ON NUCLEAR DIFFUSION

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I N D E X

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PREFACE

Soon the President will leave for discussions with many of the leaders of Europe. A few weeks later, the Harriman mission will leave for discussions with the Soviet leadership. It is imperative that in preparing for these discussions the United States government create a position oriented to the future instead of the past. We believe that such a position should be staffed in considerable detail, yet retain adequate negotiating flexibility.

The Defense Department has a vital interest in the preparation of such a position because the three basic elements of such negotiations would profoundly affect our national security. These elements are:

1. A Non-Diffusion Agreement with Sanctions.

2. Agreement to Stop Further Products of Nuclear Materials for Military Purposes.

3. A Nuclear Test Ban.

This volume is a further Defense Department contribution to a U.S. Government position on these issues.

APPENDIX II

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Inspection for a Production Cutoff

The U. S. has proposed cessation of the production of fissionable materials for weapons purposes on many occasions since 1956. The production cutoff has been proposed as an independent measure, coupled with transfers of weapons stocks to peaceful use, and as a part of larger disarmament packages.

The loud and consistent Soviet response has been to reject a production cutoff not "indissolubly linked to the prohibition of atomic weapons, their elimination from the armaments of States, and the destruction of atomic weapons stockpiles." The Soviets have had strong reasons to reject the proposal. They are aware that the West would insist on inspection provisions requiring a high degree of access to Soviet society and industry. They are acutely aware that the West enjoys a considerable superiority in stockpiles of fissionable materials and of weapons -- a superiority which the USSR can reduce, at least in relative terms, by continued production. They realize that the cutoff would deny them the materials requirements for future weapons systems which they may be contemplating, including battlefield nuclear weapons and AICBM defenses.

A production cutoff would be in the U. S. interest for the same reasons -- that is, it would freeze an important U. S. advantage in nuclear weapons. Perhaps its greatest value to U. S. security, however, would be as part of a "nuclear containment" package.

Cessation of the production of U-235 and plutonium for weapons purposes would be an important and perhaps essential part of any program for containing the nuclear arms race. For inducing the non-nuclear powers to

adhere to a non-proliferation agreement, it is probably necessary for the great powers to accept limitations on their own weapons program. To put meaningful limits on the strategic nuclear systems of the major powers, it would be contradictory to omit production controls on fissionable materials.

It is conceivable that the production cutoff could be sold to the Soviets in the above terms. They must realize that they cannot overcome the absolute U. S. advantage in nuclear materials production in this decade, nor probably in the next, nor at any time if the US is determined to retain its advantage. (However, it may not be necessary for them to match the U. S. stockpile in order to meet their requirements.) As for the inspection system for a production cutoff, which will be discussed below, it can at least be said that it would be significantly less onerous than the inspection of certain other disarmament measures which have been discussed at Geneva. It would at least be worthwhile to include the cutoff in an initial proposal to the Soviets.

The inspection requirements for a production cutoff have been extensively studied by the Perkins Panel. A summary of the requirements, extracted from the panel report of April 1961, is attached to this paper. Basically, the controls envisioned are these:

-- For shut-down production plants, periodic inspections or continuous external monitoring.

-- For plants remaining in operation (peaceful utilization facilities and a minimum number of production facilities), periodic or resident on-site inspection (depending on size), with full access to the facility.

-- As a check against clandestine facilities, environmental sampling of the entire country, on a coarse grid, with follow-up intensive monitoring

and on-site visits for suspect sites. This would include a quota of peremptory inspections in order to accommodate unilateral intelligence leads. The entire system would require, for monitoring of the Soviet Union, about 350 personnel.

The system recommended by the Perkins Panel is estimated to be capable of detecting annual diversion from the declared facilities amounting to 0.5 percent of the 1963 USSR stockpile of U-235 and 1 percent of the plutonium stockpile. A maximum inspection effort would reduce possible annual diversion of U-235 to 0.05 percent of stockpile and plutonium to 0.2 percent of stockpile, but would be very costly in men and dollars and would involve serious interference with plant operation and administration. If only external access to the plants were allowed, possible diversions are estimated at 2.0 percent and 4.6 percent of the U-235 and plutonium stockpiles, respectively. As for clandestine production, it is very likely that production of U-235 at a rate as large as 1 percent of the USSR stockpile per year would be quickly detected, as would clandestine plutonium -- equivalent capacity as large as 3 percent of stockpile per year.

The amount of cheating possible under the proposed system does not appear strategically significant, so long as each side retains large stockpiles. If significant reductions in weapons stockpiles are made, possible diversions should be measured, not against the 1963 stocks as above, but against the retained levels; the diversions may then become quite significant. Also, the inspection system is not addressed to, and does nothing to alleviate, the problem of clandestine stockpiles amassed before the cutoff.

The Perkins Panel inspection proposals were to be applicable to the nuclear programs of the U.S., the U.K. and the USSR. Clearly, the objectives and criteria of this central system would be different from IAEA safeguards. The IAEA system is designed to prevent diversion from specific facilities of enough fissionable material for a modest initial weapons program. The inspection system applied to the major powers neither could nor would be concerned with such small quantities but would seek to prevent diversion or clandestine production of strategically significant quantities of material (hundreds or thousands of kilograms).

There are additional reasons why controls other than IAEA safeguards should be applied to the major powers:

-- The IAEA is not technically prepared to accept such a jump in responsibilities.

-- The IAEA is not politically prepared to be cast into a sensitive role between East and West.

-- As the U. S. has concluded in its considerations of the test ban, inspection by a moderate number of our own personnel would be more reliable than inspection by a larger number of international personnel.

For the above reasons, it is concluded that verification of a cutoff of fissionable materials production for weapons, as among the nuclear powers, should be carried out by the powers inspecting one another in accordance with the Perkins proposals. Among the countries not now possessing nuclear weapons, IAEA safeguards could perform most of the equivalent functions. However, it would be necessary even in the smaller countries to make provision for search and peremptory inspection for clandestine production. (Just such a demand was raised in the IAEA when intelligence on the Israeli

reactor at Dimona was leaked). Such inspections should preferably be made by an international body, probably the IAEA.

The question whether China is a special case once more arises here. Assuming that a production cutoff agreement could go into effect before China explodes its first nuclear device, it would be preferable to place China under the generally more stringent IAEA system along with the other non-nuclear countries. However, it might be necessary in negotiations, and it would not vitiate the system, to admit China at least partially into the "club" of nuclear power practicing reciprocal inspection.

~~TOP SECRET~~

ATTACHMENT TO APPENDIX II

SYSTEMS FOR MONITORING CUTOFF

(Extract From the Report of the Panel
on the Cutoff of the Production of
Fissionable Materials for Weapons)

DECLARED FACILITIES

Table I lists five alternative cases under which diversion of production from declared USSR plants would be controlled. The Panel concluded that Case 3 represented the most probable production situation and the control system which provided the best balance between inspection effort and diversion potential for the assumption of cutoff without stockpile reduction. Significant reduction of stockpile or greater production would require more substantial inspection.

The cases listed in Table I are characterized by the operating status of atomic energy facilities in the USSR as of July 1, 1963, the intensity of inspection effort, and the type of access permitted to declared plants. Under full operating status (Case 1) all present USSR plants for producing plutonium and U-235 would remain in full operation, with production so monitored as to reduce as far as possible the amount diverted to weapons stockpiles. Under civil-only status (Case 5) all plants except civilian power-only reactors would be shut down.

Under partial operating status (Cases 2, 3, and 4) all dual-purpose and civilian reactors would remain in operation, tritium production would continue to the extent required to maintain existing tritium stockpiles, developmental and non-weapons military uses (such as submarine reactors)

would be permitted, and supporting production facilities for the above would continue to operate; these are estimated to consist of one-half of one gaseous diffusion plant, one chemical separation plant and fuel fabrication facilities. The U-235 production rate of such facilities would be 6,000 kilograms per year; this is about three times our estimate of legitimate USSR needs but was left high to show the diversion possibilities if they claim to need this much for these "partial" cases. In all cases weapons fabrication and storage sites were assumed to be declared and to remain in operation, not under inspection.

Full operating status (Case 1) was not considered a realistic situation because it would represent no reduction in fissionable material production. Moreover, the diversion possibilities at this high production rate were great in terms of absolute amount, and the cost and manpower requirements of the monitoring system were correspondingly high. Civil-only operating status (Case 5) was not considered realistic, in spite of the attractively small amount of diversion probable, because it would not permit the USSR, the US or the UK to produce U-235 for legitimate civilian or non-weapons military uses, or to operate dual-purpose reactors, and would therefore be politically unacceptable.

Under the more probable partial operating status, three inspection systems were considered. Minimal inspection effort coupled with access only external to the plants (Case 4) leads to estimated possible diversions of U-235 and plutonium of 2.0 percent and 4.6 percent of the USSR stockpile per year, which are considered unacceptably great. A substantial

inspection effort with full access to operating plants (Case 2) would reduce possible annual diversion of U-235 to 0.05 percent of stockpile and plutonium to 0.2 percent of stockpile, but would be very costly in men and dollars, and would involve serious interference with plant operation and administration.

Case 3, which uses minimal inspection effort with full access to operating plants, provides the preferred balance between inspection cost and acceptable diversion control. With a staff of 300 technical personnel in the USSR and at an annual cost of around $7 million, diversion of U-235 should be kept below 0.5 percent of the USSR stockpile, and plutonium below 1 percent. In addition, it would provide for monitoring tritium production for replacement of stockpile decay losses. Obviously, as the number of facilities increases, the cost and manpower required for the inspection system will have to increase correspondingly.

CLANDESTINE FACILITIES

The system recommended for detecting clandestine production facilities makes use of intelligence information, analysis of environmental samples overtly collected in the USSR and direct inspection of suspected sites. Suspicion of the existence or post-treaty construction of undeclared production facilities would probably be first aroused by conventional intelligence information. Analyses of environmental samples collected within the USSR would supplement this capability and provide background information for interpretation of sample data subsequently obtained during site inspection visits. The Panel concluded that neither

the detection capabilities nor background requirements of sample analysis justified the collection of such samples on a closely-spaced grid. Periodic sample collection on a widely-spaced grid is strongly recommended, however.

Once suspicion of the existence of an undeclared production facility has been aroused, either by intelligence information or by sample analyses, a staged verification procedure would be implemented. This procedure can be initiated either by sample analysis results exceeding specified criteria or by use of one of a limited number of peremptory inspections. Aerial surveys of suspected areas would be carried out to identify specific suspect sites. In addition more intensive sampling and visual observation would be permitted close to the site. Continued suspect results would provide the basis for inspection inside facilities for purposes of verification.

The probability of detecting clandestine plants of different types and production rates from different distances is stated in table II. The production potential of possible clandestine plants which could escape detection by the proposed inspection system is difficult to define in quantitative terms. It is very likely, however, that production of U-235 at a rate as large as 1 percent of the USSR stockpile (1400 kg) per year would be quickly detected, as would clandestine plutonium-equivalent capacity as large as 3 percent of stockpile (500 kg) per year. There would be a significant probability of discovering a clandestine plutonium facility within a very few years after its startup, even if its capacity

were only 1 percent of the stockpile per year.

The technical staff permanently in the USSR needed for the sampling program would consist of about 50 men, including technical personnel for aerial surveys. The annual cost of the inspection system for clandestine plants in the USSR would be about $3 million.

RECOMMENDED SYSTEM

Taken together, provisions for controlling diversion from declared plants and detecting the existence of clandestine plants would require about 350 technical inspection personnel in the USSR, and would cost about $10,000,000 per year. These systems would have a high degree of probability of detecting annual illicit diversions of 2 percent or more of the 1963 USSR stockpile of fissionable material. Adding the cost and personnel requirements for the US and UK to those for the USSR would about triple the above figures.

In summary, the recommended US system consists of (1) inspection of declared plants operating on a partial basis with full access and "minimal" inspection, except that inspection for tritium production facilities would be "substantial"; (2) external observation of declared inoperative plants to make sure they remain shut down; and (3) an inspection system for detecting clandestine plants, making use of intelligence information and a selective grid system of environmental sampling, with rights of inspection of suspected sites when evidence collected openly by the system meets certain criteria, plus peremptory rights for inspection of a small number of suspected sites per year.

The following comments on this recommended inspection system are pertinent.

The recommended system is based on the premise that diversions from declared plants plus production from undetected clandestine plants, if small compared with the existing USSR stockpile, have little effect on relative stockpile sizes and should not affect other considerations involved in a decision to negotiate a cutoff. This situation would become very different in case major stockpile reduction is considered, and might become unacceptable. Any inspection system, therefore, must contain provisions for intensification in the future if stockpiles are reduced. If countries other than the US, UK, and USSR develop weapons-production capabilities, the system will require expansion.

A high degree of access is required to limit diversion from operating plants to 10 percent of their production rate or to prove the existence of a clandestine plant. Full access to declared plants and suspect sites is far more effective than sheer size or complexity of inspection organizations. Providing an adequate degree of access, not only to plants continued in operation, but to suspect clandestine plants, may prove a very large problem for the US as well as the USSR.

The degree of access contemplated in the recommended inspection system would seriously compromise any advantage of the US over the USSR in production technology, and possibly in other areas also. On the other hand, such access would improve the US intelligence position. In view of the substantial time between the compromise of technology and the actual

coming into effect of a cutoff, resulting from the time required to train and establish inspection personnel, a sequenced installation of the inspection system seems essential, with provision for withdrawal of either party if lack of good faith becomes apparent.

Inspection of non-operating plants to insure their continued non-operation requires a relatively low degree of access and a small inspection group, with a very high certainty of assuring no production from these facilities.

The possibilities of diversion from mixed civilian-military plants which will probably continue in use require inspection within the plants, with its accompanying eventual loss of production technology. To delay this loss as long as possible, a particular staged approach was considered which would start with a complete shutdown of all plants, followed by a startup as inspection was established. In view of the grave complications to the civil program in the US, USSR and especially in the UK this was rejected as impractical. In addition, it was felt that startup after a complete shutdown might be made politically difficult for the US by the USSR.

Inspection systems which would provide for a higher degree of certainty or a greater proof of evasion than the one recommended appear impracticable at the present time since the problems of inspection and control to preclude diversion quantities of less than 2 percent of the 1963 stockpile per year greatly complicate the inspection problem. In addition, it is considered impractical to extend the inspection system

to lithium-6, heavy water, or other non-fissionable materials.

Tritium poses a special problem. The proposed inspection system provides for a substantial rather than minimal coverage of the declared tritium production and separation facility. Because there is a realistic possibility that materials capable of producing tritium may be placed in declared civil power reactors or submarine reactors, with subsequent use of a small clandestine tritium separation plant, the possible undetected production of tritium is greater than for correspondingly important quantities of plutonium or U-235.

The recommended inspection system does not consider any detailed control of military power reactors, but does contemplate control of fuel material supplied to and received from such reactors.

The recommended inspection system provides for control of civil and dual-purpose reactors. These reactors can produce substantial amounts of reactor products. The rights and agreements for access would be the same as for production-only reactors, and inspection would be similar within the bounds of the minimal level of inspection.

TABLE 1

SYSTEMS FOR CONTROLLING DIVERSION FROM DECLARED USSR PLANTS

Case	1	2	3	4	5
Plant Operating Status	Full	Partial	Partial	Partial	Civil Only
Inspection Effort	Minimal*	Substantial	Minimal*	Minimal	Minimal
Access Permitted to Plants					
a. Operating	Full	Full	Full	External	External
b. Shutdown	External	External	External	External	External
U-235					
'63 Stockpile, kg	140,000	140,000	140,000	140,000	140,000
Thruput, kg/yr	35,000	6,000	6,000	6,000	0
Possible Diversion per year					
kg	3,500	60	600	3,000	0
% of Thruput	10	1	10	50	0
% of '63 stockpile	2.5	0.05	0.5	2.0	0
Reactor Products					
'63 Stockpile, kg Pu	16,000	16,000	16,000	16,000	16,000
Thruput, kg Pu/yr	3,000	1,500	1,500	1,500	400
Possible Diversion per year					
kg	300	15	150	750	40
% of Thruput	10	1	10	50	10
% of '63 stockpile	1.8	0.1	1.0	4.6	0.2
Personnel in USSR					
Production Plants	680	600	270	50	40
Civilian Plants	35	200	35	35	35
First cost, $ million	13	16	7	2	2
Annual cost, $ million	13	16	7	2	2

* Substantial on tritium production facility.

~~RESTRICTED DATA~~
ATOMIC ENERGY ACT, 1954
AS AMENDED

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TABLE II

PROBABILITY OF DETECTING CLANDESTINE PLANTS

Annual Production Relative to 1963 Stockpile	Plutonium-Equivalent		Uranium-235 (Gaseous Diffusion)*	
	1 percent	10 percent	1 percent	10 percent
Provides Basis for Strong Suspicion				
1. Unilateral Intelligence	Possible	Very Probable	Probable	Very Probable
2. Overt, widely-spaced sample grid	Unlikely	Possible	Unlikely	Unlikely
Provides Identification of Function or Refutation of Suspicions				
1. Overt local aerial photography	Unlikely	Very Probable	Very Probable	Very Probable
2. Overt observation and environmental sampling around a perimeter distant from the target by:				
a. One mile	Probable	Very Probable	Very Probable	Very Probable
b. One to ten miles	Possible	Probable	Probable	Probable
c. Ten to 50 miles	Unlikely	Possible	Possible	Possible
Provides Proof				
Access to building	Very Probable	Very Probable	Very Probable	Very Probable

* If uranium-235 is produced in small scattered ultracentrifuge plants the probability of detection by sample evidence would be seriously degraded. The multiplicity of such plants required to produce even 1 percent of the stockpile per year would enhance the chance for intelligence detection of one or more of them, however.