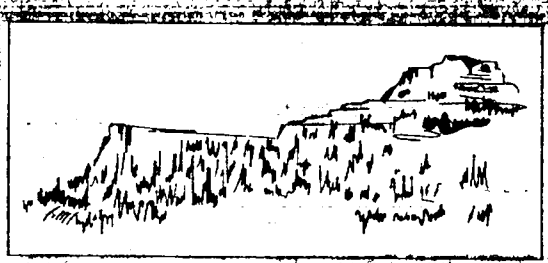
CNSS Papers

Emerging Nuclear Suppliers

William C. Potter



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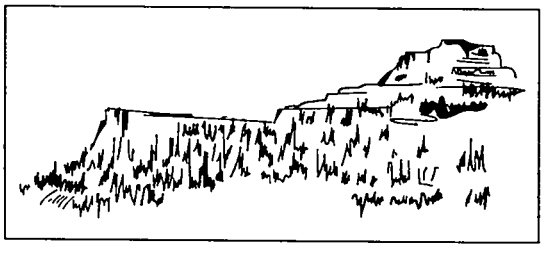

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DR. WILLIAM C. POTTER is the Executive Director of the Center for International and Strategic Affairs at UCLA. He has written widely on nonproliferation policy, Soviet nuclear export policy, and, most recently, the problem of emerging nuclear suppliers. Among Dr. Potter's most recent books are *Nuclear Power and Nonproliferation, Verification and SALT*, and *Soviet Decision Making for National Security.*

EMERGING NUCLEAR SUPPLIERS

William C. Potter

SUMMARY

The development of nuclear energy in coming decades will be strongly influenced by the issue of nonproliferation. Emerging nuclear suppliers pose a serious challenge to the international nonproliferation regime. Countries such as Argentina, Brazil, India, Japan, and Yugoslavia have the capability to export one or a combination of sensitive nuclear technologies, natural uranium, power reactors and components, research reactors and components, and technical training and advice. From early denial and secrecy, the creation in 1957 of the International Atomic Energy Agency, the 1974 formation of the Zangger Committee, to the 1980s challenge to North American and European monopoly, there has developed a growing need for centralization of information. The author describes a research project at UCLA that is constructing a data base on international nuclear transactions.

ABSTRACT

The development of a data base created to track and compile information on international nuclear transactions is discussed. This paper is based on a talk given on May 4, 1987, at the Center for National Security Studies of the Los Alamos National Laboratory. The presentation was followed by a question and answer session, which is included with the paper.

EMERGING NUCLEAR SUPPLIERS

by

William C. Potter

I. INTRODUCTION

The first thing that has to be noted is that the number of states capable of exporting nuclear materials, technology, and equipment is quite large and is growing. Among the states most often cited as emerging suppliers are countries such as Argentina, Brazil, India, Israel, Japan, Pakistan, the People's Republic of China (PRC), South Africa, Spain, South Korea, Taiwan, and Yugoslavia. Different people have different lists but these are the countries that generally appear on most people's lists. Each of these states has the capability to export one or a combination of sensitive nuclear technologies (including plutonium reprocessing, uranium enrichment, and heavy water production), natural uranium, power reactors and components, research reactors and components, and technical training and advice. Moreover, with the exception of South Korea, Taiwan, Japan, Yugoslavia, and most recently Spain, these emerging nuclear suppliers states are not parties to the Nonproliferation Treaty and do not subscribe to the major existing international nuclear export control arrangements. Although these international agreements do not prohibit the export of sensitive nuclear materials and equipment, they do reduce the proliferation risks by imposing international safeguards as a condition for their export. It is a concern of many nonproliferation experts that the emergence of the new nuclear suppliers not bound by existing international controls could erode the existing system of export restraints and threaten the viability of the international nuclear nonproliferation regime.

II. EVOLUTION OF THE ISSUE

Before I say more about the particular threat of the emerging nuclear suppliers, I think it is useful to place the issue in some historical context. If this were a gathering of international relations theorists or political economists, I would probably cast the discussion about the emergence of the new suppliers in terms of regime adaptation and transformation. In fact, the body of norms and the codes of conduct governing the peaceful uses of nuclear energy and nuclear exports is one of the most frequently cited examples of an international regime. For example, one can point to some very important legal and political instruments underlying the nonproliferation regime, including the 1970 Nonproliferation Treaty (NPT); the system of international safeguards administered by the International Atomic Energy Agency (IAEA); the so-called Zangger Committee trigger list of items, the sale of which is supposed to trigger the application of international safeguards; and, most importantly, the widespread but less than universal norm that the spread of nuclear weapons to additional states is dangerous and something to be avoided.

One can identify at least four different phases in the evolution of the nonproliferation regime that are relevant to our discussion of the emerging suppliers. The first phase, about which I'll say practically

nothing, was essentially one of secrecy and denial in which the research and development efforts in the nuclear field were primarily oriented toward military purposes and were conducted in great secrecy and in isolation from other countries. This applies both to the U.S. and the Soviets.

The second phase began in 1954 immediately following President Eisenhower's famous Atoms-for-Peace speech before the United Nations in December 1953. It gave rise to the active global promotion to the peaceful applications of nuclear energy and resulted in the creation in 1957 of the International Atomic Energy Agency. I think what is notable for our purposes is that during the second phase, the traditional nuclear suppliers, and here I mean, in particular, countries such as the United States, the Soviet Union, the United Kingdom, France, West Germany, Switzerland, Italy, Belgium, and Canada behaved very imprudently from the standpoint of nonproliferation by frequently promoting the spread of peaceful nuclear energy without adequate regard for its military implications. Indeed, for a period after Eisenhower launched the Atoms-for-Peace initiative, one could point to a rather peculiar race between the United States and the Soviet Union. It went on in tandem with the nuclear arms race. This was a race to declassify nuclear secrets in an effort to gain the allegiance of particular third world nuclear scientists. There were many conferences that were held in which both of the superpowers tried to attract as many scientists as possible to gain their support in the peaceful development of nuclear energy. It was not until 1958 for the Soviet Union (when the People's Republic of China announced its plan to exploit Soviet nuclear assistance for military purposes) and 1974 for the United States and Canada (when India exploited U.S. and Canadian nuclear assistance to detonate its nuclear device) that the major nuclear suppliers began to show much restraint in their nuclear export policies.

It is the period beginning in 1974 that I regard as the start of the third phase in the evolution of the international nonproliferation regime. This phase was characterized by two things in particular: (1) the emerging challenge by a number of European states as well as Canada to the dominant U.S. role in the international nuclear marketplace; and (2) the creation of international guidelines for the export of sensitive nuclear materials and technologies. In the minds of many of the Europeans as well as the Canadians, these two developments (that is, the challenge to the U.S. position in the international nuclear marketplace and the development of guidelines for nuclear exports) were related. In any case, coincidental with the growing challenge to the U.S. market position and also with the Indian nuclear detonation in 1974, a committee of over one dozen industrialized states, including the United States and the Soviet Union, adopted a so-called trigger list that specified the items whose exports would trigger the application of International Atomic Energy Agency safeguards for the facility for which the items were supplied. This list is usually referred to as the Zangger Committee List, after the Swiss chairman of the nuclear exporters committee, Claude Zangger.

In late 1974, however, the U.S. felt that a more comprehensive trigger list was necessary and moved to organize a new multilateral body for the purpose of regulating international nuclear commerce. This body, which began to meet in London during 1975, was known as the London Suppliers Group, or London Club, and initially consisted of the seven major suppliers of nuclear material and technology. These countries adopted what was essentially a "gentlemen's agreement" specifying that before certain sensitive nuclear materials equipment or technology was transferred, the recipient state had to agree to a number of conditions. I won't go into detail with respect to these conditions but the heart of the gentlemen's agreement was that: (1) these countries had to pledge not to use the transferred material, equipment, or technology in the manufacture of nuclear weapons; (2) they had to accept, with no provision for termination, international safeguards on all of the transferred material, facilities, and equipment; (3) they had to provide adequate physical security for the transferred material; and (4) they had to agree not to retransfer the material equipment or technology to third countries unless these countries also accepted the same conditions that applied to the original transfer of technology and equipment.

The results of the Zangger Committee as well as the London Suppliers Group have, I think, been mixed. Although the United States and the Soviet Union, as well as the United Kingdom and Canada, have for the most part cooperated on efforts to tighten exports, other traditional suppliers like Germany, France, Belgium, Italy, and Switzerland have at various times since the mid-1960s been reluctant to lose lucrative nuclear sales over the issue of stringent safeguards. One finds, therefore, the unusual spectacle of rather close U.S.-Soviet cooperation to restrict nuclear exports at the same time that U.S. cooperation with our traditional allies such as the Belgians, the Italians, the Japanese, and the West Germans, to name

but a few, has not been particularly good. In fact, you can find occasions in the past when an American or Soviet could not make a particular Suppliers' Club meeting and he would give the other superpower its proxy, a rather unusual circumstance in this age of superpower competition.

Both the Zangger Committee and the London Suppliers Group have also evoked criticism from developing countries who regard them as a vehicle of the industrialized states anxious to establish a nuclear cartel for the purpose of assuring the continued economic dependency of the third world states. At the review conferences as well as other international gatherings at which nuclear proliferation issues are discussed, the superpowers are often hit over the head with the same club because their approach to problems of nuclear power and nonproliferation are regarded as generally not sympathetic enough to the concerns of some of the third world states.

Just as the challenge to the dominant international nuclear market position of the U.S. marked the start of the third phase in the evolution of the nonproliferation regime, so I would argue the start in the early 1980s, the fourth phase, is marked by the challenge to the monopoly of the traditional North American and European suppliers by the so-called emerging nuclear supplier states, most of which are not party to the nonproliferation treaty. I think it may be useful to give two very brief country profiles on two emerging suppliers to provide a sense of both some of the problems as well as the prospects with respect to their compliance with the existing international guidelines for nuclear exports. The two countries that I have chosen simply for illustrative purposes are the PRC and Argentina. (In the discussion session we can probe the behavior of these countries in more detail and also discuss some of the other emerging supplier states behavior.)

The PRC, like many of the emerging nuclear suppliers, is a recipient of nuclear sales as well as an exporter. Indeed, it is the reported sale of enriched uranium and heavy water that has particularly alarmed nonproliferation specialists. According to press accounts, since 1980, China has shipped three percent enriched uranium to South Africa, twenty percent enriched uranium to Argentina for use in its research reactors, and heavy water to Argentina and possibly also South Africa and India. Some of you may have followed the press accounts generated by Gary Milhollin this past year about the Indian heavy water nuclear program and the alleged shipment of heavy water by the Chinese to India. I think there are some problems with Milhollin's argument, although I can relate to you my own experience when I was doing a study for the other nuclear lab on Soviet-Indian heavy water transactions which is consistent with the Milhollin's thesis. I was in Delhi doing some interviews and was talking to the scientific advisor to former Prime Minister DeSai and was told that in 1980 there had been an industrial exhibition in Delhi. This was right at the time when the Soviets were renegotiating with the Indians the shipment of their heavy water. The Soviets had been very cautious in their dealings with the Indians and insisted upon very stringent safeguard measures which the Indians didn't like at all. As a consequence there were rather protracted negotiations as to this next supply of heavy water from the Soviet Union to India. The centerpiece of the Chinese exhibition in Delhi was a large porcelain urn which I was told contained one ton of heavy water—a none too subtle sign to the Indians that should they, in fact, choose to look elsewhere for their heavy water than the Soviets, they might find a willing supplier in the Chinese, who at that time did not appear to be terribly concerned about proliferation or safeguards. In any case, by 1988 the Chinese expect to have an indigenously-produced 300-MW power reactor in operation at Qinshan, which if it is successful, may be an attractive export item because of its small power size relative to other reactors on the market. One thus finds the Chinese presently exporting uranium, heavy water, and in the future conceivably power reactors as well.

Argentina's nuclear program, which dates from 1950, is the most advanced in Latin America and also the most autonomous. The Argentine leadership has taken major efforts to obtain a complete nuclear fuel cycle including reprocessing and enrichment capabilities. At the same time, Argentina also has become a nuclear exporter in its own right. For example, since 1983 it has supplied Peru with two research reactors; entered into an agreement to sell Algeria a 500-kW research reactor, and to provide it with twenty percent enriched uranium fuel; signed an agreement with Chile to build an experimental research reactor fuel manufacturing plant; and in 1985 signed a major trade agreement with the PRC which provides for mutual assistance in the nuclear fuel cycle. It also has recently entered into important nuclear cooperative agreements with Brazil.

The cases of Argentina and China are illustrative of the major question marks surrounding the nuclear

export behavior of the emerging suppliers. Although most observers have a feeling that both countries are less inclined to follow the kind of guidelines called for by the London Suppliers' Group, there is, in fact, little information that is readily available to either support or to refute that hunch. Both states, for example, have long been highly critical of the NPT and have resisted efforts to apply international atomic energy safeguards to some, if not all, of their nuclear facilities. On the other hand, at least since 1983 the PRC has adopted a declaratory policy in support of the principles of the NPT and actually joined the IAEA in 1984. Contrary to initial press reports it also appears that China required that Argentina accept IAEA safeguards on all Chinese nuclear imports. For its part, Argentina was able to get the PRC to accept IAEA safeguards on Argentine nuclear imports, although as a nuclear weapons state the PRC is not obliged to do so by the terms of the NPT. It is also interesting to note that this is something that the U.S. was not able to do in its negotiations with the Chinese. In other words, contrary to many nonproliferation specialists' expectations, the two emerging suppliers appear to have acted responsibly at least in the several instances that I have mentioned.

III. DEVELOPMENT OF A DATA BASE ON INTERNATIONAL NUCLEAR TRANSACTIONS

The lack of information on such a basic question as the extent to which the emerging nuclear suppliers have departed from the export practices of the traditional supplier states highlights, I believe, the need for a data base on international nuclear transactions. What I will do now is describe for you the research project that I'm directing at UCLA which seeks to develop such a data base and to examine a number of hypotheses regarding the incentives for constraints on additional countries entering the international nuclear market as well as the consequences for the international nonproliferation regime of their entry.

There are three basic phases in the project. The first phase, which I have already begun to implement, entails the collection of data in machine readable form from the major nuclear trade and financial journals (*Nuclear News, Nucleonics Week, Nuclear Engineering International, Worldwide Proliferation Report*, and the *Financial Times*), as well as company bulletins from literally hundreds of firms both in the U.S. and abroad who provide services in the nuclear area. We are collecting this information on four different dimensions of nuclear export behavior for all countries for the post-1980 period. These four dimensions are *international flows*, or *transactions* (of which we distinguish among some 15 different categories); *domestic structural variables* (e.g., such things as import and export licensing arrangements, organizational actors, financing arrangements); *norms* (i.e., attitudes towards such things as other countries nuclear programs, the international nonproliferation regime, and international safeguards); and *export capabilities* (that is, not only what is being exported but what might be exported). I think this aspect of the project is unique in several respects. Aside from a more limited and a highly restricted data base being developed at the CIA, I believe that I'm correct in saying that the UCLA project I'm directing is the only computer-based data system in existence for tracking international nuclear commerce for all states.

The data base is also geared to facilitate analysis at the firm and individual levels as well as the nation state level. We have solicited information on some 1500 different firms internationally that were listed in the trade index that *Nuclear Engineering International* provides. We have been very successful in getting responses to our solicitation, to the point where I actually get nuclear salesmen calling at my office. (I recently had someone trying to sell me some valves for a nuclear reactor who misunderstood my letter requesting information.) In any case, we are now tracking global commercial transactions for over 1500 firms in nearly a hundred different items with weapons potential which have been identified in our coding index. The data base is designed to serve as an international repository for information on nuclear commerce. As I mentioned previously, we have over three dozen scholars worldwide who are advisors to the project and provide us with data. It is a very diverse group, as indicated by the parties who attended the organizing workshop a year and a half ago at UCLA. We had representatives from both of the nuclear labs, from other government agencies in Washington, from the Argentine Atomic Energy Commission, and Greenpeace. This gives you some idea of the variety of parties who, despite their different attitudes toward nuclear questions, all believe or share the assumption that there is insufficient data available with respect to nuclear supplier behavior upon which to make prudent judgments about their impact for nonproliferation. It is our belief that analysis of material collected in the data base

should enable us to test a variety of hypotheses, including such things as the similarity between the behavior of the emerging and traditional supplier states (for example, do the emerging suppliers in fact show a greater disregard for nonproliferation restraints?) and also the extent to which multinational firms are able to circumvent nonproliferation export controls. (We know, for example, that in Germany there are some fairly stringent export restraints on the law books. There's legislation which, if simply read, implies that there would not be a problem. But we also know from talking with people involved in negotiations with the Germans or the Argentines, for example, that German companies are able to rather openly circumvent these restraints, in part because there are no enforcement mechanisms.) We are also interested in learning how multinational firms are able to circumvent nonproliferation export controls. The data base should also enable us to examine trends in export behavior over time and to try to forecast proliferation developments. I would argue, for example, that had a data base comparable to the one that we are developing been in existence in the early 1970s we might well have anticipated Pakistan's quest for uranium enrichment and reprocessing technology, which instead went undetected for several years. We are looking not just at complete technologies but the components of these technologies.

The second phase of the project, which is also started, involves a series of comparative case study analyses of the domestic and external factors that shape the nuclear export policies of the eleven emerging suppliers of major interest to us. These factors are likely to vary from country to country, and I would argue that an intelligent nonproliferation strategy will have to discriminate among the different suppliers (i.e., a strategy that may be effective with respect to Argentina, may be irrelevant for Pakistan, for South Korea, or for any other country). Among the specific research questions we are interested in exploring in this phase of the project are: (1) Do economic considerations override or reinforce political and military factors in decisions to enter the international nuclear market? (2) Are external markets necessary to subsidize domestic nuclear programs? (3) To what extent are nuclear investment decisions made with an eye to weapons program spinoffs? (4) How do the existing set of nuclear nonproliferation norms and export guidelines influence the nuclear program decisions of the emerging suppliers? (5) And finally, although this is not meant to be a comprehensive but just a suggestive list, to what extent and by what means have the emerging suppliers sought to alter the existing nonproliferation regime?

The third and final phase of the research project will begin later this year and involves the effort to make use of the findings from both the data base as well as from the comparative case studies to devise more general propositions about the factors shaping the export policies of the emerging suppliers. Then, and only then, can we really seriously assess alternative strategies for managing the nonproliferation risks that are discerned. We are under some pressure to make policy recommendations. How do you deal with it? Our argument has been that until you have a better picture of what is actually going on out there it really makes no sense to recommend nonproliferation strategies. That is the real motivation for both the data base and the comparative case studies.

IV. QUESTIONS AND ANSWERS

Q. Do you track everything that's in NRC regulations and on the nuclear referral list?

A. That was one starting point. We also took the items from the London Suppliers Group list, talked with nuclear engineers, and made the rounds in Washington (e.g., people in Lew Dunn's office, the Department of Energy, and the CIA). I gave Bob Selden a copy of the coding index to distribute among you folks, gave people in Z-Division (at LLNL) copies, talked to people like Sandy Spector, who works on this from a nonclassified standpoint; they sat down and tried to compile the information that these people presented. We started out with a list which is maybe three-fourths of what appears presently on the coding index. We have dropped some and added others based upon their comments. Where we probably are weakest is on chemical items which may, in fact, have dual uses (in part because the journals that we have access to and are making use of tend not to focus on chemical components). But we do have a number of dual-use items. We have been fairly comprehensive, but again one of the reasons for our coming here is to try to get your input. One of the nice things about our computer base is that whenever we make an entry, it indicates the date on which the entry was made. We can always go back and supplement with new items should that become necessary.

Q. What is your sense of China's behavior, in particular press reports of China's cooperation with Pakistan?

A. I suspect there are a number of people in the room here who have a much better sense of where things stand at the moment than I do. Since 1983, certainly 1984, the Chinese have for the most part acted in what I would regard as a generally proper manner with respect to not undermining the terms of the NPT, at least in terms of their nuclear exports. We know of changes, for example, in their policy towards South Africa, which had previously blatantly violated the spirit of the NPT. It's more difficult to say with respect to Pakistan. There clearly are interactions between nuclear experts in Pakistan and in China. I have been told by some people (in Washington) who follow this carefully that it is not terribly clear the extent to which Pakistanis are receiving assistance from the Chinese, as opposed to perhaps providing some assistance to the Chinese, particularly in the enrichment area. Until recently the main concern has been with the provision of assistance with respect to the nuclear trigger. But I just don't have more detailed information on that. And I think (my hunch is) that if you talk to a half dozen people in Washington with access to classified information you're going to get at least two, if not a half dozen, different interpretations of the nature of the interaction.

Q. What is the scope of your data base? How comprehensive and reliable will an unclassified data base be in this area?

A. There is a temptation in any kind of a project like this one to try to do everything in the nonproliferation domain. We have had our own internal battles as to what we code and what we do not code and how we try to interpret the information. My perspective is that while there are a host of interesting questions having to do with nuclear weapons proliferation, one of which I've written about extensively having to do with the incentives and disincentives that drive different countries' nuclear weapons programs, that really is not the focus of this study. The primary focus is on tracking nuclear exports, nuclear transactions, because this is an area where we know very little. Here the "we," I would argue, is not just those of us in our ivory towers in Los Angeles, but also, unfortunately, many of the people I think who should know this information in Washington. One of the major factors leading to the project was the encouragement that we received from governmental actors in State and ACDA, who claimed that they needed this kind of information for their own discussions and deliberations with other national actors. The issue of the other kinds of incentives and disincentives which affect nuclear weapons decisions is certainly true, but it's not the main thing we're trying to accomplish in this particular project. I think a more serious issue that you raised has to do with how comprehensive and how reliable, really, the data base that we generate will be and the question, "What use is an obviously incomplete and perhaps not perfectly reliable data set?". At the present time we simply don't have access to any kind of all-inclusive data base. That is also the case for people with access to classified data within the government. It is certainly the case that there will be a set of transactions which are undertaken in great secrecy that we're not going to pick up. I would argue, however, that by relying on multiple sources of information (that includes the different nuclear journals, in addition to the kinds of newsletters that we are obtaining information from) we can assemble a useful data base. And there are two other sources of information that I didn't really mention that we are utilizing. One, we have dozens of specialists in the field advising us, including Larry Scheinman, George Quester, Sandy Spector, David Fischer, Joe Pilat, and Randy Rydell, to name just a few. We also have representatives in Germany, in Israel, in Argentina, all of whom are being paid to track developments in their home countries, or countries that they are following. They are doing interviews. Quester, for example, just came back from Taiwan, where he was to collect data to be entered into the data base. In addition, we have a colleague who heads a nuclear consulting firm that has field representatives in many of the countries of interest. He has instructed his field representatives to generate information relevant to our study so that in time at least many of the relevant gaps will be filled. The other thing I would argue is that much of the literature, which you might argue should be classified, is nevertheless available in the public domain in bits and pieces. The problem in the past for the researcher who is interested in getting a handle on the problem is that it is scattered in bits and pieces throughout journals, many of which are extremely expensive. Our Center project subscribes to some of the major journals that even UCLA, which has one of the major research libraries in the US, cannot afford. My argument is that by systematically coding (that is going

cover-to-cover) we are able to pick up bits and pieces and then use the computer to assemble them in a fashion that provides a more comprehensive picture. One of the reasons that Livermore is interested in what we are doing, presumably, is that they will take our data base derived from public sources and supplement it with their classified material so that the data base that emerges will have the best of our world (i.e., the public domain) as well as the classified literature. It's still not going to be perfect, but I would argue that it's the best that's available and that this better set of data we will have provided will be a better basis for making policy recommendations about nonproliferation strategy.

Q. Won't your data base be misleading? You will not be able to draw useful conclusions from your unclassified data base, will you, given the uncertainties, the duplication of citations, and the like?

A. To some extent that's true. The great advantage we have is that every entry we use has bibliographic information, and since we have the hard copy, we can go back and compare sources of information. It's certainly true that *Nuclear News, Nuclear Engineering International, Nucleonics News*, etc., tend to report on the same items. But that's not always the case. The hub of your questions has to do with what inferences we could make from our unpublished data bases. I have not worked the classified literature. On the other hand, I have done a number of studies both in the realm of verification as well as in the nuclear export and nonproliferation area. My experience, having talked with people who work the same area on the classified side, is that while I may miss certain things, for the most part, at least in my limited experience, relatively reliable inferences can be drawn from the public domain in these particular areas. It's also the case that reliance on classified sources of information, (e.g., cable traffic) doesn't ensure reliability or importance. So I am not persuaded that the inferences one draws from the public domain are necessarily going to suffer anymore than the inferences drawn from the classified domain which ignores what is available in the public literature, particularly in the nuclear trade area. I think there are tradeoffs with both kinds of data. It's a problem. I recognize the problem. I would hope that, given the support we have received from not only foundations but also governmental agencies and actors who deal with the classified information, their encouragement is well-founded. I assume that ACDA and Livermore would not be encouraging us in this enterprise if they felt we were going to be compiling a meaningless or misleading data set, and so I feel comfortable that the support that they are providing means we are proceeding along the right track.

Q. Isn't it true that probably the greatest use for your data base will be made by the CIA? Presumably Livermore may be doing something in this area; I don't see anything wrong with that. In fact, I would hope that the CIA would support your efforts.

A. Different people are interested in different kinds of questions. I have my friends who work the area of political economics who are very much interested in the issues of why the emerging suppliers in fact choose to enter the international nuclear market. They could care less about proliferation considerations that may be of prime importance to people in Washington. There are important political science questions, economic questions, that can be tapped. I'm doing this less because the government is interested and more because I see this as a source of important information for people like myself who write on this from an academic perspective. To some extent I see the data base we are assembling as something similar to what the International Institute for Strategic Studies tries to do with their public *Military Balance*. It's a readily accessible, comprehensive data set that should be of use to people working the proliferation field whether they are in the government or outside of the government in this country or elsewhere. I can generate literally dozens of research hypotheses which I would argue my data set will enable me better to answer than one could in the absence of that data set. Maybe they're not the key questions that you want me to answer but they're of interest to me and I would find them very useful. Someone like Sandy Spector, for example, who publishes his annual proliferation report has been out to our Center and really is captivated by this use of the computer to track information. It will make his task much easier.

Q. Doesn't the IAEA have precisely the data base you are now trying to create?

A. I was in Vienna just three weeks ago and was anxious to talk with the people who, in fact, supervised a number of the major data sets that they have developed. It turns out to be a vast bureaucracy, and I talked with someone who I thought was in charge of everything, and he really didn't have a good

handle on what was going on with respect to all of the data bases which I thought were formally under his jurisdiction. I would hope to make available our information to them and to profit from the information that they presently have. In fact, one of the things I hope to be able to learn when I'm with you is how to access more readily *Atominder* and to actually obtain some of the materials that, at least theoretically, are available to IAEA member states. It is my understanding from talking with people at the IAEA that there are liaison officers appointed for each of the member states who are supposed to control access to the data set, although I have yet to find anyone who has made use of the data to which he presumably controls access. Maybe some of you can shed some light on this. There is a fellow at Oak Ridge who I think is the liaison officer for the different data sets that the U.S., as a member state, is supposed to be able to tap. This is clearly something that is important, and we're presently exploring how to cooperate better with the IAEA. Larry Scheinman, who is on leave from Cornell University and is one of the advisors to Hans Blix at the IAEA, is also an advisor to our project and is interested in promoting close cooperation between the IAEA and our own activities. So we are pursuing this line of cooperation, although it's at a very preliminary stage at the moment.

Q. I would think one indication of the usefulness of this was the fact that you've been able to note multinational company behavior. In what form is the data available to others? Who's it available to? What kind of reports do you generate?

A. First of all, on the multinationals, I think you are absolutely correct. Too much of the prior work on the nuclear export issues has focussed on national actors, and I think as a consequence we have missed some of the most interesting forms of activity which really are at the firm level. Whenever we code any transaction, we also code it for the firms involved. For example, we can print out every time that KWU or Sulzer Brothers or Framatome was engaged in any kind of activity for a given time period or for a given item. So I think you're right. In terms of access to the data, this is again something that we are developing. First of all, you have to realize that a year ago there was no data set. It was more a glimmer in my eye as to what was going to develop. It turns out to be a difficult programming task, at least given my reliance upon student programmers (who I might say have done things which some of our outside experts said could not be done). The gravest problem has been developing a coding manual which enables us to have a fairly high degree of intercoder reliability. It is one thing for me to code to my satisfaction and another thing when I have ten other people doing the work. Getting a high degree of intercoder reliability is a major difficulty, and I really appreciate why prior efforts to do this have not been successful. So we are really only at the first stage. What we have right now is an IBM AT. We have yet to actually install a modem, which we plan to do. At the present time, people who want to access the information essentially have to ask the questions or ask for searches for certain periods of time, and we provide them the material. We can give them the printout summaries as well as the hard copies. We are providing that to some of our case study authors at the moment. But the intent over the course of the next year is, through our modem, to provide a linkup whereby Sandy Spector in Washington can directly access our data base, as can David Fischer, whether he's at home in Cambridge or on his home in the Greek Isles. In principle, all of these parties should have access. We're doing this on a nonprofit basis, which is a main reason why we are looking for foundation support. The Rockefeller Brothers have been generous in providing us support which should make it possible to continue the operation for at least another two years without much difficulty. A number of people have suggested that it would be a great idea to do this commercially. How do you do it commercially? There are enough people out there who would like access to the information. It's difficult, however, to run that kind of commercial operation at a university. And I would simply prefer not to have to do that if I can get the funding without strings attached from the foundations, and so far I have been successful. The foundations see this as an ideal way of networking. They are supporting different proliferation projects. They would like all of their proliferation specialists to make use of our data set and I am pleased to oblige. The arrangement with Livermore is very straightforward, and they have provided funding for my student coders. They have also given us access to periodicals that we were not able to purchase ourselves because we just did not have the funds. In return they get the diskette, which they can use for their own purposes. There are no strings attached in terms of what we code or who else gets the information. That is the same kind of arrangement I would like to be able to work out with you. The other great benefit of the project is that

we are training fairly large numbers of very competent students, some of whom at least will probably continue to work the field.

Q. What are the backgrounds of most of these students?

A. There are a wide variety of students, although the majority of them have backgrounds in political science. I usually get the best students from my classes. We also have several law students who are involved. We have one student who has a double major, one being in biology. I do not recall any student who has come in with a hard sciences background, although we would welcome that kind of student. Coding is not a simple issue and you need to know both the technical issues as well as the political issues that are involved.

Q. The reason I asked that is that has been the downfall of some data bases put together earlier.

A. We are working on the reliability problem now. It is a very real problem. And that is why our data set has not grown more than it has. I have been fairly firm in not entering information until I am satisfied that we have a high degree of intercoder reliability. You may have an enormous data base and it is meaningless, as you have suggested, if you are not coding properly.

Q. Are people from the Soviet Bloc involved in this activity? Do you have access to what they're doing in an unclassified way in this area?

A. We are coding Soviet and East European nuclear behavior, which is one of my particular areas of interest. We certainly are paying careful attention to materials that we have been able to obtain with respect to Soviet and East European nuclear exports. If you are asking do we have people in the Eastern Bloc who are providing us with information, at the moment we've had consultations with people, one person in particular, a Yugoslav (if you want to treat Yugoslavia as Eastern). I have talked with senior people on the Soviet side who have invited me to speak in the Soviet Union and to describe our data base, but we do not yet have any kind of cooperative agreement with them. And I would welcome input from any party, but to date we do not have any kind of an arrangement with a Soviet or East European, other than some preliminary discussions with the Yugoslavs.

Q. Years ago I was involved in compilation of nuclear cross sections. This was an enormous operation. And we were able through official channels to invite Soviet participation, and they assigned people at various laboratories to provide data. My guess is that you could probably do that.

A. That is the intent. I do, in fact, have monies for travel to the Soviet Union for this purpose and also related to the study that I am undertaking on Soviet decision making for Chernobyl. To some extent there is an overlap, at least in terms of my interviews, but to date we just have not developed that kind of contact.

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