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WORKSHOP ON INSTITUTIONAL ASPECTS OF  
PROLIFERATION RESISTANCE

December 19, 1977

Summary Report

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by

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## N O T I C E

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On December 19, 1977 a one-day workshop on institutional aspects of nuclear proliferation resistance was held at the Harvard Program for Science and International Affairs (PSAI), 9 Divinity Avenue, Cambridge, Massachusetts. The workshop was organized by the MIT Department of Nuclear Engineering, PSIA, and the US Department of Energy (DOE), and was sponsored by DOE in conjunction with its Non-Proliferation Alternative Systems Assessment Program (NASAP). The co-chairmen were Albert Carnesale of PSIA, Hugh Kendrick of DOE, and Marvin Miller of MIT.

The objective of the meeting was to improve our understanding of the overall structure of the proliferation problem and the role institutional/political arrangements can play in support of technological measures to prevent proliferation. Specifically, the workshop sought to focus attention on three related aspects of the proliferation problems; i.e.,

1. Can a set of attributes be used to establish meaningful criteria for the proliferation resistance of nuclear systems? In general, what is the utility of a game/decision theory approach to proliferation?
2. Assuming that a methodology involving attributes is useful, what is the impact of institutional arrangements such as international fuel service centers on the values of attributes? That is, how effective are institutional arrangements as complements to technological barriers in providing proliferation resistance.

3. Does international control or ownership of fuel cycle facilities serve non-proliferation objectives enough so that the effort to structure such centers is worth the political and other costs it may entail?

Marvin Miller of MIT, Henry Rowen of Stanford and Laurence Scheinman of the US State Department made formal presentations, Hugh Kendrick of DOE introduced NASAP, Albert Carnesale of PSIA presided as the workshop chairman, and Thomas Schelling of Harvard provided concluding observations. The following is a summary of the day's discussions culled from the rapporteur's notes and tapes; the workshop Agenda and List of Participants follow the summary.

#### Morning Session

A. Carnesale, fresh from a meeting in Vienna of the technical coordinating committee of the International Fuel Cycle Evaluation study (INFCE), opened the workshop with a brief progress report on INFCE, which he likened to an "international Ford-Mitre study" with a focus on nonproliferation. He outlined the missions of the eight INFCE working groups, and drew the distinction between the mission of NASAP and that of INFCE. NASAP will provide technical support for the US role in INFCE, but as a national effort, it will tread on ground which is clearly inappropriate for international consumption; e.g., studies related to fabrication of weapons derived from fuel cycle materials. H. Kendrick elaborated on the goals of NASAP. These have changed to a certain extent since the program was initiated in April 1977--antedating INFCE by approximately six months--but its primary focus remains the same; i.e., to identify nuclear power systems which offer a high degree of proliferation resistance and have all the other requisite virtues;



e.g., efficient resource utilization, commercial acceptability, and high marks in the safety and environmental impact areas. Kendrick stressed that DOE was open to suggestions from all quarters, and, in particular, was seeking advice in devising criteria for judging the proliferation resistance of nuclear systems.

#### M. Miller

In his paper, "Attributes, Decisions, Games and Proliferation Resistance," Miller illustrated how the proliferation resistance problem looks from the vantage point of decision/game theory. He spoke of both the promise and pitfalls involved in this approach; among the latter he mentioned in particular the difficulty of "getting inside the proliferator's head" to get a sense for which of the attributes which (hopefully) characterize proliferation resistance are most important to specific nth countries in particular situations. A methodology would be valuable as a guide to a logical analysis of the proliferation problem, but it could not tell us when we had neglected or misjudged an important piece of information. That is, it must be seen as a complement to, not as a substitute for, creative insight and imagination. Miller concluded with some remarks about the need for more study of the feasibility of incremental sanctions for incremental violations--a theme which was taken up later by several of the other participants--and the problems involved when there are more than two players actively involved in the "proliferation game."

#### Discussion

Carnesale prefaced the discussion with a suggestion that the participants focus on describing attributes of proliferation-

resistance and on how to measure them. (This suggestion was largely ignored.)

H. Rowen of Stanford opened the discussion by noting the importance of exposing the civilian cover of nuclear programs which had joint military and civilian objectives. One of the means to this end would be to examine the economic rationale of going nuclear as a source of energy, particularly in the LDC's. However, he didn't wish to underestimate the problems associated with applying an economic test; e.g., there were no agreed-upon criteria for evaluating the economic worth of a civilian nuclear program. The case was complicated by a history of promotional activity by suppliers on behalf of nuclear power which has provided justification for economically unsound civilian programs.

R. Rosenthal of DOE and L. Scheinman of the US State Department referred to the desire of many countries for energy independence and technological prestige--"the national airlines syndrome"--as factors that further complicate the search for an unambiguous test of covert weapon objectives.

W. Harris of Rand thought that Rowen's economic criteria were relevant, notwithstanding the difficulty of applying them. If some nth country expressed interest in having a reprocessing plant so large that it would clearly optimize plutonium output rather than minimize the cost of electricity, the signal would be loud and clear. In other cases, such as using a breeder program to justify reprocessing, it would be much harder to get additional warning by making an economic analysis of the program.

J. Dietrich of Combustion Engineering and N. Rasmussen of MIT criticized the preoccupation within NASAP on finding new fuel

cycles which would offer dramatic increases in proliferation resistance. Such systems, if they did exist, were far down the road as far as technological maturity was concerned. Meanwhile, there would soon be 500 reactor systems extant, 400 of which would be LWRs, and we had to solve the proliferation problem posed by these systems. Future reactor systems would take two or three decades to develop and install; we had time to deal with them but could not for the present ignore the LWR system.

M. Nacht of PSIA suggested to M. Miller that he (Miller) attempt to validate the decision theory approach to the non-proliferation problem by demonstrating that it jibed with the historical record; he suggested Israel as a good test case. F. Culler of ORNL liked Nacht's idea, but thought that Israel was not representative of nth countries which are going nuclear.

H. Raiffa of the Harvard Business School, also referring to issues raised in Miller's talk, felt that the public debate was focusing the methodology effort. If you looked at other areas, it was hard to articulate the basic attributes of a problem; if you tried to do it in the abstract, the most important attributes were invariably left out. Finding attributes was an iterative process. Quantification was not as important in the beginning as taking the logical first steps.

Rowen, returning to NASAP, was troubled by the excessively abstract nature of much of the work undertaken there. There were nuclear programs and there were countries; specific cases could be examined to great effect. In doing so, one discovered that the role of suppliers was not all that important; regional

problems seemed to dominate the concerns of the proliferation candidates. T. Greenwood of OSTP contrasted Rowen's specific case-by-case approach with the need to seek an international consensus cast in general terms. Rowen replied that he didn't disagree with Greenwood or Nacht, but when modeling it was preferable to look at the problems concretely.

Harris suggested that Miller incorporate alternative rules of trade for international nuclear commerce when he played his two-person games between supplier and proliferator. He was certain that these rules of trade were more important in determining outcomes than technical fuel cycle choices.

Culler reminded the participants that President Carter's emphasis on nonproliferation marked a dramatic shift in US policy. For example, we had approximately ten years of timely warning concerning India's nuclear intentions and decided to do nothing to prevent the inevitable detonation in 1974. This remark prompted Gray of International Energy Associates to suggest that it might be better not to have too much time so we could react from the gut. In a similar vein, G. Rathjens of MIT later commented that even if we were unprepared to react to ambiguous information, some countries might be more prepared to do so, in which case it was better that nobody have the information.

L. Dunn of Hudson Institute pointed out that the threat of pre-emptive proliferation or a regional "stampede" decreased with greater warning time. M. Nacht suggested that regional stampedes and pre-emptive proliferation were empirically unverified.

Harris agreed with Dunn that the likelihood of highly accurate warning would decrease the incentives to proliferate. However, as a practical matter, warning systems were not so finely tuned, and if there were any incentive for early prediction, there was a danger that an imprecise warning system would encourage pre-emptive action. He felt that most of the sources of warning were independent of the fuel cycle. In the past we have received early, albeit ambiguous warning, but lacked any agreement on procedures to handle the information, much less any agreement on sanctions.

Carnesale articulated the developing consensus among the participants that deciding on what to do with warning in advance was at least as important as the length of time involved in warning. He thought that this consensus implied the need for international arrangements.

T. Schelling of Harvard directed the group's attention to the potential audience for early warning inside the proliferating country. It would be useful to know how far foreign countries could go toward shortening or lengthening lead times before committing themselves to a bomb program or provoking reactions from a group inside or outside the government; e.g., the political opposition, the military establishment, and the general public. We need a rich typology of decision points and lead times for different types of governments. Schelling added it was sometimes embarrassing to be triggered at unwelcome times. W. Donnelly of the Congressional Research Service proposed that the level of internal opposition to nuclear power be one criterion for evaluating proliferation resistance.

Greenwood cautioned that specifying sanctions ahead of time gave countries an opportunity to build around them. For example, a country threatened with a loss of its enrichment services would have an incentive to develop its own capability or find another supplier. In addition, once a country detonated a bomb, some countries would be encouraged to cultivate the friendship of the proliferator; the unanimity required for effective sanctions could not be relied on. Nacht contended that some countries loomed larger in applying sanctions than others. The US had a good track record for effective unilateral arm-twisting in the interest of non-proliferation, even in the absence of international consensus.

Rowen traced many of the difficulties of combatting proliferation to the process of decision-making. Policy makers only had to make a commitment to the next incremental step, which didn't necessarily imply an irrevocable decision for nuclear weapons. Scheinman agreed, but thought the world was now more proliferation-conscious and this made it harder to play this game. G. Skolnikoff of MIT and Raiffa saw a political value in having certain decisions recognized as crucial regardless of the intent behind them. Schelling added that he knew no way to distinguish between a government that was doing its best to hold the line by compromising with weapons advocates where it least mattered, from a government that was keeping its options open, but wanted to approach the capability of producing weapons. The difficulty of deciding on intentions put an high premium on coming to an agreeemnt on the obligatory interpretation we would place on a government's actions.

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Afternoon Session

H. Rowen

When the workshop reconvened after quiche and salad, Henry Rowen of Stanford delivered his paper entitled "The Relation of Technical to Institutional Factors in a Non-Proliferation Strategy." In his remarks, Rowen noted with concern the growing access of countries to readily fissionable materials as a by-product of the spread of civilian nuclear technology and the concomitant increased incentive to acquire nuclear weapons. The main task was to design mixes of technologies and political arrangements that strengthened incentives in non-nuclear states to remain without nuclear weapons, and to encourage international ties and technical postures which were more stable in crises than was likely now. These objectives would have to be compatible with economic and reliable suppliers of energy as well as enhance perceived security in non-weapon states.

Countries were led to demand nuclear weapons because of perceived threats from regional adversaries and concerns that the latter might suddenly acquire nuclear explosives. Factors which inhibited the demand for nuclear weapons were: the uncertain response of larger powers, worries that future conflicts might be enormously destructive, and fear that nuclear weapons might escape governmental control in internal disturbances.

The decision to acquire nuclear weapons was influenced on the supply side by the marginal costs of steps beyond those undertaken for non-military purposes. These costs varied with the

size and sophistication of programs, but there were many products useful for military as well as non-military programs. Another class of costs were the risks associated with having or moving towards nuclear weapons. The present rules offered civilian "cover" for the incremental steps that might be undertaken for military purposes. These ambiguities had a bearing on efforts to use the time from commitment to making a bomb, or the time from diversion to building explosives, for warning.

Some nuclear programs were so grossly uneconomic that this was a useful indicator of more than economic incompetence. A greater degree of agreement on economic criteria should be sought in INFCE even if consensus was unattainable.

Rowen next discussed rules of international conduct whose objective was to increase the critical time to a bomb. The current generation of reactors without recycle provided a benchmark. This meant no highly enriched uranium except in research reactors and did not square with the use of centrifuges or wider dissemination of laser technology for uranium enrichment. In some cases the removal of spent fuel was appropriate. The benchmark was incompatible with regional reprocessing; the problem with reprocessing was the product, not ownership of the plant.

The adoption of this benchmark would make diversion of weapons-grade materials stand out more clearly against the civilian nuclear background. If a government were to move toward a bomb, more actions would have to be undertaken covertly, and if such moves were detected, the signals would be less ambiguous.

A longer critical time and the availability of clear signals did not necessarily mean warning; this required interpretation of



signals. Even with warning there might be no effective action as in the case of India. However, action based on early warning offered the possibility of deflecting moves at lower cost.

Rowen described the issue of discrimination in applying international rules of conduct as troubling. Discrimination between weapon and non-weapon states was incorporated into the Non-proliferation Treaty (NPT) and was practiced by governments in their nuclear export policies. While nuclear power was more or less competitive in larger states, it was uneconomic in most developing countries. A rule that attempted to draw a line among states would be difficult to sell de jure, even if widely applied de facto. Such "split" systems might prove to be politically acceptable, but acceptance would be aided by political arrangements which made evident that no economic discrimination was intended.

Weaker rules of nuclear conduct would permit mixed oxide fuel, but preclude highly enriched uranium, plutonium, U-233 except perhaps in irradiated or spiked form. Critical time to a bomb of a few days was better than nothing. Isotope separation for uranium could be restricted to weapons states or to internationally-owned or safeguarded plants. This was especially desirable if isotope separation technologies with short critical times were in danger of being widely adopted.

#### Discussion

Following presentation of the paper, Rowen opened the second-round of discussion by reiterating the following points: the rule of international nuclear conduct should be to limit immediate access to weapons grade material, the LWR without plutonium recycle

was the logical standard against which to compare other nuclear systems for their proliferation resistance, and international commerce in plutonium and reprocessing services was undesirable, independently of how it was managed.

Schelling cautioned that ownership of weapons grade material was an important institutional parameter. If ownership of materials were shared, a country could not misuse materials without absconding with another's property. The violation of rules and contracts was a serious break. Rowen contended that shared ownership in itself was not a deterrent in the event of crisis. There was some utility in knowing where things were going, but that was insufficient grounds for confidence.

Greenwood thought it instructive to discuss Rowen's benchmark nuclear system in relationship to clusters of nuclear systems as they tended naturally to emerge along a continuum of proliferation resistance. Nuclear systems in Cluster I would not employ explosives-useable material and would not provide any opportunity to use the fuel cycle to produce such material. Cluster II contained systems where facilities might exist within the fuel cycle that could be used to gain access to explosives--useable material but the cost, time, difficulty and warning time of doing so would be at least as great as if such material were made outside the fuel cycle. Cluster III systems had facilities from which weapons-useable material could be gotten easier from the fuel cycle than outside it. Cluster III systems would have weapons-useable material moving in the fuel cycle but would still leave safeguards and physical protection. Technological barriers to proliferation fell from I

to IV leaving institutional barriers as the strongest protection against proliferation. Possession of an enrichment facility would jump a country from I to III. A reprocessing facility could possibly be modified to prevent a country moving into the Cluster III category. Rowen remarked that today's rules placed us in Cluster IV.

Harris expressed doubt that Rowen would find consensus on rules for the once-through light water reactor unless he first won acceptance of rules for demonstration breeders and commerce in fissile plutonium. Countries were suspicious of attempts to sidetrack their breeder programs and Rand was projecting demand for plutonium in breeder programs in non-weapon states outside Europe and Japan. Harris also thought that the IAEA required authority to retrofit existing plants with new safeguards as they were developed. Culler responded that this authority was already found to some extent in the NPT, and had been exercised in the area of physical protection. Someone commented there had also been significant changes in surveillance techniques at plant level. Scheinman agreed but noted that compliance with upgraded safeguards was voluntary.

Gray emphasized some positive features of an internationalized fuel cycle; e.g., the checks and balances associated with mixed ownership, internal auditing at several levels, the existence of reprocessing facilities that were potential elements of a multinational organization, and the potential for natural economic dominance to freely assert itself in such an organization. Rowen responded that it did not matter who controlled the plant, but it

did matter who controlled its products. Multinational ownership of reprocessing facilities did not alleviate concerns about secure fuel supply. Multinational ownership of enrichment plants held more promise because one could be sure that low enriched uranium alone was produced.

Culler summarized the elements of a consensus concerning the technical and institutional aspects of proliferation reached by the technical community at the Institutional Conference on Nuclear Power held last spring in Salzburg, Austria. The technical experts agreed: (1) that holding large inventories of fissile or irradiated material in non-weapons states was improper, and it should be removed; (2) that the safest place for plutonium might be in the reactor system; (3) on the necessity for international control, even if international ownership were only a possibility; (4) on the importance of real time accountability--the ability to strike a material balance in 24 hours; (5) on a system of auditing; (6) that upgrading of physical protection was possible; (7) that plants be built to ensure remote disabling if inspectors were removed; (8) that all streams be made radioactive; and, finally, (9) on the need for sanctions. Given proper institutions, technical solutions can aid and abet non-proliferation goals.

Rose warned of a clear divide between weapons and non-weapons states that created suspicions among LDCs. The US appeared as an unreliable partner and the LDCs appeared vulnerable to a supplier's cartel. As a consequence they might try to go the nuclear route alone. Dunn sensed that strengthening safeguards and applying sanctions to breaches at the back-end of the fuel

cycle could gain legitimacy internationally. Carnesale interjected that fear of sanctions might encourage countries into separate nuclear development. Dunn said it depended on the sanctions and the limited number of countries with preponderant influence.

Miller wondered whether an effective US policy on nonproliferation was compatible with a view of nuclear power as a "last resort." Rose answered that the US seemed to be of two minds on nuclear energy, and that it projected an image of ambiguity and uncertainty that threatened our leverage over other countries. Carnesale saw the uncertainty working both ways. It appeared as if we wanted to hold everybody else back to catch up or as if we want to delay because it is not important to us.

L. Scheinman

Scheinman emphasized the political community's role in providing institutional arrangements that could bridge the gaps left by technology. However, he cautioned that both technical and political approaches alone had real limits. The spread of technology could not be averted over the long term. This was true of the broad field of nuclear technology, and specifically some of its more sensitive components, such as reprocessing and enrichment technologies. We could not overlook the moral as well as practical dimensions of the problem. Efforts to deny access to technologies having significant social and economic promise would be perceived as discriminating and as exacerbating the deep cleavages between haves and have-nots.

Measures to control or deter the spread of potentially inimical technologies could be sought through: (1) technical efforts to design non-inimical technologies; (2) political/legal mechanisms to secure agreement among technology suppliers as to what should be supplied to whom; and (3) political/structural measures to accommodate demanders by offering them opportunities to share in the management, ownership and/or product of a facility.

The search for technical routes that reduced the inimical characteristics of technologies was likely to yield only partially satisfactory results and had to be accompanied by ancillary institutional and political measures. Institutional arrangements could reinforce technical approaches and/or compensate for deficiencies in technical approaches. The current risk was that in reacting to perceived oversimplifications by the political community of the reach of technological problem-solving, the technical community would place too great a burden of expectations on the political community's ability to provide answers.

International institutional arrangements could enhance the perceived trustworthiness of bilateral or multilateral legal commitments to transfer resources. However, there were potential costs to the technologically advanced states which advocated or supported these institutions. The existence of institutions deprived the US of bilateral or, at least, weakened our leverage. On the other hand, participation of key suppliers furthered the US objective of securing a common posture. One other drawback of institutions was the reduction in US flexibility to undertake separate initiatives.

Scheinman adverted to the international fuel bank as an example. The fuel bank is attractive because it could (1) serve to provide added credibility to US commitments to assure reliable supplies of nuclear fuel; (2) be a tangible indicator of the sincerity of advanced nuclear states to avoid deepening discrimination between haves and have-nots; and (3) delay the spread of sensitive fuel cycle activities under national control. On the debit side, the bank could: (1) curtail our ability to upgrade non-proliferation conditions as new problems emerged; (2) limit our independence of action; and (3) allow other countries to circumvent supply prohibitions imposed by the NRC, Congress or the President.

On balance, Scheinman was persuaded that the costs of establishing international institutions or political mechanisms to support US non-proliferation objectives were outweighed by the benefits. The bottom line was that if we sought to persuade states to defer intended technological developments while exploring alternative safer technical pathways, then we had to maximize assurances regarding availability and accessibility of nuclear fuel supplies. Access could not be subject to capricious political conduct by suppliers.

A similar set of questions was raised regarding spent fuel storage as the first component of a multi-national fuel cycle center. Here it was necessary to determine whether establishment of spent fuel storage committed the US to a broader range of activities, e.g., reprocessing, or created a presumption with respect to the next steps. How far could we go in making concessions to ensure a sufficiently broad membership before diminishing returns set in? It was also important to know the risk of prematurely enhancing or re-inforcing national commitments to nuclear power by removing

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problems associated with the nuclear fuel cycle, e.g., disposal of the spent fuel.

### Discussion

Carnesale opened the last round of discussions by asking how multinational fuel centers would influence the rate at which national fuel centers spread.

Scheinman wondered whether this was the right question to ask. We should not give up searching for combinations of technical and institutional measures that carried us beyond the levels of safety seemingly guaranteed by multinationalizing sensitive areas of the present fuel cycle. We should not hasten to prejudice the technical evaluations of alternative fuel cycles; it was important to prove that the technical approaches offered no solution; not to assume it. The institutional framework was a double lock on the most proliferation resistant alternative technology. Carnesale pointed out that INFCE was considering multinational arrangements for each fuel cycle alternative.

Greenwood cited the present LWR regime as an example of a fuel cycle made more resistant to proliferation through an institutional arrangement; i.e., providing limited supplies of low enriched uranium. Layer after layer of further institutional arrangements could be made to reinforce the inherent proliferation resistance of this fuel cycle.

Rowen, after listening to Dunn's remark that Rowen's idea of a benchmark standard denied the possibility of trade-offs among institutional arrangements and the proliferation resistance



inherent in the technical make-up of the fuel cycle, expressed his concern that there was a serious blurring of time in the discussion. People were talking as if there were an array of choices available now when there were not. There was a need for more conscious and explicit recognition of the feasibility of phasing in various technical and institutional measures as a function of time.

Harris perceived an urgent need to institutionally retrofit present reprocessing facilities in nuclear weapon countries before INFCE's end two years hence. Unless we now guaranteed access to these reprocessing facilities at fair prices, we would have to contend with additional commitments to reprocessing centers by non-weapon states.

Nacht thought INFCE had an image problem with institutional measures being viewed as less substantive than the search for proliferation-resistant technologies. He feared that INFCE's value would be measured only by its success in finding the technical fix. More effort should be devoted to showing that institutional steps were not vacuous and to peddling some of the better institutional ideas.

At this point, Schelling was asked to conclude the workshop with his observations on the day's discussions.

He began by noting that the highest officials of the US government hadn't become interested in the problems of proliferation until three years ago and that a balanced view took a long time to develop in a complex field where opinions were strongly held. Only recently had policymakers begun to recognize the connections

among domestic energy problems, foreign energy problems, nuclear energy and proliferation. As a consequence, there had been an abrupt change of direction in the US government from cultivating nuclear energy throughout the world to warning of the dangers of nuclear power.

Foreign governments were somewhat bewildered by US policy and could not be blamed for suspecting skulduggery. Although he didn't believe in it himself, he did admit that apparent skulduggery was the explanation with the highest a priori plausibility. Even participants of the Ford-Mitre study were caught off guard by how not only uncomprehensible but unbelievable and suspicious their point of view appeared to foreigners who probably knew the previous US position better than they did, and were able to be uncomprehending and suspicious in a way the Ford-Mitre group was unable to anticipate.

Schelling was heartened that governments which were expected to acquire nuclear weapons fifteen years ago had not, and could no longer do so overtly, given their adherence to the NPT. He speculated that there must be a long period of internal debate about the merits of acquiring nuclear weapons before countries were prepared to renounce them. We could perhaps coax these countries through the maturing periods during which they overcame the nuclear temptation. The US could take credit for the fact that there had been no overt demonstrations that nuclear weapons could do countries any good except in the East-West nuclear strategy stand-off.

We could help other governments to come to an appreciation that they didn't want the dangers implicit in owning nuclear weapons or weapons grade materials. We could help them find an excuse for not going down the proliferation path by offering respectable ways of putting weapons grade material at arm's length physically, legally, financially or commercially. The primary use of military force was internal, not external. Making governments think about the problems involved in assigning responsibility for weapons grade materials would have the advantage of making them question whether they would rather be free of the problem altogether.

His final thought was that institutional arrangements were better used as a vehicle for getting other governments to stop and think about the seriousness of a decision to acquire weapons rather than as a way for us to tie their hands and thus provoke resistance.

#### Postscript

Several major themes dominated the discussions:

(1) The problem of civilian cover; in particular, could an economic test expose programs which had joint military and civilian objectives.

(2) The relative virtues of country-specific vs. generic approaches to the development of insights into the problem of assessing the proliferation resistance of nuclear systems. A related issue was how to judiciously blend technical and political measures so as to maximize proliferation resistance.

(3) The efficacy of sanctions; there was general agreement that the track record of the international community was poor in this respect, not because of a lack of warning but a lack of political will. More study should be given to the sanctions question, keeping in mind, however, that

(4) carrots were just as important as sticks. We must recognize the legitimate nuclear aspirations of other countries. International nuclear fuel cycle centers for enrichment, reprocessing, and spent fuel storage were seen as a way of advancing nonproliferation objectives while blurring the distinction between nuclear haves and have-nots. Countries should also be persuaded that nuclear weapons are not worth the financial and political costs; however, it might be hard for the US to preach this gospel while sitting on top of a gigantic arsenal.

Among the post-mortems on the workshop which have been received to date, the comments of Warren Donnelly seem particularly germane at this point: "If you publish a summary, it would help greatly to write in basic English and to avoid the special vocabularies which are appearing. For example, there must be a better, less artificial word than 'attributes.' Why not 'characteristics?' Sooner or later those who write and think about proliferation will have to take their ideas out of the warm nest. When that time comes, the ideas should be readable and understandable by the uninitiated, particularly Members of Congress and their staff." We hope that we have provided an accurate account of the workshop in the spirit of Donnelly's remarks.

M.D.  
M.M.

AGENDA  
WORKSHOP ON INSTITUTIONAL ASPECTS OF  
PROLIFERATION RESISTANCE

Harvard Program for Science and International Affairs

Monday, December 19, 1977

8:30 a.m.	Coffee	
9:00	Introduction	A. Carnesale, PSIA
9:15	An Overview of NASAP	H. Kendrick, DOE
9:30	Attributes, Games, Decisions and Proliferation Resistance	M. Miller, MIT
10:00	Discussion	
11:45	Lunch	
12:30 p.m.	Tailoring Institutional Con- straints as Complements to Technological Barriers to Proliferation	H. Rowen, Stanford
1:00	Discussion	
1:45	Nonproliferation and Inter- national Fuel Cycle Facilities: Some Cautionary Notes!?	L. Scheinman, State Department
2:15	Discussion	
3:45	Concluding Remarks	T. Schelling, Harvard

MIT/PSIA/DOE WORKSHOP ON INSTITUTIONAL ASPECTS  
OF PROLIFERATION RESISTANCE

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Monday, December 19, 1977

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