIONAL INFORMATION

W. MARCUSE, OFFICE OF RESEARCH AND TECHNOLOGY APPLICATIONS, BROOKHAVEN NATIONAL LABORATORY, UPTON, LONG ISLAND, NEW YORK 11973. (516) 282-2103, FTS: 66b-2103.

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U. S. Department of Energy Application Assessment Record

BNL

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory

BROOKHAVEN NATIONAL LABORATORY

2. Title
Palladium-109 Labeled Lymphocytes - A New Agent for Lymphoid Ablation Therapy.

3. Date (Initial and Revisions)
March 21, 1984

4. Contact
William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973
(516) 282-2103 Commercial - 666-2103 - FTS

5. Number DOE/BNL-20

6. Patent # 4,500,508 issued 2/19/85 ^{License Status} assigned to the U.S. DOE

7. Categories

400703 - Radioisotope Production, 550601 Unsealed Radionuclides in Diagnostics.

8. Technology Description (What Problem Does It Solve and How).

A new method for labeling lymphocytes with Palladium-109 has been developed. The labeled lymphocytes carry the Palladium-109 selectively to lymphoid tissues and spleen. It has proven more effective for selective lymphoid ablation than many other agents that are presently in use. Other therapeutic radionuclides (beta-emitters causing little cell damage) and diagnostic radionuclides may also be used to label lymphocytes using this method.

9. Description
Palladium-109, labeled compounds, radiochemistry, radiotherapy, radiopharmaceuticals, immunosuppression, diagnosis, diagnostic techniques, diagnostic uses, therapy, lymphocytes, lymph nodes, lymphatic system.

10. Why is this better than existing technology?

Palladium-109 labeled lymphocytes show potential for more selective lymphoid irradiation and thus for more effective immunosuppression than agents now used for this purpose. Lymphocytes labeled with Palladium-109 or other suitable beta emitters might be useful in the treatment of certain lymphomas, autoimmune disease, and splenic disorders.

11. Stage of development

Experimentally used in animals. Human use anticipated.

12. Potential uses and spinoffs

Radiopharmaceutical(s) for diagnosis and treatment of malignant growths in lymph system tissue, and for immune suppression therapy.

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13. Descriptive Literature Availability and Author

Author(s) R.A. Fawwaz, S.C. Srivastava, T.S.T. Wang, T. Prach, P. Richards, P.O. Alderson
Title Ablative Lymphoid Irradiation in Experimental Animals by Pd-109 Oxine Labeled Lymphocytes

Journal J. Nucl. Med Vol 23 Issue No.5 Year 1982 Pages 58

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) S.C. Srivastava, R.A. Fawwaz, T.S.T. Wang, T. Prach, P. Richards, P.O. Alderson

Title Palladium-109 Labeled Lymphocytes - A New Agent for Lymphoid Ablation
Proc. 4th Intl. Symp. Radiopharm.
Journal Chem., Julich, Germany

Vol Aug.23-27 Issue _____ Year 1982 Pages 122-123

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) R.A. Fawwaz, S. Oluwole, S.C. Srivastava et al.

Title Potential of Palladium-109 Labeled Lymphocytes for Selective Lymphatic Ablation

Journal Nuclear Medizin Vol 23 Issue _____ Year 1984 Pages 333-335

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Operated by Associated Universities, Inc., for the United States Department of Energy

DOE/BNL-20

PALLADIUM-109 LABELED LYMPHOCYTES - A NEW AGENT FOR LYMPHOID ABLATION THERAPY

A NEW METHOD FOR LABELING LYMPHOCYTES WITH PALLADIUM-109 HAS BEEN DEVELOPED. THE LABELED LYMPHOCYTES CARRY THE PALLADIUM-109 SELECTIVELY TO LYMPHOID TISSUE AND SPLEEN. IT HAS PROVEN MORE EFFECTIVE FOR SELECTIVE LYMPHOID ABLATION THAN MANY OTHER AGENTS THAT ARE PRESENTLY IN USE. OTHER THERAPEUTIC RADIONUCLIDES (BETA EMITTERS CAUSING LITTLE CELL DAMAGE) AND DIAGNOSTIC RADIONUCLIDES MAY ALSO BE USED TO LABEL LYMPHOCYTES USING THIS METHOD.

STAGE OF DEVELOPMENT

EXPERIMENTALLY USED IN ANIMALS. HUMAN USE ANTICIPATED.

APPLICATION

PALLADIUM-109 LABELED LYMPHOCYTES SHOW POTENTIAL FOR MORE SELECTIVE LYMPHOID IRRADIATION AND THUS FOR MORE EFFECTIVE IMMUNOSUPPRESSION THAN AGENTS NOW USED FOR THIS PURPOSE. LYMPHOCYTES LABELED WITH PALLADIUM-109 OR OTHER SUITABLE BETA EMITTERS MIGHT BE USEFUL IN THE TREATMENT OF CERTAIN LYMPHOMAS, AUTOIMMUNE DISEASE, AND SPLENIC DISORDERS.

PATENT STATUS

PATENT #4,500,508 ISSUED 2/19/85, ASSIGNED TO U.S. DOE

PUBLICATIONS

R.A. FAWWAZ, S.C. SRIVASTAVA, T.S.T. WANG, T. PRACH, P. RICHARDS, P.U. ALDERSON, ABLATIVE LYMPHOID IRRADIATION IN EXPERIMENTAL ANIMALS BY PD-109 UXTINE LABELED LYMPHOCYTES, J. NUCL. MED., 23, P 58 (1982) (ABSTRACT).

S.C. SRIVASTAVA, R.A. FAWWAZ, T.S.T. WANG, T. PRACH, P. RICHARDS, P.U. ALDERSON, PALLADIUM-109 LABELED LYMPHOCYTES - A NEW AGENT FOR LYMPHOID ABLATION. PROC. 4TH INTL. SYMP. RADIOPHARM. CHEM., JULICH, AUGUST 23-27, PP. 122-123 (ABSTRACT).

R.A. FAWWAZ, S. ULUWOLE, S.C. SRIVASTAVA ET AL., POTENTIAL OF PD-109 LABELED LYMPHOCYTES FOR SELECTIVE LYMPHATIC ABLATION, NUCLEAR MEDIZIN, 23, 333-335 (1984).

ADDITIONAL INFORMATION

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TELEPHONE: (516) 282-2103, FTS: 666-2103

U. S. Department of Energy Application Assessment Record

bnl
all

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory

BROOKHAVEN NATIONAL LABORATORY

2. Title Technique for Detecting Gaseous Impurities in Silane, Germane, and Other
Semiconductor Process Gases

3. Date (Initial and Revisions)

Jan. 30, 1985

4. Contact

William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973
(516) 282-2103 Commercial - 666-2103 - FTS

5. Number

DOE/BNL-21

6. Patent #

Patent status-none

License Status

none/not necessary

7. Categories

140501 - Solar Energy: Photovoltaic Conversion, 360601 Materials: Preparation
and Manufacture

8. Technology Description (What Problem Does It Solve and How).

Silane gas (SiH_4) is used in the electronics industry for the deposition of thin layers of high purity silicon. Large quantities will be used in the future in the fabrication of photovoltaic devices. Both applications are enhanced by improved silane purity. A technique known as modulated molecular beam mass spectrometry has been developed which can detect gaseous impurities in silane with a sensitivity of 0.1 part-per-million (ppm). Previously unexplained variations of the electronic properties of hydrogenated amorphous silicon thin films were found to be attributed to different chlorosilane concentrations in the silane. This technique can provide a quality control measurement of the purities of process gases. The technique has also been applied to the semiconductor process gases disilane (Si_2H_6), dichlorosilane (SiCl_2H_2), silicon tetrafluoride (SiF_4), germane (GeH_4), diborane (B_2H_6), argon (Ar), and hydrogen (H_2).

9. Descriptors

Silanes, silicon, silicon compounds, impurities, quality control, molecular beams, mass spectroscopy, electrical properties, physical properties, deposition, photovoltaic cells.

10. Why is this better than existing technology?

Detects and quantifies lower levels of gaseous impurities in silane than existing capabilities.

11. Stage of development

The technique exists and is operating in a laboratory setting at BNL. Several photovoltaic device manufacturers have also adopted the technique for use in quality control of incoming process gases.

12. Potential uses and spinoffs This technique has application as a quality control measure for the production of high purity silicon for the electronics industry for hydrogenated amorphous silicon photovoltaic device and integrated circuit manufacturers.

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-- Do Not Use For Classified or Proprietary Information --

Author(s) R.R. Corderman and P.E. Vanier
Title Mass Spectrometric Studies of Impurities in Silane and Their Effects on the Electronic Properties of Hydrogenated Amorphous Silicon
Journal J. Applied Physics Vol 54 Issue No. 7 Year 1983 Pages 3987-9

Report No. _____ Availability _____

Cost _____ 14 Package No. _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No. _____ Availability _____

Cost _____ 14 Package No. _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No. _____ Availability _____

Cost _____ 14 Package No. _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No. _____ Availability _____

Cost _____ 14 Package No. _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No. _____ Availability _____

Cost _____ 14 Package No. _____

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DOE/BNL-21

TECHNIQUE FOR DETECTING GASEOUS IMPURITIES IN SILANE

SILANE GAS (SiH_4) IS USED IN THE ELECTRONICS INDUSTRY FOR THE DEPOSITION OF THIN LAYERS OF HIGH PURITY SILICON. LARGE QUANTITIES WILL BE USED IN THE FUTURE IN THE FABRICATION OF PHOTOVOLTAIC DEVICES. BOTH APPLICATIONS ARE ENHANCED BY IMPROVED SILANE PURITY. A TECHNIQUE KNOWN AS MODULATED MOLECULAR BEAM MASS SPECTROMETRY HAS BEEN DEVELOPED WHICH CAN DETECT GASEOUS IMPURITIES IN SILANE WITH A SENSITIVITY OF 0.1 PART-PER-MILLION (PPM). PREVIOUSLY UNEXPLAINED VARIATIONS OF THE ELECTRONIC PROPERTIES OF HYDROGENATED AMORPHOUS SILICON THIN FILMS WERE FOUND TO BE ATTRIBUTED TO DIFFERENT CHLOROSILANE CONCENTRATIONS IN THE SILANE. THIS TECHNIQUE CAN PROVIDE A QUALITY CONTROL MEASUREMENT OF THE PURITIES OF PROCESS GASES. THE TECHNIQUE HAS ALSO BEEN APPLIED TO THE SEMICONDUCTOR PROCESS GASES DISILANE (Si_2H_6), DICHLOROSILANE (SiCl_2H_2), SILICON TETRAFLUORIDE (SiF_4), GERMANE (GeH_4), DIBORANE (B_2H_6), ARGON (AR), AND HYDROGEN (H_2).

STATE OF DEVELOPMENT

THE TECHNIQUE EXISTS AND IS OPERATING IN A LABORATORY SETTING AT BNL. SEVERAL PHOTOVOLTAIC DEVICE MANUFACTURERS HAVE ALSO ADOPTED THE TECHNIQUE FOR USE IN QUALITY CONTROL OF INCOMING PROCESS GASES.

PATENT STATUS

NONE/NOT NECESSARY

PUBLICATIONS

R.R. CORDERMAN AND P.E. VANIER, MASS SPECTROMETRIC STUDIES OF IMPURITIES IN SILANE AND THEIR EFFECTS ON THE ELECTRONIC PROPERTIES OF HYDROGENATED AMORPHOUS SILICON, J. OF APPLIED PHYSICS, VOL. 54. NO. 7, 1983.

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U. S. Department of Energy Application Assessment Record

BNL

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory

BROOKHAVEN NATIONAL LABORATORY

2. Title

Low Cost Thin Polymer Film Solar Collectors

3. Date (Initial and Revisions)

July 24, 1984

4. Contact

William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973
(516) 282-2103 Commercial - 666-2103 - FTS

5. Number

DOE/BNL-22

6. Patent #

4,559,924

License Status

7. Categories

141000 - Solar Collectors and Concentrators

8. Technology Description (What Problem Does It Solve and How).

This solar collector is characterized by a low material density. Models have been built with weights as low as 1/2 lb per square foot - ten times less than conventional designs. The material has high strength-to-weight ratios and can withstand wind loads in excess of 140 mph and high speed projectile impacts. Light weight permits easy installation and is architecturally compatible with existing buildings. Simplicity of design provides rapid production rates, high throughput, and low per unit capital costs. The collector is designed for a drain back operation that eliminates the need for antifreeze, resulting in safer, lower cost, and more reliable operation.

9. Descriptors

Solar absorbers, solar energy, solar equipment, solar collectors, solar heating, solar industry, wind loads, dynamic loads, polymers, films, materials, design, manufacturing, installation.

10. Why is this better than existing technology?

This technology should lend itself to low cost production and installation and should be easier to maintain than conventional materials. It appears to be a solar energy source that should be able to compete with fossil energy sources at current prices without a subsidy.

11. Stage of development

A number of collectors have been made and tested and have demonstrated proof of concept. There is a need to investigate and perhaps demonstrate prototype production.

12. Potential uses and spinoffs Solar heating, and air conditioning. Production methods and techniques may be of benefit, or benefit from polymer film materials and methods being developed and applied in industry, particularly in aerospace.

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-- Do Not Use For Classified or Proprietary Information --

13. Descriptive Literature Availability and Author

Author(s) W.G. Wilhelm and J.W. Andrews

Title The Development of Polymer Film Solar Collectors: A Status Report

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No BNL 51582

Availability _____

Cost _____ 14 Package No _____

Brookhaven National Laboratory, Upton, New York, August 1982

Author(s) W.G. Wilhelm

Title Thin Polymer Film Collectors as a Contribution to the Solar Industry

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No BNL 34937

Availability _____

Cost _____ 14 Package No _____

Brookhaven National Laboratory, Upton, New York, June 1984

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

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DOE/BNL-22

LOW COST THIN POLYMER FILM SOLAR COLLECTORS

THIS SOLAR COLLECTOR IS CHARACTERIZED BY A LOW MATERIAL DENSITY. MODELS HAVE BEEN BUILT WITH WEIGHTS AS LOW AS 1/2 LB PER SQUARE FOOT - TEN TIMES LESS THAN CONVENTIONAL DESIGNS. THE MATERIAL HAS HIGH STRENGTH TO WEIGHT RATIOS AND CAN WITHSTAND WIND LOADS IN EXCESS OF 140 MPH AND HIGH SPEED PROJECTILE IMPACTS. LIGHT WEIGHT PERMITS EASY INSTALLATION AND IS ARCHITECTURALLY COMPATIBLE WITH EXISTING BUILDINGS. SIMPLICITY OF DESIGN PROVIDES RAPID PRODUCTION RATES, HIGH THROUGHPUT AND LOW PER UNIT CAPITAL COSTS. THE COLLECTOR IS DESIGNED FOR A DRAIN BACK OPERATION THAT ELIMINATES THE NEED FOR ANTIFREEZE RESULTING IN SAFER, LOWER COST, AND MORE RELIABLE OPERATION.

STAGE OF DEVELOPMENT

A NUMBER OF COLLECTORS HAVE BEEN MADE AND TESTED AND HAVE DEMONSTRATED PROOF OF CONCEPT. THERE IS A NEED TO INVESTIGATE AND PERHAPS DEMONSTRATE PROTOTYPE PRODUCTION.

APPLICATIONS

COMPETITIVE SOLAR HEATING AND COOLING SYSTEMS WITH HIGH RELIABILITY AND LOW MAINTENANCE. INDUSTRIAL APPLICATIONS WILL REQUIRE EXTENSIONS OF PERFORMANCE CAPABILITY. DESIGN INTEGRATES WELL WITH SIDING ON CONVENTIONAL STRUCTURES AND DOES NOT COMPROMISE ATTRACTIVENESS OF BUILDING DESIGNS.

PATENT STATUS

PATENT #4,559,924

PUBLICATIONS

W.G. WILHELM, AND J.W. ANDREWS, THE DEVELOPMENT OF POLYMER FILM SOLAR COLLECTORS: A STATUS REPORT. BNL-51582

W.G. WILHELM, THIN POLYMER FILM COLLECTORS AS A CONTRIBUTION TO THE SOLAR INDUSTRY. BNL-34937.

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U. S. Department of Energy Application Assessment Record

bnl

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory

BROOKHAVEN NATIONAL LABORATORY

2. Title

Ocular Radioactivity Monitor

3. Date (Initial and Revisions)

October 4, 1984

4. Contact

**William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973
(516) 282-2103 Commercial - 666-2103 - FTS**

5. Number

DOE/BNL-23

6. Patent #

U.S. Patent 4,479,931License Status available for non-
issued 10/30/84 exclusive or exclusive licensing7. Categories **550601 Medicine-Unsealed Radionuclides in Diagnostics; 550901 Pathology-Tracer Techniques; 551001 Physiological Systems-Tracer Techniques; 440103 Radiation Instrumentation - Nuclear Spectroscopic Instrumentation.**

8. Technology Description (What Problem Does It Solve and How).

The instrument relates to the detection of cancerous tumors and other degenerative diseases of the eye by the detection of radioactivity from injected radiopharmaceuticals.

9. Descriptors

Eyes, blood flow, neoplasms, physiology, pathology, radiation detectors, tracer techniques, diagnostic techniques, nuclear medicine, biological localization, radiopharmaceuticals, labeled compounds.

10. Why is this better than existing technology?

The instrument and methodology provides an inexpensive apparatus in the diagnosis of ocular cancer, and this apparatus and method are suitable for clinical and mass-screening applications. The diagnostic test is non-invasive, simple to perform, and does not require highly sophisticated personnel to administer the test. The subject is exposed to a lower level of radiation than with other known nuclear medical techniques for diagnosis of ocular cancer.

11. Stage of development

The instrument has been evaluated in control subjects and patients with pathologically confirmed ocular melanoma tumors.

12. Potential uses and spinoffs

The instrument will be valuable in preclinical studies, particularly for screening populations at risk (i.e., women and men with prior history of breast cancer and lung cancer, respectively.

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13. Descriptive Literature Availability and Author

Author(s) R. M. Lambrecht, S. Packer, and H. L. Arkins

Title Differential Radioactivity Monitor for Non-Invasive Detection of Ocular Melanoma

Journal Nuclear Medicine Communications 5 Vol _____ Issue _____ Year 1984 Pages 381-386

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) New York Times, November 3, 1984, p. 30.

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No _____ Availability _____

Cost _____ 14 Package No _____

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DOE/BNL-23

OCULAR RADIOACTIVITY MONITOR

THE UNIQUE FEATURES OF THE INSTRUMENT INCLUDE A PATIENT POSITIONING DEVICE TO ALLOW ACCURATE VERTICAL AND INDEPENDENT HORIZONTAL POSITIONING OF TWO RADIATION DETECTORS. ELECTRONICS ARE PROVIDED TO ALLOW SIMULTANEOUS DETECTION AND RECORDING OF RADIOACTIVITY IN EITHER EYE FROM AN INJECTED RADIOPHARMACEUTICAL (E.G., GALLIUM-67 CITRATE).

STAGE OF DEVELOPMENT

THE INSTRUMENT HAS BEEN EVALUATED IN CONTROL SUBJECTS AND PATIENTS WITH PATHOLOGICALLY CONFIRMED OCULAR MELANOMA TUMORS.

APPLICATIONS

TUMOR DETECTION, ESPECIALLY MALIGNANT EYE MELANOMA, STUDY OF OCULAR BLOOD FLOW PARTICULARLY IN GLAUCOMA AND IN DEGENERATIVE DISEASES OF THE POSTERIOR SECTION OF THE EYE.

PATENT STATUS

PATENT #4,479,931 ISSUED 10/30/84 AVAILABLE FOR EXCLUSIVE OR NON-EXCLUSIVE LICENSING.

PUBLICATIONS

R.M. LAMBRECHT, S. PACKER, AND H.L. ARKINS, DIFFERENTIAL RADIOACTIVITY MONITOR FOR NON-INVASIVE DETECTION OF OCULAR MELANOMA. NUCLEAR MEDICINE COMMUNICATIONS 5, 381-386 (1984).
NEW YORK TIMES, NOVEMBER 3, 1984, P. 30.

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U. S. Department of Energy Application Assessment Record

bnl

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory

BROOKHAVEN NATIONAL LABORATORY

2. Title

Non-Intrusive Measurement of D_2O/H_2O Mole Percent of Heavy Water in Drums

3. Date (Initial and Revisions)

May, 1986

4. Contact

William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973
(516) 282-2103 Commercial - 666-2103 - FTS

5. Number

DOE/BNL-24

6. Patent #

Not patented

License Status

7. Categories

055001 - Nuclear Fuels Accountability and Safeguards

8. Technology Description (What Problem Does it Solve and How).

A method to assay D_2O concentrations of heavy water in 210 liter drums under field conditions without opening the drums. The problem was solved by using the fact that the speed of sound in D_2O/H_2O mixtures is a unique function of mole fraction and temperature. An ultrasonic signal is projected diagonally through the drum. The time for return determines the velocity. The velocity depends upon the square root of the ratio of the bulk modulus to the density. Since the instrument can also measure the water level and the weight of the drum can be readily measured, one knows the density as well as the ratio of bulk modulus to density. Moreover, one can measure the change of velocity with temperature, thus insuring that what is measured is heavy water.

9. Descriptors

Nondestructive analysis, measuring methods, ultrasonic testing, acoustic measurements, sealed sources, containers, containment, packaging, liquids, liquid wastes, heavy water, ultrasonic waves, ultrasonography, velocity, accounting, inventories, safeguards.

10. Why is this better than existing technology?

At present there is no non-intrusive method that does not involve nuclear techniques. Moreover, the nuclear techniques require bulky equipment and radioactive sources.

11. Stage of development

Prototype has been demonstrated and contracts have been let for five units. These will be used by Savannah River Laboratory and IAEA inspectors.

12. Potential uses and spinoffs

Might be possible to use method to non-intrusively measure accountability. Might be used to assay well defined liquids in sealed containers or inaccessible locations.

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13. Descriptive Literature Availability and Author

A. Fainberg, M.S. Zucker, J.R. Lemley, E.V. Weinstock

Author(s)

Assay of Heavy Water in Barrels for Safeguards Purposes

Title

Proceedings 3rd ESARDS Symposium on Safeguards

Journal and Nuclear Material Management

Vol

Issue

Year

1981

Pages

Report No

Availability

Cost

14 Package No

Author(s)

M.S. Zucker

Title

An Ultrasonic Method for Measurement of D_2O/H_2O Concentration

Journal

Institute of Nuclear Material Management

Issue

Year

Pages

Report No

Proc. 21st Annual Meeting, INMM, Palm Beach, Florida, July 1980, p. 51.

Availability

Cost

14 Package No

Author(s)

M.S. Zucker

Title

Current Status of D_2O Assay Using Ultrasonics

Journal

7th ESARDA Symposium on Safeguards and Nuclear Material Management

Vol

Issue

Year

Pages

Report No

Liege, Belgium, May 21-23, 1985, p. 185-192.

Availability

Cost

14 Package No

Author(s)

Title

Journal

Vol

Issue

Year

Pages

Report No

Availability

Cost

14 Package No

Author(s)

Title

Journal

Vol

Issue

Year

Pages

Report No

Availability

Cost

14 Package No

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DOE/BNL-24

NON-INTRUSIVE MEASUREMENT OF D_2O/H_2O MOLE PERCENT OF HEAVY WATER IN DRUMS

A MEASUREMENT OF ASSAYING D_2O CONCENTRATIONS OF D_2O/H_2O IN 200 LITER DRUMS UNDER FIELD CONDITIONS WITHOUT OPENING THE DRUMS. THE METHOD DEPENDS UPON THE FACT THAT THE SPEED OF SOUND IN D_2O/H_2O MIXTURES IS A UNIQUE FUNCTION OF MOLE FRACTION AND TEMPERATURE. AN ULTRASONIC SIGNAL IS PROJECTED DIAGONALLY THROUGH THE DRUM. THE TIME FOR RETURN DETERMINES THE VELOCITY. THE VELOCITY DEPENDS UPON THE SQUARE ROOT OF THE RATIO OF THE BULK MODULUS TO THE DENSITY. SINCE THE INSTRUMENT CAN ALSO MEASURE WATER LEVEL AND THE WEIGHT OF THE DRUM CAN BE READILY DETERMINED, ONE KNOWS THE DENSITY AS WELL AS THE RATIO OF BULK MODULUS TO DENSITY. MOREOVER, ONE CAN MEASURE THE CHANGE OF VELOCITY WITH TEMPERATURE, THUS CONFIRMING THAT WHAT IS MEASURED IS HEAVY WATER, SINCE IT WOULD BE IMPOSSIBLE TO COUNTERFEIT THE SPEED OF SOUND, THE DENSITY, AND THE CHANGE OF SPEED OF SOUND WITH TEMPERATURE.

STAGE OF DEVELOPMENT

A FINISHED INSTRUMENT DEVELOPED WITH THE AID OF THE PANAMETRICS COMPANY WAS JUST DEMONSTRATED AT THE IAEA IN VIENNA (APRIL, 1986).

APPLICATIONS

IS USED TO MAKE SAFEGUARDS AND NUCLEAR MATERIAL ACCOUNTABILITY MEASUREMENTS. THIS IS THE ONLY NON-INTRUSIVE MEASUREMENT TECHNIQUE THAT DOES NOT REQUIRE BULKY EQUIPMENT AND NUCLEAR SOURCES. HAS POTENTIAL FOR USE IN THE MEASUREMENT OF WELL DEFINED LIQUIDS IN SEALED CONTAINERS OR INACCESSIBLE LOCATIONS.

PATENT STATUS

NOT PATENTED

PUBLICATIONS

A. FAINBERG, M.S. ZUCKER, J.R. LEMLEY, E.V. WEINSTOCK, ASSAY OF HEAVY WATER IN BARRELS FOR SAFEGUARDS PURPOSES. PROCEEDINGS 3RD ESARDA SYMPOSIUM ON SAFEGUARDS AND NUCLEAR MATERIAL MANAGEMENT, 1981.

M.S. ZUCKER, AN ULTRASONIC METHOD FOR MEASUREMENT OF D_2O/H_2O CONCENTRATION. INSTITUTE OF NUCLEAR MATERIAL MANAGEMENT, PROCEEDINGS, 21ST ANNUAL MEETING, INMM, PALM BEACH, FLORIDA, JULY 1980, P. 51.

M.S. ZUCKER, CURRENT STATUS OF D_2O ASSAY USING ULTRASONICS. 7TH ESARDA SYMPOSIUM ON SAFEGUARDS AND NUCLEAR MATERIAL MANAGEMENT, LIEGE, BELGIUM, MAY 21-23, 1985, P. 185.

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U. S. Department of Energy Application Assessment Record

bnl

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory

BROOKHAVEN NATIONAL LABORATORY

2. Title

Multi-mode Computer Interface for Data Acquisition for Nuclear Medicine Imaging Devices

3. Date (Initial and Revisions)

April 23, 1985

4. Contact

**William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973
(516) 282-2103 Commercial - 666-2103 - FTS**

5. Number

DOE/BNL-25

6. Patent

Not patented

License Status

7. Categories

**550601 - Biomedical Sciences Basic Studies; Medicine. Unsealed
Radionuclides in Diagnostics - 550600 - Medicine.**

8. Technology Description (What Problem Does It Solve and How).

The interface accepts data from 16 independent devices, including two scintillation cameras and auxiliary instruments. The data are digitized and transferred to a minicomputer. The camera event spatial coordinates plus the energy associated with each event are recorded along with electrocardiographic data, pulmonary data, the rate of activity from other detectors, etc. The interface was developed for the Unicon imaging device, but with modification, should prove usable with other nuclear medical and magnetic resonance imaging devices. The computer interface provides the data processing capability that permits correlation of scintigraphic events with other physiologic and system signals.

9 Descriptors Nuclear medicine, scintiscanning, diagnostic techniques, radioisotope scanning, images, image converters, image scanners, data processing, digitizers, electronic equipment, organs, respiratory system, blood circulation, nuclear magnetic resonance, gamma cameras, image processing.

10. Why is this better than existing technology?

The interface is unique in its capability to identify up to 16 data sources, with flexible format, maintaining true temporal relationships. One can see time correlated activities, previously not available. High priority data sources can be initiated by the device and other variables by external clock or internal software controlled clock.

11. Stage of development

A prototype has been produced and is operating in conjunction with the Unicon medical imaging device at Brookhaven.

12. Potential uses and spinoffs

The device with modification should be usable and improve the information from nuclear medicine and magnetic imaging devices. It will provide knowledge of the concentrations of radionuclides as a function of time and body organ.

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13 Descriptive Literature Availability and Author

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March 15-18, 1982. IEEE Cat. No. 82-CH1751-7

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Author(s) G.W. Bennett, A.B. Brill, I.G. Zubal, R.W. Rowe, Y. Bizais, R. DobertTitle Unicon - A Single Instrument for PET, SPECTARD Clinical ImagingJournal Proc. of World Congress on Medical Physics & Biomedical Engineering, 1982, Hambu
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Author(s) I.G. Zubal, R.W. Rowe, Y. Bizais, G.W. Bennett, A.B. BrillTitle Software Programmable Multi-Mode InterfaceJournal Proc. First Computer Society Int'l Conference on Medical Computer Science, Phil.
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Author(s) I.G. Zubal, Y. Bizais, G.W. Bennett, A.B. BrillTitle Dual Gated Nuclear Cardiac ImagingJournal IEEE Trans. Nuc. Sci. Vol NS-31 Issue _____ Year Feb.1984 Pages 566-9

Report No. _____ Availability _____

Cost _____ '14 Package No. _____

Author(s) _____

Title _____

Journal _____ Vol _____ Issue _____ Year _____ Pages _____

Report No. _____ Availability _____

Cost _____ '14 Package No. _____

Operated by Associated Universities, Inc., for the United States Department of Energy

NUMBER-BNL-0025

MULTI-MODE COMPUTER INTERFACE FOR DATA ACQUISITION
FOR NUCLEAR MEDICINE IMAGING DEVICES

THE INTERFACE ACCEPTS DATA FROM 16 INDEPENDENT DEVICES, INCLUDING TWO SCINTILLATION CAMERAS AND AUXILIARY INSTRUMENTS. THE DATA IS DIGITIZED AND TRANSFERRED TO A COMPUTER. THE CAMERA EVENTS PLUS THE ENERGY ASSOCIATED WITH EACH EVENT ARE RECORDED ALONG WITH ELECTROCARDIOGRAPHIC DATA, PULMONARY DATA AND THE RATE OF ACTIVITY. THE INTERFACE WAS DEVELOPED FOR THE UNICON IMAGING DEVICE BUT, WITH MODIFICATION, SHOULD PROVE USABLE WITH OTHER NUCLEAR MEDICAL AND MAGNETIC RESONANCE IMAGING DEVICES. THE COMPUTER INTERFACE PROVIDES THE DATA PROCESSING CAPABILITY THAT PERMITS REAL TIME ANALYSIS OF RELATED ACTIVITIES IN DIFFERENT ORGANS AND PORTIONS OF THE BODY.

STAGE OF DEVELOPMENT

A PROTOTYPE HAS BEEN PRODUCED AND IS OPERATING IN CONJUNCTION WITH THE UNICON MEDICAL IMAGING DEVICE AT BROOKHAVEN.

APPLICATIONS

THE INTERFACE IS USED WITH NUCLEAR MEDICINE IMAGING DEVICES. IT CREATES THE CAPABILITY OF PROCESSING THE IMAGED INFORMATION AND PROVIDING KNOWLEDGE OF THE CONCENTRATIONS AND RATES OF CHANGE OF CONCENTRATION OF RADIONUCLIDES IN CORRELATED ACTIVITIES, PREVIOUSLY NOT POSSIBLE.

PATENT STATUS

NOT PATENTED

PUBLICATIONS

G.W. BENNETT, Y. BIZAIS, K.I. KIRN, Y. YONEKURD, G. ZUBAL, A. BRILL, THE UNICON, A UNIVERSAL NUCLEAR IMAGING CONSTRUCT, PROC. INT'L WORKSHOP ON PHYSICS AND ENGINEERING IN MEDICAL IMAGING, ASILOWAR, CA. MARCH 1982, IEEE CAT. NO. 82-CH1751-7.

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ADDITIONAL INFORMATION

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U. S. Department of Energy Application Assessment Record

Assessment required by P.L. 96-480 and DOE Order 5800.1

1. Laboratory BROOKHAVEN NATIONAL LABORATORY		
2. Title Reliable and Intense Polarized Ion Source for Particle Accelerators		
3. Date (Initial and Revisions) September 24, 1986		
4. Contact William Marcuse, Bldg. 475, Brookhaven National Laboratory, Upton, NY 11973 (516) 282-2103 Commercial - 666-2103 - FTS		
5. Number DOE/BNL-26	6. Patent # Not patented	License Status
7. Categories 430301 - Particle Accelerators; Auxiliaries and Components; Ion Sources		
8. Technology Description (What Problem Does it Solve and How). <p>This device generates a uA beam current considerably stronger than other sources of this kind. The highly efficient design of ten mA pulsed cesium source and its neutralizer is much more reliable, decreasing the amount of maintenance and unanticipated downtime. This improves the efficiency of expensive accelerators and is less disruptive to experiments. It is a better solution as a source of high intensity polarized ions than any other existing to date.</p>		
9. Descriptors <p>Polarized beams, ion sources, beam neutralization, ion beams, proton beams, particle beams, anions, ions, charged particles.</p>		
10. Why is this better than existing technology? <p>It surpasses the other polarized negative ion sources in intensity (I), as well as exceeding other sources by at least a factor of four in the figure of merit p^2I (P is the polarization degree). It provides stable and reliable operation for weeks on end without maintenance.</p>		
11. Stage of development <p>The source has been produced and is currently used to produce a 15-25 GeV polarized proton beam at Brookhaven.</p>		
12. Potential uses and spinoffs <p>The beam has potential application in magnetic confinement fusion device because of advantages of enhanced cross sections and directionality of the reaction products.</p>		

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Santa Fe, NM, 1983Report No. IEEE Trans. Nucl. Sci., Vol. NS-30 Availability _____
2708 (1983)

Cost _____ 14 Package No. _____

Author(s) Th. Sluyters, J. Alessi, A. KponouTitle Status of the AGS Polarized Negative Ion SourceJournal AJP Conference Proceedings No.117 Vol. 25 Issue _____ Year 1984 Pages _____Report No. International Workshop on Polarized Ion Sources, Vancouver, Canada, 1983. Availability _____

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Author(s) Th. Sluyters, J. Alessi, A. KponouTitle Status and Future Plans for the BNL Polarized H-SourceJournal AIP Conference Proceedings 111 Vol. 736 Issue _____ Year 1984 Pages _____Report No. Third International Symposium on the Production and Neutralization of Negative Availability _____
Ions and Beams, Brookhaven National Laboratory, 1983

Cost _____ 14 Package No. _____

Author(s) J. Alessi, A. Kponou, Th. SluytersTitle A 25 uA Pulsed Polarized H-SourceJournal 6th International Symp. on High Energy Spin Physics Vol. _____ Issue _____ Year _____ Pages _____
Marseille, France, 1984

Report No. _____ Availability _____

Cost _____ 14 Package No. _____

Author(s) A. Kponou, J. Alessi, Th. SluytersTitle The AGS Polarized H-SourceJournal IEEE Trans. Nucl. Sci. NS-32 Vol. 1764 Issue _____ Year 1985 Pages _____Report No. Particle Accelerator Conference, Vancouver, Canada, 1985. Availability _____

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Author(s): J.G. Alessi, A. Hershcovitch, A. Kponou, T. Niinikoski,
Th. Sluyters

Title: Polarized H-Source Development at BNL
Linear Accelerator Conference, SLAC, 1986

BROOKHAVEN NATIONAL LABORATORY

FACT SHEET

Operated by Associated Universities, Inc., for the United States Department of Energy

DOE/BNL-26

RELIABLE AND INTENSE POLARIZED ION SOURCE FOR PARTICLE ACCELERATORS

THIS DEVICE GENERATES A μ A BEAM CURRENT CONSIDERABLY STRONGER THAN OTHER SOURCES OF THIS KIND. THE HIGHLY EFFICIENT DESIGN OF TEN MA PULSED CESIUM SOURCE AND ITS NEUTRALIZER IS MUCH MORE RELIABLE DECREASING THE AMOUNT OF MAINTENANCE AND UNANTICIPATED DOWNTIME. THIS IMPROVES THE EFFICIENCY OF EXPENSIVE ACCELERATORS AND IS LESS DISRUPTIVE TO EXPERIMENTS. IT IS A BETTER SOLUTION AS A SOURCE OF HIGH INTENSITY POLARIZED IONS THAN ANY OTHER EXISTING TO DATE.

STAGE OF DEVELOPMENT

THIS SOURCE HAS BEEN PRODUCED AND IS CURRENTLY USED TO PRODUCE A 15-25 GEV POLARIZED PROTON BEAM AT BROOKHAVEN.

APPLICATIONS

THE SOURCE CAN BE USED TO GENERATE NEGATIVE IONS FOR ANY EXPERIMENTAL MACHINE. IT SURPASSES THE OTHER POLARIZED NEGATIVE ION SOURCES IN INTENSITY (I) AS WELL AS EXCEEDING OTHER SOURCES BY AT LEAST A FACTOR OF FOUR IN THE FIGURE OF MERIT P^2I (P IS THE POLARIZATION DEGREE). IT PROVIDES STABLE AND RELIABLE OPERATION FOR WEEKS ON END WITHOUT MAINTENANCE.

PATENT STATUS

NOT PATENTED

PUBLICATIONS

J. ALESSI, A. KPONOU, R. RAYMOND, TH. SLUYTERS, STATUS OF THE AGS POLARIZED NEGATIVE ION SOURCE. PARTICLE ACCELERATOR CONFERENCE, SANTA FE, NM, 1983, IEEE TRANS. NUCL. SCI., VOL NS-30 2708 (1983).

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(CONTINUED)

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APPENDIX A

MANAGEMENT PLAN OFFICE OF UTILITY RESEARCH AND INDUSTRIAL SUPPORT (OURIS)

Background

Brookhaven National Laboratory (BNL) is a multiprogram research laboratory owned and controlled by the U.S. Department of Energy (DOE) and operated under contract by Associated Universities Incorporated. The laboratory programs span a broad range of research activities and include:

- o Chemistry
- o Biology
- o High Energy and Nuclear Physics
- o Energy Conservation
- o Environmental Science
- o Instrumentation Development
- o Applied Materials Science
- o Applied Mathematics
- o Medical
- o Applied Nuclear Energy
- o Structure of Matter/Solid State Physics
- o Related Engineering Development

In order to carry out the great variety of research and applied development programs, BNL is staffed by a diverse group of scientists and engineers with specialized technical skills. In addition to the broad scope of research programs and projects for DOE, the Nuclear Regulatory Commission (NRC), and some specialized work for other Government agencies, a prime mission of BNL is the design, construction, and operation of specialized research facilities used by researchers from universities and industry in pursuit of fundamental knowledge. A major role played by the resident research staff is to interact with outside academic and industrial users. The need for new specialized research facilities is determined by the research community, specific needs of outside prospective users in discussion with the resident research staff.

Engineering skills required to support the multiprogram efforts at BNL range from the traditional electrical, chemical, mechanical, and civil engineering skills to highly specialized expertise required in the design of particle accelerators, nuclear reactors, nuclear waste management systems, superconducting devices, and the maintenance of large ultra-high

(Appendix A cont'd.)

vacuum and related support systems. In operating this complex array of specialized hardware and unique devices, BNL must be able to deal with the associated mundane maintenance and administrative complexities familiar in the Government, academic, and business communities. In addition, a basic general skill at BNL is problem solving, i.e., the ability to deal with diverse technical problems for the first time and arrive at practical/economic solutions.

In carrying out these multifaceted responsibilities, BNL now faces the additional challenge of meeting the Congressional requirement of technology transfer, i.e., making the results of research and special expertise developed in ongoing laboratory research programs available to U.S. industry. The exact requirements for technology transfer and the relevant legislation is discussed in Appendix A.

This plan is part of the overall technology transfer mission of the laboratory and is focused on the specific needs of the electric and electric gas utilities. Brookhaven National Laboratory has always had an applications focus. For many years it was a leader in seeking peaceful uses for the atom. Early in its history, it was involved in developing conceptual ideas for nuclear fission power reactors. This was the initial mission of other national laboratories as well. A great deal of collective work by national laboratories in this area resulted in the initial technology base for nuclear power in the United States. Nuclear power technology is now well established in the utility industry, but problems remain which must eventually be resolved. Safety is of fundamental importance with longevity, reliability, and availability being the keys to favorable economics.

Regardless of current energy prices, e.g., oil, energy conservation remains a long-term goal of the U.S. Efforts in this direction were begun at the other national laboratories and at BNL in the mid-1970s and conservation continues to be a significant effort at BNL. Efforts in conservation, past and ongoing, have been undertaken in oil, gas, and electricity utilization.

In summary, BNL is a place where a great deal of creative technical expertise is resident. This talent will continue to be used to solve the multitude of problems involved in the frontiers of basic research and technology development short of commercial products. Congress has now mandated that in addition to the prime missions of the Laboratory, it must make the fruits of Government-supported research available to industry, i.e., as

(Appendix A cont'd.)

desired by industry and as is appropriate. Industry is encouraged to use this and other unique national laboratory facilities.

BNL View of Utility Problems

The prime function of a utility is to supply energy on demand at minimal cost, with high reliability and a maximum degree of safety to customers and utility working staff. Utilities have major investments in plants and support facilities. Thus, enhancing the productivity, longevity, availability, and reliability of this investment is of paramount importance.

In addition, everyone recognizes the need to emphasize conservation and demand management. Utilities and all industrial organizations must have a sound scientific technological response to health, safety, and environmental risks associated with their operations.

It is of paramount importance to develop and evolve new generation schemes, energy production and storage technologies consistent with the above requirements and at affordable costs to customers. In some cases this involves the exploration of new directions in science and technology that promise fundamentally new methods of electricity production, energy production, delivery, and more efficient end use. Some examples are renewable energy, advanced materials, better fuels utilization (especially coal). Control of materials and systems degradation is of special interest. Finally, the development of related science is appropriate to stimulate work that is relevant to current and future utility needs.

In the long run, utilities and American industry in general will only survive and prosper by an influx of new ideas, concepts, materials, and the intellectual stimulation of the scientific community. As utilities develop a better defined interface with the scientific community, the fruits of innovation and creative problem solving may be realized. In addition, one approach to achieving the above goals is to be able to effectively mobilize scientific people and encourage their movement between the research and utility communities.

BNL Utility Interactions

At the present time, BNL carries out a number of projects and programs for utilities. Some are supported by the Electric Power Research Institute (EPRI) and others are supported by the

(Appendix A cont'd.)

Gas Research Institute (GRI). In addition, there are specific efforts under direct contracts with individual utilities and organizations such as the Empire State Electrical Energy Research Corporation (ESEERCO). For example, exclusive of efforts for EPRI and GRI, BNL is expected to have utility contracts under way this fiscal year in excess of \$500,000 with higher levels expected in fiscal year 1987.

These activities have been developed by research investigators at BNL through contacts in individual utilities and ESEERCO. The BNL Directorate has encouraged such interactions and through direct communication between the Directorate and utility managements is endeavoring to build more such working relationships.

The BNL Directorate now sees the need to establish this effort in a more formal and organized fashion. It is the opinion of the Directorate that it will benefit the needs of the utilities as well as allow broader technical development of the BNL staff interested in dealing with utility problems and related research needs.

Organization and Function of BNL Utility Interactions

1. Establish an organizational structure (office) at BNL at the level of the Directorate, which will coordinate, oversee, and provide technical as well as management quality control over all utility contracts. This would include efforts for individual utilities, ESEERCO, GRI, and EPRI.

In the current structure shown in the organizational chart attached, individual Department Chairmen are responsible for a collection of divisions with specific R&D mission responsibilities. In general, non-DOE projects are initiated at the division level and carried out within individual divisions. The responsibility for project execution belongs to the division manager working in close collaboration with individual investigators appropriately managed by the contract sponsor. The Department Chairman gauges overall performance, is responsible for the administration and fiscal aspects of the projects, and represents a level of quality control. In different departments there are variations of this basic scheme of BNL management of R&D work for other organizations.

In general, the Directorate is not directly involved in work for others, i.e., non-DOE-supported efforts; however, in

(Appendix A cont'd.)

the organizational scheme proposed, the Directorate will have overview over all utility-related efforts.

2. Identify utility problems that can be addressed by BNL Staff. The organizational unit established will have the primary function of interfacing with the utilities with the object of identifying utility problems, and people with problems. In general, problems/projects will be of short duration, i.e., from weeks to months, up to a year-plus, but not in excess of two years. It is felt that problems of very long duration or large scale should continue to be managed by EPRI or GRI. We would expect heavy emphasis at BNL on contract durations of approximately one to perhaps two years and on short-term problems measured in months.

3. Identify most competent BNL Staff to deal with specific problems.

In this case, success depends on a knowledgeable staff and the authority of the Directorate to cycle people in and out of an ongoing effort for short periods of time.

4. Aid utilities to more effectively interface with the academic community and other Government laboratories, in addition to BNL.

BNL is a semi-academic institution, i.e., a hybrid organization which is able to interact with academia and industry. A basic goal of this effort would be to find the means and encourage the short-term free exchange of technical people between the utilities, a national laboratory, and academic institutions. Such mobility could breed innovation and creativity with utility research staffs.

One approach to establishing such relations is to evolve a management scheme in which BNL would distribute low level utility funding to the university community. This would be done in collaboration with utility research staffs.

Organizational Structure and Funding

It is proposed that BNL establish an "Office of Utility Research and Industrial Support" (OURIS) in the BNL Directorate as a specific responsibility of the Associate Director for Applied Programs (ADAP). The current responsibilities of the ADAP are shown in the attached organization chart. This new office would operate in parallel with the current Office of Research and Technology Applications (ORTA), also under the ADAP. The ORTA presently has the prime responsibility for overall technology transfer at BNL and is mandated by Congress.

The OURIS would be managed by a full-time BNL senior scientist/engineer and supported by a half-time secretary/staff person. This secretary/staff person will be full-time and work in support of the ORTA and OURIS, respectively, with half-time devoted to each function.

Funding support for the 1-1/2 full-time equivalents in the OURIS will be via BNL overhead funds and corresponds to a cost of approximately \$130,000 per year, which would include support services, materials, and supplies, as well as travel. Justification for this expenditure is based on the expected level of individual program support plus continued efforts for ESEERCO, EPRI, and GRI.

The OURIS would be responsible for the four functions described above and be under the direct supervision and oversight of the ADAP.

Individual projects/programs will be developed via interactions between the OURIS and individual department staff. Decisions to fund any specific effort will be made by the individual utility or related funding organization. Each program or project will be judged by the utility on its own merit. It is expected that each proposal submitted by BNL that is utility related will be reviewed by the OURIS, the responsible division manager, and the responsible Department Chairman, and only recommended by the ADAP if it meets the following criteria:

1. The work is related to the DOE/BNL mission.
2. BNL staff has a unique ability to deal with the subject matter.
3. The work may require special facilities or equipment available at BNL.

(Appendix A cont'd.)

4. Industrial expertise is not available to address the problem on a timely effective and economical basis.

5. The work is of substantial technological or scientific content and/or is in the national interest.

6. The effort must not have any detrimental impact on existing or planned DOE programs.

Utility Review

Even though funds for utility projects/programs will come from individual utilities or related organizations, the overall effort will undergo periodic collective utility review. This will assure the general relevance of all projects/programs to the utility industry and serve as another level of quality control.

The present Utility Advisory Committee will serve this function. The ADAP should establish the exact size and utility representation in the group and suggest a meeting frequency which should be a minimum of once a year perhaps every four to six months. At each of their meetings they will make a report to the Directorate, as such be established as consultants to BNL. In consultation with the ADAP and the OURIS, they will establish suitable criteria for judging the relevance and success of BNL utility programs/projects.

Overall Level of Effort

The total level of utility, ESEERCO, EPRI, and GRI funding at BNL in fiscal year 1986 is approximately \$1,600,000. It is not possible to establish an upper bound or optimal level of funding for work of this nature at BNL. An upper bound on funding is determined by the available BNL staff and must be consistent with BNL responsibilities to DOE and NRC. With this in mind, the overall level of utility project/programs should be carefully watched by the Directorate, the ADAP, and the Utility Advisory Committee to be sure a minimum level of effectiveness is maintained.

An upper bound level of funding of all work for others at BNL is established by DOE policy as 20% of the total, whereas within this bound the upper limit of utility funding should be determined by effectiveness without having an adverse impact on the overall BNL mission for DOE and NRC.

(Appendix A cont'd.)

Associates Program

An additional approach which would help cement good working relationships with utility organizations is to establish an Associates Program which would allow rapid response by the laboratory to immediate and critical problems of individual utilities. The associates would consist of member public utilities, each contributing a minimal amount of funding, e.g., \$5,000 to \$10,000 per year. This funding would establish a firm contractual arrangement with BNL to deal with proprietary as well as nonproprietary work up to a given level on a quick response basis. The following benefits accrue:

1. BNL staff would be available via the OURIS to deal with short-term problems, i.e., those requiring several days to one or two weeks response time.
2. BNL staff would have access to ongoing utility program/project information as appropriate. (This would be a benefit to DOE.)
3. Utility staffs would participate in annual or semiannual program reviews.
4. Specific utility staff could spend time at BNL and interact with the BNL staff, e.g., to develop collaborative/-cooperative research programs.

As appropriate, this idea of an Associates Program needs to be developed in more detail, especially to define the benefits to the utilities and to BNL.

Summary

This represents an initial plan which would allow more extensive and effective involvement between BNL and the utilities. It is meant to serve as a discussion paper and stimulus for more communication on the topic of BNL utility technical interactions.

APPENDIX B

THE BNL MINI INCUBATOR FACILITY

Background

In November, 1985, the Laboratory Office of Research and Technology Applications (ORTA) initiated discussions with the New York State Urban Development Corporation (UDC), SUNY at Stony Brook, Polytechnic University, the Industrial Development Agencies of Suffolk and Nassau Counties, the New York State Department of Commerce, the New York State Science and Technology Agency, NASA, the Nassau/Suffolk Bi-County Planning Commission, the Long Island Forum for Technology and numerous local industrialists, community leaders and venture capitalists. The intent of these discussions was to explore the creation of a facility for start-up, technology based companies on Long Island. Over a hundred of these "incubator facilities" have been established in the United States.

The plan is not to limit the start-ups to technologies developed at Brookhaven. At other incubators some of the start-ups are often low technology support activities. However, BNL technology might provide start-ups in areas such as air sampling devices, including air infiltration measurements, light source analytical instrumentation, radiopharmaceuticals, food irradiation, catalysts, small decentralized fuel cells, physical applications of biological processes, superconductivity, polymeric electrical insulation, vacuum technologies, and polymer concretes.

In the past several years, incubator facilities have been created at over 100 locations. Their goal is to create local employment, add to the tax base, and expand the nation's new innovative industrial technology endeavors. Such facilities exist at R.P.I., in New Haven, Conn. associated with Yale, and at four locations in Pennsylvania associated with the Univ. of Penn., Carnegie Mellon, Lehigh, and Penn. State. New Jersey is in the process of creating several incubators and the ORTA has been closely involved with the FAA Center in assisting in the creation of the Southern New Jersey Technology Consortium centered on the FAA Center near Atlantic City. The ORTA has also interacted with Science Park in New Haven.

Since the commitment of the Long Island community to an incubator appears to be lukewarm, the ORTA approached the DOE Division of Laboratory Management (they are charged with the DOE responsibility for technology transfer) to get their reaction to

(Appendix B cont'd.)

the establishment of a mini-incubator at the Laboratory. They strongly supported such an effort and agreed that if a mini-incubator was set up at the laboratory, it would be useful in and of itself and might spur more interest on the part of the Long Island community. Community support is necessary if UDC is too participate. DOE pointed out that incubators have been created by other DOE laboratories: at ORNL by Martin Marietta, at Ames Laboratory, at the Solar Energy Research Institute and at Los Alamos. The Brookhaven incubator would be unique in that it would occupy Government space. None of the others are located on Federal Government property.

After a thorough search of the Laboratory, the ORTA was able to identify space in the Medical Building which could be used for one or at most two initial tenants. Almost from the beginning there was an indication of demand, as potential tenants made the ORTA aware of their interests. The proposal was discussed with the local Area Office and the Chicago Operations Office as well as with DOE Headquarters. Their major concern was government liability and it was agreed that this could be worked out by contract language and insurance requirements placed upon the tenant. As of December of this year the only remaining policy obstacle was the ownership of intellectual property by the tenant. This obstacle has apparently been overcome, although the details must be worked out.

Purpose

The unique environment that exists in the vicinity of a large, operating, high-quality, technical organization can prove very valuable to a neophyte industry. It is easy to get together with technical peers at lunch or before or after work and for discussions with respect to particular problems. In some cases the use of these same individuals as consultants is expedited. The availability of the research library is a valuable resource. Just the general intellectual ambience in itself is important. If there is need for access to an unusual instrument or to make difficult analytical measurements, these may be accessed at the laboratory, whereas they would not even be known to an outsider.

If the incubator grows and a home is built for it, special technical services may be created within the incubator for use primarily by incubator tenants. The one at New Haven includes consultants that assist in business planning and marketing, computer rental or time sharing companies and others that sell programming services to the tenants. The ability to share conference rooms, receptionists, and other support personnel is valuable. One of the most difficult problems that an engineer or

(Appendix B cont'd.)

scientist faces in starting up a new enterprise is financial management and legal requirements. The Hofstra University Business School and Law School have expressed interest in developing support activities if an incubator is established. In fact Hofstra, might be willing to take equity positions as payment for services rendered. This is a possibility for the Laboratory that would seem to be permitted under legislation now under consideration in Congress.

Size and Location

Ideally even a mini-incubator should aim for about five or six tenants. This is because it takes about this many start-ups to create a demand for a full time typist/receptionist, and other centrally shared services. An ideal situation would be if these start-ups are located contiguously. Also in an ideal situation there would be a mix of wet laboratory, shop or assembly space and office space that would fit the needs of the prospective tenants. Because of the difficulty of finding any space at Brookhaven, no less contiguous, and with any specific mix of facilities, the ORTA plans to proceed on an ad hoc basis based upon the space and tenants available. Certainly an upper limit would be five to six tenants, and more realistically one to two.

The very existence of a mini-incubator might spark the community interest necessary to create a full scale incubator near the laboratory.

Charges

The Laboratory must meet two DOE requirements in setting a price for the use of the facilities. One of these is that the fee must be set at a level no lower than the cost to acquire use of equivalent space outside of the laboratory. The laboratory has made a survey to determine what an appropriate fee would be. The second requirement is that the Laboratory must receive full cost recovery for any use of government property or services. In the case of the use contract, it is difficult to perceive that the Laboratory's costs will exceed the charge. The user would probably write a purchase order to obtain access for a year and would pay one twelfth of the amount each month. However, if the user wishes to use other laboratory services, such as graphic arts, photography, the central computer, reproduction, or shops, these services will be charged for on a full-cost recovery basis. Even personnel costs, e.g. a fraction of a secretary's time could be arranged this way. Some of these charges, may be included in

(Appendix B cont'd.)

the contractual arrangements, most would be accessed through the use of purchase orders.

Normally a user would pay for modifications and other up-front charges at the beginning of the use. It may be worthwhile to explore approaches whereby the user could prorate these over the life of the contract, with the understanding that the outstanding balance would become due if the contract were terminated prematurely.

Procedures

After a prospective user has seen the facilities available, and has been told what they would cost, the Laboratory legal staff should thoroughly explain the restrictions and limitations that might be imposed. The user should then be asked to prepare a non-proprietary description of the kind of work that is planned, the laboratory services that might be used, the provisions that will be made to meet laboratory health safety and environmental requirements, and plans for self-insurance for those risks that DOE or the Laboratory require. This proposal will then be reviewed by the DOE Area Office for DOE approval, the Safety and Security Committees and Plant Engineering for assurance that safety and security requirements are met, The Office of Research and Technology Applications to determine administrative feasibility, the Department landlord of the space where the user will be located to determine that the Departmental programs will not be adversely impacted, and Laboratory management to assure acceptance of the user and the proposed work. The normal agreement will be for one year with the expectation that it will probably be renewed once. Since it is hoped that these start-ups will be successful and wish to move to more appropriate locations, it will be understood that the user is expected to leave at the end of the second year. Renewals for a period beyond this should only be considered when the user can show potential success that might be jeopardized by moving to another location at that time.

Criteria

The following criteria will be used to assess proposals from prospective users.

- o The proposed work is consistent with the Laboratory image.
- o The proposed work is likely to lead to a commercial product or service.
- o No special safety, environmental or health problems are associated with the proposed work.

(Appendix B cont'd.)

- o The user demonstrates that there is a reasonable prospect that adequate funding will be available for the proposed period of use.
- o A mutually satisfactory intellectual property agreement can be reached.
- o The user must demonstrate how AUI (BNL) and DOE will be protected against personal liability or suits for financial loss.
- o A mechanism will be established so that BNL staff can be used in a consulting role with appropriate reimbursement made to BNL.
- o BNL support that is supplied under full-cost recovery will be on a best efforts basis and at the sole risk of the user. AUI (BNL) or DOE will not be liable for losses incurred due to availability or operability of equipment or personnel.

APPENDIX C
LICENSE AGREEMENT
FOR USERS OF THE BNL MINI-INCUBATOR

Note: Does NOT include License Agreement Appendixes A and B.

LICENSE AGREEMENT

This License Agreement ("Agreement"), effective this _____ day of _____, 198____, is between Associated Universities, Inc., Upton, New York, 11973, ("AUI") and _____, having a principal place of business at _____ ("Contractor").

Whereas, AUI has entered into a contract ("Prime Contract") with the United States Department of Energy ("DOE"), designated as Contract No. DE-AC02-76CH00016, for the operation of a research laboratory known as Brookhaven National Laboratory ("Brookhaven").

Whereas, under the terms of this Prime Contract, and in connection with the operation of Brookhaven, AUI is willing and able to license use of certain designated facilities at Brookhaven for specified limited purposes, as more particularly specified herein, on the terms and conditions more fully set forth herein.

Now, therefore, in consideration of the mutual covenants herein and other consideration, as called for by this Agreement, the parties mutually agree as follows:

I. DESCRIPTION OF LICENSED FACILITY

1. The only licensed facility on the Brookhaven site to which Contractor is given access or use rights comprises that portion of Building No. ____, located on _____ Street, consisting of _____ square feet of floor space which now bears the Room No. _____ and is accessible through a common entry doorway to said building facing on said street. The licensed facility is acknowledged by the parties hereto to be in good repair and operating condition and is licensed as such on an "as is" basis.
2. The licensed facility includes _____ operating lighting fixtures and associated wiring and on-off switches, _____ heat exchanger units operably connected to _____, and _____ electrical wall outlet sockets wired to a source of alternating current, approximately 120 volt, electric power. _____ telephone connecting jacks are installed in the licensed facility.
3. The following items of equipment, furniture, and other miscellaneous property, all of which are acknowledged to be in good repair and condition, are included in the licensed facility:
4. There are _____ windows in the licensed facility and each window is provided with an installed _____ blind or curtain that is in good repair and operating condition. The ceiling of the licensed facility is in good condition and is covered by a water-tight roof.

II - TERM OF AGREEMENT

1. This Agreement is effective as of the date appearing at the outset of the Agreement and shall continue in effect for two (2) years, ending on the ____ day of ____, 198__, unless terminated earlier, as provided for herein. It is understood by the parties that in the normal course of events the license granted hereby will not be renewed or extended; however, in the event that there are special circumstances that make such a renewal or extension desirable to both of the parties, such a renewal or extension may be negotiated subject to all of the approvals required for the present license.
2. Prior to the date of termination of this Agreement, Contractor shall remove all of Contractor's equipment and property from the licensed facility and the Brookhaven site. Failure of Contractor to remove such equipment and property, or otherwise take steps to terminate its activities under this Agreement by the stated date of termination, shall give Contractor no further or additional rights hereunder or to the licensed facility. Upon termination of this Agreement, Contractor shall leave the licensed facility in the same condition it was in at the commencement of this Agreement, reasonable wear and tear excepted.
3. The failure or omission of AUI to terminate this Agreement for violation of any of its terms, conditions or covenants shall not be deemed to be a consent by AUI to such violation, and shall not bar, estop or prevent AUI from terminating the Agreement thereafter, either for such, or for any subsequent violations of any such term, condition or covenant.
4. In the event of the inability of AUI to make available to Contractor the licensed facility at the time herein fixed for the commencement of the term of this Agreement, neither AUI, the U. S. Government, nor their agents shall be liable for any damage caused thereby; nor shall this Agreement become void or voidable as a consequence thereof, but in such event the Contractor shall not be liable for the pro-rata, un-used portion of the license fee until such time as AUI can make the licensed facility available to Contractor.

III - CONTRACTOR'S RESPONSIBILITIES

1. Title to the licensed facility and to all of the furnishings, equipment and property in the licensed facility at the time this license commences is, and shall remain, in the U. S. Government. The Contractor shall be fully responsible for any loss of such furnishings, equipment or property and for any damage to such furnishings, equipment or property or to the licensed facility itself during the term of this Agreement, reasonable wear and tear thereof excepted.
2. The Contractor agrees to maintain the licensed facility and all AUI provided furnishings, equipment and property in it in good, neat and orderly condition and in working order. All necessary maintenance and repairs thereto shall be at the sole expense of the Contractor, unless this obligation is waived by AUI. AUI retains the right of final

approval of all repairs or alterations that Contractor undertakes to make in the licensed facility.

3. The Contractor agrees to indemnify and hold harmless AUI, the U. S. Government, and the employees and agents of either as well as any guest scientists or other visitors to the Laboratory, against any liability or claim for property damage or personal injury, resulting from Contractor's use of or access to the licensed facility and associated furnishings, equipment, and property covered by this Agreement, unless said damage or injury is the result of the negligence of AUI or the U.S. Government.

IV - RESTRICTED USE PROVISIONS

1. Contractor shall use the licensed facility and associated furnishings, equipment and property therein only for the purpose of _____, and subject to all of the terms and conditions of this Agreement. No other portion of said Building No. _____ or of any other facility on the Brookhaven site is licensed hereby to the Contractor. Nothing in this Agreement shall give the Contractor any right to occupy or use the licensed facility or associated building, buildings or land of the Laboratory for any purpose or under any conditions other than those set forth in this Agreement.
2. The Contractor shall be solely responsible for maintaining the security of any of its own property that is or may become located in the licensed facility or that is or may be in transit to or from that facility. The Contractor shall provide, at its own expense, all property and equipment, beyond that specifically identified above, which Contractor wishes to temporarily install or use in the licensed facility. All installation and removal costs for such property and equipment and the costs associated with restoring the licensed facility to its original condition will be borne exclusively by the Contractor. Contractor will not install or remove equipment in the licensed facility without first obtaining the written approval therefor from AUI.
3. Nothing in this Agreement shall be construed as constituting Contractor and AUI or Brookhaven as partners, or as creating the relationship of employer and employee, franchisor and franchisee, master and servant, or principal and agent between them, and Contractor is forbidden from implying any such relationship in its advertising or publications. Contractor is forbidden from using Brookhaven National Laboratory or Associated Universities, Inc. on its letterhead or in any other correspondence as its mailing address.

V - PAYMENT

1. As consideration for the license granted herein, the Contractor hereby agrees to pay AUI a fixed license fee of \$ _____ per month payable on the first day of each month. This monthly license fee represents full cost recovery to AUI. Upon the execution of this Agreement by both parties, Contractor will promptly tender payment of \$ _____ for the last month's license fee, and a further payment of \$ _____ to be

held by AUI as a security deposit for the full and faithful performance of the terms of this Agreement. All such payments shall be made to:

Accounts Receivable Department, Bldg. 134B
Brookhaven National Laboratory
Upton, New York 11973

2. AUI shall provide, without additional charge, all electric power, heat, air conditioning, water, sewage, refuse and snow removal normally necessary for the licensed facility, as it is used exclusively for the above-stated Contractor's purpose during the term of this Agreement.
3. Any other services provided by AUI to Contractor will be at Brookhaven's full cost recovery rate.

VI - ADVERTISING RESTRICTIONS

The Contractor shall not make any use of the names "Brookhaven National Laboratory", "Associated Universities, Inc.", "U. S. Government", "U. S. Department of Energy", or their equivalents, in any display, sign, poster, stationery or other advertising matter, except to the extent that AUI or the Government may approve in advance such a potential usage.

VII - APPLICABLE RULES AND REGULATIONS

1. Under this Agreement, the following employees or agents, and only those individuals, will be afforded access to the Brookhaven site and to the Licensed Facility:

Name

Name

Position

Position

2. The Contractor shall comply with all rules and regulations issued by AUI or DOE, including without limitation regulations relating to security and access to the Brookhaven site or to equipment such as computers and restricted access buildings, cleanliness of premises, operation, parking, loading and unloading of vehicles and storage of inflammable, toxic or other dangerous materials, or use thereof in the licensed facility or on the Brookhaven site. AUI and DOE reserve the right to deny access to the Brookhaven site, and to the licensed facility, to any person, if, in the opinion of either AUI or DOE, such access would be prejudicial to the public interest. Should employment or continued employment of any person by the Contractor be deemed by AUI to be prejudicial to the public interest, that person shall be immediately removed from the licensed facility and the Brookhaven site and shall be denied further access thereto by the Contractor. Such rules and regulations shall be reasonable but it is to be understood that they may prevent the Contractor from carrying on certain aspects of its business in the licensed facility.

3. AUI and the U. S. Government or its representatives shall have the right at all times, before, during and after the term of this Agreement, to enter the licensed facility for the purpose of examining or inspecting the same, and of making such repairs or alterations therein or in other parts of the building housing said licensed facility as AUI or the U. S. Government shall deem necessary in connection with said facility or building.

VIII - PERMITS AND LICENSES

The Contractor shall obtain, at no cost to AUI, all permits and licenses governing the conduct or operation of the undertakings by Contractor in achieving the above-stated purposes in the licensed facility. Contractor shall abide by all applicable laws, regulations, ordinances, rules and regulations of the U. S. Government, the state of New York and of any other duly constituted authority having jurisdiction over its operations, as may be necessary under the circumstances.

IX - ASSIGNMENT

This Agreement may be assigned by AUI to DOE or to a successor operator of Brookhaven. The Contractor may not transfer, assign or sub-license its rights hereunder or any interest therein.

X - INSURANCE

1. The Contractor will, at no cost to AUI, maintain policies providing, at least, the following insurance protection, which insurance protection shall apply to all operations of the Contractor under this Agreement and to employees and agents of the Contractor engaged therein.
 - (a) Workmen's Compensation - coverage as provided in the Workmen's Compensation Law of the State of New York, including occupational disease coverage for minimal limits of \$50,000 per person in any one case and additional minimal Employees' Liability of \$100,000 per occurrence.
 - (b) General Liability - insurance coverage of at least \$250,000/\$500,000 for bodily injury liability and \$50,000 for property damage in the comprehensive policy form.
 - (c) Vehicle Liability - insurance with coverage of at least \$250,000/\$500,000 for bodily injury liability and \$50,000 for property damage liability in the comprehensive policy form.
2. The Contractor shall also provide an endorsement to its liability policies either (i) naming Associated Universities, Inc. and the U. S. Government as additional insureds, or (ii) insuring the Contractor's obligations under the paragraph hereof entitled "Contractor's Responsibilities", Article III, above.
3. The Contractor may purchase at its own expense such additional or other insurance protection as it may deem necessary or desirable.

4. The Contractor shall furnish to AUI a certificate of insurance to show compliance with the foregoing insurance requirements, at the time this Agreement is signed.

XI - BROOKHAVEN'S AUTHORIZED REPRESENTATIVE

Mr. James Desmond, Business Manager, Brookhaven National Laboratory, is AUI's Authorized Representative for matters dealing with this License Agreement. Any questions or requests are to be directed to his attention at 516-282-3330.

XII - ADDITIONAL PROVISIONS

Appendix A is annexed hereto and made a part hereof. It contains additional provisions to this Agreement. As used throughout Appendix A, the word "Contract" shall mean License Agreement.

XIII - PATENT AND TECHNICAL DATA PROVISIONS

Appendix B is annexed and made a part hereof. It sets forth the intellectual property provisions of this Agreement. This Agreement is issued under the DOE "Class Waiver of Government Rights in Inventions Arising From the Use of DOE Facilities and Facility Contractors By or For Third Party Sponsors" and the patent and technical data provisions in Appendix B are consistent with said waiver. The license fee paid by Contractor to AUI hereunder represents full cost recovery to AUI.

XIV - ENTIRE AGREEMENT

This Agreement contains all of the terms and provisions between the parties with respect to the subject matter hereof, and no other promise, agreement or understanding made heretofore with respect to that subject matter shall be binding on either party.

XV - APPROVAL

This Agreement is subject to the written approval of DOE and shall not be binding unless so approved. This Agreement does not bind nor purport to bind the U. S. Government.

CONTRACTOR

ASSOCIATED UNIVERSITIES, INC.

By _____

By _____

Title _____

Title _____

Date _____

Date _____

APPROVED:

U. S. DEPARTMENT OF ENERGY

By _____

Title _____

Date _____