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Author(s): J. B. Wilhelmy

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INTRODUCTION

Without strong ties to academic institutions and to the broader scientific and technological community, Los Alamos will lose the scientific vitality essential to meeting the ever-changing needs of national security. Just as certainly as the end of the Cold War and the subsequent Comprehensive Nuclear Test Ban have caused drastic shifts in national policy and in the mission priorities at National Laboratories, the future will be no less demanding. Universities provide the life-blood of the Laboratory through new students, postdoctoral fellows and technical staff members. These young scientists contribute strongly to the mission of the Laboratory and will provide the next generation of scientific excellence needed for many programs including the maintenance of the nuclear weapons stockpile. During the latter half of this century, the United States has welcomed many of the brightest and best students from around the world to its academic institutions. They in turn have helped fuel the technological revolution that drives the U.S. economy, and today they account for fully 50% of the graduate students in crucial scientific and technical fields. We will greatly impede our ability to maintain the necessary contact with academic institutions that the Laboratory mission requires if major restrictions are imposed upon interactions with foreign national scientists. Such restrictions are currently being considered based on recent national and congressional concerns about security at the National Laboratories and on the absolute necessity for protecting classified information against unauthorized disclosure. Given these opposing tensions, the Fellows at Los Alamos National Laboratory (see section A of the Appendix) have considered the situation and present here what we believe are important arguments addressing the position of foreign national scientists as visitors, students, postdoctoral fellows and technical staff at the Laboratory. There is already clear evidence of erosion in foreign national participation and general morale at the Laboratory, and, unless this issue is addressed with dispatch, the Laboratory is likely to lose a critical resource that we will not soon recover. In support of the direct arguments presented, we provide additional documentation in the Appendix.

At Los Alamos we must and do take the protection of classified data seriously, as we and our predecessors, have for more than fifty years. Also for more than fifty years, open and classified research and development have successfully coexisted at Los Alamos. This

coexistence has resulted in an enhancement of both the security and the scientific prestige of the Nation. With very few, carefully controlled exceptions, it is the Department of Energy's and the Laboratory's policy and procedure that only cleared U.S. citizens -- not foreign nationals -- have access to classified material. In fact, if there is a security risk at the Laboratory, it most likely would not come directly from the foreign nationals. However, we acknowledge there is certainly a risk, for which we must be constantly vigilant, of indirect access to classified information through the interactions between foreign nationals and cleared U.S. citizen members of the Laboratory.

The purpose of this report is threefold. First, we point out why foreign nationals are extremely important to the Laboratory mission and how, in that role, they have made major contributions. It should also be noted that the Laboratory has always employed many naturalized citizens in both classified and unclassified research. Next, we analyze the security questions and discuss the impact of foreign national involvement. Finally, we address the potential impact that restrictions in foreign national involvement would have on the Laboratory's science and technology base and discuss effects that have already been felt. This analysis must be done within the context of the Laboratory's mission in National Security (nuclear weapons, threat reduction, and non-nuclear defense issues) and in applied and fundamental research that address civilian and military needs. Our conclusion is that the excellence in science and engineering brought to the Laboratory by foreign nationals in our unclassified programs is extremely important for strengthening our science and technology base and ensuring the well-being of the Laboratory and the successful execution of the Laboratory's mission. We further conclude that the security risks associated with foreign national involvement at the Laboratory can be successfully controlled, and we make certain recommendations based on our analysis.

FOREIGN NATIONAL PRESENCE

Foreign nationals constitute a significant fraction (see Appendix Section B) of young scientists trained in this country today. They are represented at the Laboratory in the postdoctoral and student programs at similar fractional levels and at somewhat lower levels as technical staff members (459 foreign nationals - not yet U.S. citizens - are currently in technical positions at the Laboratory either as permanent, limited term, postdoctoral fellow or student). They participate only in the unclassified, open portion of the Laboratory. They have performed admirably in this context and are highly valued employees (see Appendix Section C). The real issue is: why the Laboratory cannot simply restrict employment to U.S. scientists since they too perform very well and are

presumably a lower security risk. There are several answers to this question that revolve around the international nature of science and technology and the international student and academic population at our universities. A recent National Science Board report on higher education in science and engineering tracked the demographics of foreign national participation in science and engineering over the past decade. They note that foreign nationals, particularly from India and China, now constitute a sizeable fraction of the pool of available young scientists being trained in the U.S. For example, the percentage of foreign nationals receiving Ph.D. degrees reached 47% in American universities in 1994 and is currently greater than 50% in some subfields. An extreme example is in the areas of nuclear engineering, nuclear materials, and radiation transport that are of prime interest to the laboratory mission. The collapse of the nuclear power industry in this country has severely limited the interest in this subfield among U.S. born students so that significantly more than 50% of graduate students in this area are foreign born. These conditions have had important consequences for Los Alamos recruitment of scientific talent, and not just to the degree the statistics would indicate. For example, a recent job search done at Los Alamos National Laboratory for a postdoctoral fellow to participate in an applied research program in nuclear materials was advertised in Physics Today and on a Laboratory web site. This ad produced 24 applicants, none of whom were U.S. citizens! The major shift in the population of US graduate schools is the issue – 10-15 years ago this was not a major factor in our recruitment efforts, but it is today.

Given the facts about the sources of young scientists, we can find answers to why foreign national involvement at Los Alamos is critical. We must attract the best and brightest to Los Alamos to maintain the vitality of our underlying science and technology base that supports all of our basic and programmatic efforts. Unlike in totalitarian states that may be able to force their best scientists to work on weapons programs, national security laboratories in democratic countries must compete for scientists who have many other employment options. The best scientists will always be attracted to institutions where they have the best opportunity to engage in forefront, exciting work. The initial involvement of many who come to the Laboratory is not in the weapons program. They are often attracted by the breadth of the on-going high quality research in other Laboratory projects. Some eventually discover equally challenging problems in weapons work. To maintain the vitality of all this research we need broad scale interactions throughout the world wide scientific community. If we have a discriminatory policy that only permits U.S. citizens at Los Alamos, our academic colleagues are likely to interpret this as a lack of commitment to the breadth required for scientific excellence and may be less likely to advise their best students to come to the Laboratory, even if the students are U.S. citizens. Given the change in the demographics of graduate education in the

sciences, it can often be the case that a foreign student candidate may be significantly superior to the U.S. students available to fill some of the important unclassified positions. In the short term, the Laboratory might survive an approach that excluded foreign scientists, but in the long term this policy would be disastrous for the Laboratory and the national security developments required by the nation. Thus, we conclude that to maintain the scientific and technological vitality of the Laboratory, to obtain excellent scientists in general and specifically in fields of interest to the Laboratory but of limited interest to U.S. citizens, and to maintain the cooperation and respect of the academic institutions and the candidate scientists, the Laboratory must not restrict the access of foreign nationals into its unclassified programs.

SECURITY CONSIDERATIONS

National security is a serious matter for the Laboratory. Foreign governments certainly target National Laboratories for information gathering, and restrictions and controls are needed to prevent classified information from falling into the wrong hands. Whereas we have made strong arguments for including foreign nationals, security concerns push in other directions. The important point is that the question of restricting foreign nationals at the Laboratory must consider both the risks associated with their inclusion and the consequences of their exclusion. In this context we need to consider two categories, classified information and sensitive information.

A. Classified Information

Restrictions or controls help to ensure that classified information is not divulged by cleared Laboratory personnel, and to ensure that non-cleared personnel, whether foreign nationals or U.S. citizens, do not have access to secure areas or to classified information. Outside of these secure areas contact with foreign nationals can take place both on-site in the open unclassified areas and off-site away from the Laboratory. The latter contact often involves travel to foreign countries, where official travel usually includes interaction with scientific or other personnel. During regular security briefings Laboratory members are informed about and trained in proper procedures to ensure that classified information is protected, both physically and orally. In addition to foreign travel, personnel contacts within the U.S. or on-site at the Laboratory are subject to similar constraints and procedures.

Foreign nationals whether physically or not physically present at the Laboratory offer the potential for illicit transfer of classified information. Such a transfer would require,

however, either a breakdown of physical access rules or a conscious action on the part of cleared Laboratory personnel to divulge controlled and protected information. Neither can be absolutely ruled out. Physical breach of the security perimeter is unlikely but cannot be ruled out. Breach of disclosure regulations by cleared personnel is always possible, regardless of nationality; recall that in World War II, with the exception of Klaus Fuchs, it was U.S. citizen to U.S. citizen disclosures that provided information that eventually reached the Soviet Union.

The key to the protection of classified information and materials lies in the security education and the constant vigilance and commitment of the cleared staff of the Laboratory and its contractors. Recent events have raised concerns about security violations and information disclosures, and they emphasize the necessity for Laboratory personnel to continue to follow both the letter and the spirit of the law rigorously. Personnel must continue to be alert to possible compromises, including conveying classified information to foreign nationals.

In summary, we agree that the presence of foreign nationals at the Laboratory does offer a potential avenue for disclosure of classified information; however, the most likely method for this disclosure to occur is through a strong violation of security by a cleared U.S. citizen. If security is carefully monitored and emphasized we believe that this avenue can be controlled successfully. However, we do acknowledge that serious violations appear to have occurred in the past because of security infractions by cleared personnel.

B. Sensitive Information

Most of the unclassified information produced at the laboratory is intended for publication in the peer reviewed scientific and technical literature and is thus available to the general public. The Laboratory's strong participation in this area is central to a major fraction of its mission, namely to aid and augment the technical information base of the United States and the world, for example in areas of global warming and the protection of nuclear materials. An important secondary function of disseminating this information is the role it plays in maintaining the career development of the technical staff, the Laboratory's reputation, and its recruitment activities. In addition to this open information, the Laboratory does produce sensitive information that includes personnel information, proprietary information accumulated in collaboration with American industry, other technologically-important but unclassified information deemed of potential value to the United States, and information about certain nuclear materials and related handling and processing of those materials. Foreign nationals at the Laboratory

have a greater opportunity to obtain such unclassified information, but the accompanying consequences are likely to be smaller for this type information. How much smaller depends on the specific information. For example, National Laboratories certainly develop valuable unclassified technology but, unlike the situation for the industrial sector, this is not proprietary information critical to their profitability and/or ultimate existence. The consequences of losing some of this information are, in our opinion, small when balanced against the outstanding positive contributions made by foreign national scientists at Los Alamos. For example, a foreign national was instrumental in inventing the high temperature superconducting wire processing method developed at Los Alamos. Without the involvement of this foreign national Los Alamos probably would not have any information to divulge on this forefront subject. On the other hand, some restricted but unclassified information could be damaging to national security if it were disclosed.

The important point with regard to sensitive information is that the restrictions applied should be proportional to the risk. We note with great concern that in the recent debate on foreign nationals, severe restrictions have been proposed that would impact technical unclassified areas of low risk for which no solid evidence of any wrongdoing with respect to sensitive information disclosure exists. Recent characterizations proposed for sensitive information have become so general that almost everything falls in this category if broadly interpreted. Unnecessary expansion of the list of sensitive topics severely limits the free exchange of information in the international community. For example, if all research on plutonium is declared sensitive, then the international scientific exchange that has benefited the U.S. in, for example, providing credibility on scientific issues associated with the opening of the Waste Isolation Pilot Project (WIPP) would be lost. A very serious effort needs to be made to ensure that the vague and ill-defined category ‘sensitive’ remains realistic and does not become all encompassing. The problem comes from confusing the severe consequences of classified information disclosure with the less dangerous loss of sensitive information. This would have a chilling effect not just on foreign national involvement but on the work of almost every scientist at the Laboratory.

CONSEQUENCES

The impact on foreign national involvement at the Laboratory is already being felt. We feel the need to make known some of the consequences of the present policies and uncertainties surrounding the present security issues. A number of talented foreign national postdoctoral fellows, limited term staff, and permanent staff have already accepted positions elsewhere because of the uncertainty associated with the environment

for foreign nationals at the Laboratory. Several foreign nationals have been denied access to their offices, postdoctoral fellows have not been renewed based on newly-applied criteria, and foreign nationals have been denied the opportunity to apply for Laboratory positions for which they are qualified. In this February's Laboratory postdoctoral selection process all five of the top candidates selected for the highly coveted Director-funded Los Alamos Fellowships were foreign nationals. Of these five, three (including the top two) rejected the offers. The three that rejected the offers were all from sensitive countries (Russia, China, and India). The top two communicated with their sponsors that the current Laboratory situation was the reason for going elsewhere. A number of the very best staff who traditionally mentor postdoctoral fellows have decided not to recruit foreign nationals because of their uncertain future. Staff members who depend on the availability of top young postdoctoral fellows conclude that they cannot do their jobs if this continues. Further, the atmosphere created by severe restrictions on foreign nationals will almost certainly result in the exodus of many of our best American scientists. The long-term loss of many of these people would be disastrous for the Laboratory. Foreign national staff members are unsure about their sources of funding owing to the already limited range of funding that can be used to support them. They further feel unable to do their jobs, as association with perceived sensitive topics is fraught with uncertainty; better to do nothing than to get involved with a sensitive subject. To make matters worse, what even constitutes sensitive information is extremely vague and uncertain.

The above examples, and many others (e.g., foreign travel restrictions for U.S. citizens, restrictions in the use of Laboratory Directed Research and Development funding, the temporary suspension of foreign nationals from working at the Laboratory, temporary denial of smart-card access to foreign postdoctoral fellows, highly restricted building access for foreign nationals, etc.) have sent shock waves through the foreign-national community at the Laboratory. Quite simply, the foreign-national community is in an understandable panic, and many are actively seeking external employment despite the fact that it is quite unlikely that their current positions are in jeopardy. Despite efforts by Laboratory management and by Secretary Richardson to reassure foreign nationals of their position in the Laboratory, the general feeling within the foreign-national community is that their future is uncertain at best. This is compounded by initial restrictive adverse actions that were taken in recent weeks. These actions speak louder than words and though the strong statements from Director John Browne, Secretary Richardson and our Congressional delegation offer reassurances, they must be followed by immediate and forceful actions to reverse these disastrous trends.

CONCLUSIONS

The need to protect classified information and the potential for security risks associated with a foreign national presence are clear. However, we conclude that although the presence of foreign nationals at the Laboratory does offer a potential avenue for disclosure of classified information, if carefully monitored this avenue can be controlled successfully through education and procedural adherence by the source of the information – U.S. citizens. Given that there has been, as Laboratory Director John Browne said in his Congressional testimony on May 5, 1999, "an extremely serious compromise of the security of classified nuclear weapons information" and also given the sheer size of our foreign national involvement and foreign exchange programs, it is necessary for staff and management to make a special effort to heighten security awareness and tighten security procedures. This should be a graded approach taking into consideration the risks of the information involved and consequences of the restrictive actions proposed. With the demise of the Former Soviet Union, it has become U.S. policy to provide technical assistance for the assurance of the safety and security of special nuclear materials there. It must be recognized that to adhere to this policy we must exchange scientists and have foreign national visitor participants in this important component of our national security. We conclude that foreign-national participation is vital in open areas of the Laboratory to maintain the intellectual capacity to perform the Laboratory mission. We also conclude that scientific exchange in the international community that includes sensitive countries is vital to the well-being of the Laboratory and to our ability to execute our immediate and long-term missions. We recommend that:

* Staff and management take steps to improve the protection of classified and sensitive information in the environment of a foreign national presence in the unclassified open areas.

* In order to support the mission of the Laboratory effectively, appropriate foreign-national participation from sensitive and non-sensitive countries be maintained at the Laboratory.

* With heightened security awareness, the laboratory’s participation in Russian and Chinese exchange programs and scientific exchanges in international forums be maintained.

* To protect the Laboratory’s vitality and effectiveness, foreign nationals continue to be considered full participants in the Laboratory culture.

* Laboratory policy with regard to foreign national participation should be clearly established, implemented uniformly and communicated to all Laboratory personnel

We conclude our remarks with quotes from Senator Domenici (R-NM), Senator Jeff Bingaman (D-NM), DOE Secretary Richardson, and the National Academy of Sciences:

"… based upon my personal knowledge and experience, scientist-to-scientist contact is critical in this modern world. I support a review of the net value and cost of certain programs that create contact between scientists from the labs and scientists from sensitive nations. But, a wholesale prohibition not only seems misplaced in light of the espionage cases of which we have knowledge, but actually counter-productive to America's interests."

Senator Pete Domenici – press release May 5, 1999

"There's always a danger that Congress will overstep and enact measures that do more harm that good to our national security. Shutting down the foreign visitor programs, for instance, would wall off our scientists from important information and make it much harder to accomplish vital goals like reducing the threat posed by Russia's aging nuclear arsenal."

Senator Jeff Bingaman – press release May 25, 1999

"When the classified areas of our national labs are properly secured, cooperation with foreign scientists can be conducted safely. We do not engage in this cooperation because we can, but because it is in our national interest to do so. This is in America's national security interest to cooperate with foreign scientists. The strength of the programs that support our nuclear arsenal is in the quality of its broad scientific base, which is at the heart of our efforts to maintain our weapons without nuclear testing."

DOE Secretary Bill Richardson –Remarks to National Academy of Sciences, May 12, 1999

"We are deeply concerned about the consequences of potentially inappropriate restrictions on the program for foreign visitors at the Department of Energy's national laboratories. Such restrictions could harm our U.S. national interests by impeding scientific progress, weaken the nation's role as a key player in the international scientific community, and endanger international cooperative activities that bolster our national security and well-being by addressing such issues as nuclear safety and environmental cleanup."

APPENDIX

A. Los Alamos National Laboratory (LANL) Fellows

The Fellows are a group of senior LANL scientists and engineers who have been recognized for their outstanding technical accomplishments. Fellows come from all directorates of the Laboratory, span a wide range of technical backgrounds and contribute broadly to National Security, applied research and to fundamental research at the Laboratory. Many of the Laboratory Fellows are also Fellows of Professional organizations such as the American Physical Society, have won prestigious national and international scientific Awards and Prizes (E.O. Lawrence Award (APS), APS Prize for New Materials, Bonner Prize, etc) and serve on advisory panels covering a wide range of scientific topics. Several of the Fellows are Members of the National Academy of Sciences. Of the 72 Fellows currently employed by the Lab, 14 were born in a foreign country.

B. Foreign Nationals and the Pool of Young Scientists:

For several decades, the National Science Foundation has had statutory responsibility for compiling statistics and trends pertaining to the state of science and engineering (S&E) in the U.S. These data are published in Science and Engineering Indicators, which has been viewed since 1957 as a "measurement of national economic strength." The Fellows recognize that certain trends brought out in Science and Engineering Indicators 1998 are centrally relevant to the issues currently surrounding employment of foreign nationals at Los Alamos National Laboratory.

In recent years there has been what the NSF describes as "global diffusion of S&E education":

* From 1986 to 1995, the rate of first (undergraduate) university degrees in science and engineering increased 4.8% in Asia and Europe but only 1.3% in North America.

* While the number of S&E doctorates in the U.S. doubled from 1986 to 1995, this was primarily due to foreign doctoral students.

* From 1986 to 1995 the number of foreign recipients of S&E doctorates from U.S. universities increased at an average rate of 8.2% annually while the number of U.S. born Ph.D. recipients increased at an average annual rate of only 1.9%. (More than half of the foreign Ph.D. students over this period came from China, Taiwan, India and South Korea.)

* The U.S. is by far the world's largest spender for scientific research and development, but it does not lead the world in the number of advanced degrees awarded in S&E.

* Foreign nationals have recently accounted for slightly more than half of the postdoctoral fellowship appointments at U.S. universities.

* Approximately 30% of current mathematics and computer sciences professors in the U.S. are foreign born.

While foreign-born scientists have always been prominent in our culture and at Los Alamos National Lab, we are now witnessing a conspicuous nation-wide demographic shift towards employment of foreign-born scientists and engineers. In 1993, 23% of the S&E workforce in the U.S. were foreign-born; Asians, who represented 4% of the U.S. population, held more than 10% of the science and engineering jobs. These proportions are likely to increase:

* About half of new S&E jobs each year require masters or doctoral degrees; 60% of Asians currently in the S&E workforce possess advanced degrees compared to 40% of U.S. citizens.

* The NSF projects that S&E employment will increase by 44% during 1996-2006, three times the projected rate for all occupations (14%), and that approximately three-fourths of the new jobs will be in the computer sciences, a field in which Asians account for 39% of Ph.D. recipients.

* A survey of foreign S&E Ph.D. recipients between 1992 and 1996 revealed that 68% were planning to locate in the U.S. (47% of foreign Ph.D. recipients who earned their doctorates in 1990-1991 were working in the U.S. in 1995.)

The employment patterns at Los Alamos National Laboratory reflect these national trends. The percentage of foreign nationals employed at the Lab in all positions (staff,

technical, support) is lower than in the national S&E workforce, (459 foreign nationals are currently employed by LANL.). However:

* The percentages of foreign graduate students, postdoctoral fellows and staff members are virtually identical to what is seen in U.S. universities.

* Between December 1997 and February 1999, 340 individuals applied for LANL postdoctoral appointments, of whom 53% were foreign nationals. Of these, 41% were from sensitive countries.

The Laboratory must be able to hire scientific employees of the highest caliber if it is to maintain its current standards of excellence. The pool from which these employees must come will include an increasingly large percentage of foreign nationals. A case in point is the Lab's Postdoctoral Fellowship Program, an internationally recognized and vital asset of the Laboratory that is essential in bringing state-of-the-art skills and knowledge to Los Alamos. Ph.D. recipients from the top university programs in the United States are superbly trained in the latest research techniques, instrumentation, and singular wisdom that cannot be obtained from literature or other sources. Postdoctoral fellows are much more than a pair of hands for laboratory or computational work and often move on to become the next generation of Laboratory staff members. With this in mind, it is essential that the best available candidates are hired, but this is by no means a controlled, straightforward process. Postdoctoral applicants are intensely scrutinized by committees at LANL for their scientific excellence and likelihood for future success, and the most gifted candidates (13%) are offered Lab-funded postdoctoral fellowships. The current statistics at Los Alamos (12/97-present) show that slightly more than 50% of the candidates selected for the most prestigious postdoctoral positions at the Laboratory are non-U.S. citizens, including 20% from sensitive countries. Often, however, the most highly qualified candidates are simply unavailable at the right time or snatched up by universities and industrial labs, so the Laboratory is in a highly competitive situation for the best talent in the world.

C. LANL History of Foreign National Involvement

The Early Years

Foreign born scientists have been a vital component of LANL since the inception of the Manhattan Project. At the time the center of nuclear research was Europe and for the U.S. to have a forefront effort in developing fission weapons it was imperative that we have

access to top scientists. Names such as Bethe, Fermi, von Neumann, Tuck, Mark, Segre, Chadwick, Teller and Ulam define an era. All foreign born, all with ties to Los Alamos, and all serving the U.S. with honor and distinction. Particular examples that are noteworthy include:

* Demonstration of the feasibility of a nuclear reactor for plutonium production at Stagg Field (University of Chicago) by Enrico Fermi, an Italian physicist, who was technically an enemy alien.

* The purity standard for the uranium fuel (to minimize the deleterious effect of light metals such as boron and cadmium in the fuel) was determined in Los Alamos mostly by foreign nationals including Fermi, Bethe and Teller. When plutonium impurity problems occurred, it was Cyril Smith of Massachusetts Institute of Technology (a Briton), who established the purity levels required to achieve the needed metallurgical physical properties, fabrication and corrosion resistance for plutonium.

* Much of the early pulsed power work in the Post WWII era was advanced at Los Alamos Scientific Laboratory by the research and consultations of Charles Martin (of Britain) at Los Alamos.

Recent History

During the more modern era, before being named LANL Director, Siegfried Hecker, a naturalized US citizen and eminent metallurgist, pursued a better understanding of plutonium metallurgy, which is a cornerstone to the present science-based stock-pile stewardship program. Other more recent examples of contributions to national security issues and to applied/fundamental research include:

* The experimental and theoretical developments in quantum computing and quantum cryptography led by now naturalized citizens Richard Hughes (UK), Wojciech Zurek (Polish), and Raymond Laflamme (Canadian)

* The development of advanced accelerator technology for SDI applications by Stanley Schriber (Canadian, Nat. US) and Roger Pynn (UK) leading the Los-Alamos-Neutron-Science-Center (LANSCE) experiments.

* Development of new nano-structured materials and characterization of superconducting thin films by Harriet Kung (Taiwan, Nat. US).

* Recognition of the use of nuclear radiography as a dynamic probe of dense material by Avigdor Gavron (Israel, Nat. US).

* Major theoretical advances in nonlinear materials properties including solitons and condensed matter systems by Alan Bishop (UK, Nat. US). He is the recipient of the E. O. Lawrence Award and a Fellow of the APS.

Throughout this period, LANL has maintained active international interactions. We were strong participants in the "Atoms for Peace Initiative" started by President Eisenhower. We have pioneered the field of radiation biology. We have developed the highest-powered nuclear accelerator. We have developed forefront fusion and laser technology. The international flow of information has aided all of our accomplishments. A partial list of contributions by foreign scientists including those from sensitive countries has also been compiled by the Fellows and is given below.

Recent Examples of Excellence in Research Performed by Foreign Nationals
These individuals have contributed to scientific work of great value to science at Los Alamos. Excerpts from this list are given below and it is only a partial list developed by the Fellows.

1. An Indian scientist is the Principal Investigator of a DARPA-sponsored project to develop a novel method for the detection of or for countering biological agents that might be used by terrorists or other hostile parties.

2. An Israeli citizen was instrumental in the discovery of the giant isovector monopole resonance observed for the first time in pion single charge exchange at the Los Alamos Meson Facility (now LANSCE).

3. An Israeli citizen, as a Director-funded post-doctoral fellow, helped explain the significance of the difference in proton and neutron deformation measured in pion-nucleon scattering at LAMPF.

4. A Canadian scientist, a former Oppenheimer post-doc fellow, has been a key contributor to the Sudbury Neutrino Observatory project and the leader in the trapped atom experiment. (The SNO project has received great press in the public and scientific journals and press).

5. A Yugoslav scientist (now a citizen and a full professor at New York University) worked at LANL on the quantum theory of reactive molecular collisions. His work at LANL led to the first fully accurate reaction probabilities in three-dimensional physical space. The findings could be applied to the development of fluorine-hydrogen lasers and to the single most important (H + O2) reaction in all of combustion chemistry.

6. A Chinese scientist, a former Oppenheimer Fellow, was awarded the LANL Fellows' Prize for Outstanding Scientific Research for his research on turbulence. He is one of the leading researchers in numerical simulations of turbulence.

7. A Chinese scientist contributed to critical aspects of the Accelerator Transmission of Waste (ATW) program as both a Director's Funded post-doctoral fellow and as a technical staff member. He initiated most of the current fuel separation technologies and now heads the lead-bismuth spallation and ATW target development.

8. A Chinese post-doc provided crucial experimental expertise for the Magnetic Resonance Force Microscope. This project was instrumental in the development of the quantum computing initiative.

9. A Chinese scientist, a former Oppenheimer Fellow and subsequent technical staff member, was co-developer of the Ion Beam Assisted Deposition processing of high-Tc superconducting wire. This is a very promising technology for high field superconducting magnets.

10. A Chinese scientist has substantially increased the laboratory's instrumentation capabilities in time resolved spectroscopies. He was offered a permanent position at the Lab but has elected to go to the University of Pennsylvania Chemistry Department because of the uncertainty surrounding the current situation for foreign nationals.

11. An Icelandic scientist, a Director-funded post-doctoral fellow and now Associate Professor of Chemistry at the University of California at Santa Cruz, did elegant and widely acclaimed work on spectroscopy and the dynamics of biological energy conversion processes.

12. A Spanish-born scientist was a LANL postdoctoral associate and is now an Associate Professor of Chemistry at the University of Puerto Rico. He was a major contributor to the development of time-resolved infrared spectroscopies for applications

to bio and photo-dynamics related to the dynamics of ligand exchange reactions and oxidize enzymes.

13. A British scientist was a postdoctoral fellow and is now Associate Professor at the University of Otago, New Zealand. At LANL he was regarded as one of the most important contributors to time-resolved infrared and Raman spectroscopies and their applications to photo-physics of inorganic complexes and the conversion of light into usable energy.

14. A Finnish visiting research fellow at LANL developed LANL's capability to observe, by infrared spectroscopy, individual chemical bonds in large proteins and to identify the structures observed in the infrared by site-directed mutagenesis.

15. A German scientist came as a postdoctoral researcher, became a technical staff member, and is now a Principal Investigator on U.S. radionuclide storage programs including WIPP and the Yucca Mountain Site Characterization Project. He brought with him experience from the programmatic responsibilities of the German Gorleben Project on radionuclide storage problems.

16. A Russian scientist was widely recognized as a condensed matter theoretician before coming to Los Alamos. While at LANL he has made significant and substantial contributions to the development of a phenomenological theory of high temperature superconductivity (HTS) in this technologically important field. He has discovered the "Josephson plasma resonance" as a means of determining vortex correlations in superconductivity and is widely regarded as the leading LANL theorist in the area of HTS.

17. A recently hired Indian scientist who is already a recognized leader in the emerging field of self-organizing materials (self-assembly, biometric materials and organic-inorganic hybrids) continues to make seminal contributions since coming to Los Alamos.

18. A Chinese born scientist who has lived in the U.S. for over ten years was brought in to help with developing a new optical biosensor. He has been able to achieve sensitivities for the detection of protein toxins like cholera that are better than the most sensitive lab-based methods while being faster and simpler. His contributions laid the foundation for the first miniature sensor-array system for the detection of biological toxins and pathogens that can be used for environmental detection and early diagnosis of

infection. His group intends to hire this scientist but is likely to lose him to an industrial job offer because of the current situation.

19. A German scientist who was a postdoctoral fellow developed the first approaches at the Lab for using scanning probe methods to study soft condensed matter systems. He is now an associate professor at Freiburg University in Germany.

20. A French scientist who spent a year at the Lab as a research fellow performed the early lattice dynamics calculations for Peierls-distorted quasi-one-dimensional materials that have become a text book example of phonon dispersion in low-dimensional materials. He is now an Associate Professor of Physics at University du Maine in le Mans France.

21. A naturalized U.S. citizen who was born in China came to the Lab on a Director's funded postdoctoral fellowship and was the first to synthesize supramolecular assemblies showing unusually high optical nonlinearities. He is now a permanent staff member and has made important contributions in the development of chemical sensors for the detection of chemical warfare agents and land mines.

22. A Russian postdoctoral fellow made important contributions to understanding two-dimensional turbulence in novel laboratory experiments. This work was reported in Science, Science News, AIP News, Physics Today, and was an APS research highlight for 1998. He also made valuable contributions to unclassified, Advanced-Strategic-Computing-Initiative-related shock-tube physics. Because of restrictions on Laboratory funds for foreign nationals, he was not hired at the Laboratory despite a strong desire to do so. He has accepted a job in the Mechanical Engineering Department at the University of New Mexico.