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A Reprint of the
Executive Summary
of the October 1991 Report to Congress:
**Verification of Nuclear Warhead
Dismantlement and Special Nuclear
Material Controls**

November 2008



Pacific Northwest
NATIONAL LABORATORY

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Pacific Northwest National Laboratory
Richland, Washington 99352

Preface

With the renewed thinking and debate about deep reductions in nuclear weapons, to include new recent proposals about eliminating nuclear warheads altogether, I thought it would be useful to republish the general conclusions of the Robinson Committee Report of 1992. This report is sometimes referred to as the *3151 Report* from Section 3151 of the National Defense Authorization Act for Fiscal Year 1991, from where its requirement originated. The only previous major U.S. effort on the subject at the time was conducted as Project Cloud Gap in the early 1960s.

The two leading proponents for the report were Senators Edward Kennedy and John Glenn. The legislation required President George H. W. Bush to form a Technical Advisory Committee on Verification of Fissile Material and Nuclear Warhead Controls and to prepare a report for Congress on the subject of nuclear warhead dismantlement and fissile material controls. As soon as this requirement became known, Dr. Vic Alessi, then working at the Department of Energy, asked me to form an internal working group comprised of a small team of technical specialists from the national laboratories to begin thinking about a response. In the mean time, he worked with the White House to get the effort assigned to DOE, which it eventually was.

Dr. Alessi, with White House concurrence, asked Ambassador C. Paul Robinson of Sandia National Laboratories to head the Advisory Committee. Its membership was comprised of prominent leaders from within the DOE weapons complex as well as three persons from outside the complex knowledgeable in these matters. Several deliberative meetings were held at very restrictive levels of classification, and the report was completed to everyone's satisfaction, except for the fact that it could not be delivered to the Congress unclassified as requested. The full report remains classified to this day.

However, all of us felt it was important to generate an unclassified executive summary in order for the overall results to receive wider distribution. This is the document reprinted in this report. The Committee, as outlined in the summary, concluded that there would be many very difficult problems to overcome, with some not being possible to solve (such as highly accurate knowledge of baseline warhead and fissile material inventories, and also the relative lack of efficacy of NTM). It was supposed that this would not be the answer some were hoping for, and given the makeup of the Committee, might raise questions. For this reason, we asked Dr. Sid Drell and the MITRE JASONS to perform a peer review of the report. This was accomplished at JASONS facilities in California at the same levels of classification as the original report. The conclusions were upheld, and some new ideas were even suggested. This effort was overtaken by events to some degree with the dissolution of the Soviet Union, and the unprecedented cooperation on nuclear matters which quickly ensued, but it has renewed relevance today. And even though the effort did not get widespread distribution and notice at the time, it did become the basis of a significant R&D program in the Department for several years thereafter.

It is with this background that the unclassified Executive Summary of the Robinson Committee Report is reprinted here.

Jim Fuller
November 2008



Department of Energy
Washington, DC 20585

MAY 5 1992

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Report to Congress on *Verification of Nuclear Warhead
Dismantlement and Special Nuclear Material Controls*

Congress directed the President, as part of the National Defense Authorization Act for Fiscal Year 1991, to establish a Technical Advisory Committee on Verification of Fissile Material and Nuclear Warhead Controls and provide the subject report. President Bush delegated his responsibilities for this requirement to Admiral James Watkins in April 1991. These tasks have been completed and a copy of the report is enclosed for your information.

President Bush's Nuclear Initiative, as presented in September 1991, de-emphasizes negotiation of formal cooperative verification measures for the post-START drawdown of nuclear weapons. Instead, a more expeditious approach based on transparent unilateral actions is being implemented. The Committee's report, completed prior to the President's Nuclear Initiative, notes the extreme difficulty in monitoring and confidently assessing Soviet production of nuclear warheads and special nuclear material, and therefore supports the President's approach. Enclosed with this memorandum is a copy of the President's transmittal letter to Congress concerning the Report.

The Technical Advisory Committee, chaired by Ambassador C. Paul Robinson of Sandia National Laboratories, was comprised of preeminent technical experts in the relevant fields. Their Charter was limited to the technical assessment of on-site monitoring techniques, inspection arrangements, and national technical means which could be used to verify the dismantlement of nuclear warheads, a ban on production of plutonium and highly-enriched uranium, and the disposition of the materials from the dismantled warheads. The Department of Energy's Office of Arms Control and Nonproliferation facilitated the Committee's activities. To those of you within the Defense Programs community at the field offices, production facilities, and National Laboratories who contributed and otherwise supported this task, both Ambassador Robinson and I offer our sincere thanks for your efforts.

Note that the full report is SECRET RESTRICTED DATA - NOFORN - WNINTEL, containing sensitive information pertaining to the weapons production complex. The Executive Summary, found on pages 5 to 12, is unclassified and is also provided as a stand-alone document.

A handwritten signature in dark ink, reading "Victor E. Alessi".

Victor E. Alessi
Director
Office of Arms Control
and Nonproliferation
Office of the Secretary

THE WHITE HOUSE
Office of the Press Secretary

For Immediate Release

October 7, 1991

TEXT OF A LETTER FROM
THE PRESIDENT TO THE SPEAKER OF
THE HOUSE OF REPRESENTATIVES AND
THE PRESIDENT OF THE SENATE

October 7, 1991

Dear Mr. Speaker: (Dear Mr. President:)

I am transmitting with this letter a report to the Congress: Verification of Nuclear Warhead Dismantlement and Special Nuclear Material Controls, as required by section 3151 of the National Defense Authorization Act for Fiscal Year 1991. The report reflects the views of a Technical Advisory Committee on the subject defined by Congress: on-site monitoring techniques, inspection arrangements, and national technical means that might be useful to verify the dismantlement of nuclear warheads, a ban on the production of plutonium and highly enriched uranium for nuclear weapons, and the disposition of these materials recovered from dismantled nuclear warheads.

A distinguished panel of Government and nongovernment technical experts was assembled, according to Federal Advisory Committee Act guidelines, to serve as the Technical Advisory Committee under the requirements of the Act. They have summarized their findings in the unclassified Executive Summary, and approve the material presented in the classified full report, initially prepared by the Department of Energy. The Technical Advisory Committee had full independence in expressing their expert opinions on these matters. The Committee was chaired by Ambassador C. Paul Robinson who served as the U.S. Ambassador to the Nuclear Testing Talks.

The mandate to the Committee in the legislation was challenging. It is difficult and potentially misleading to evaluate verification issues in isolation from the details of a potential agreement. Since there are no such agreements drafted, the adequacy of the verification measures could only be discussed in broad and general terms. That said, the report makes clear the difficulties and risks involved. As the Advisory Committee reports, the United States could not effectively verify the number of existing warheads or the amount of special nuclear material currently on hand. We likewise could not have high confidence in discovering clandestine warhead or special nuclear material stockpiles. In addition, the report notes the extreme difficulty of monitoring the many potential paths in which nuclear warheads or special nuclear material could be produced.

The Committee charter was limited to the assessment of technical verification arrangements and techniques, and therefore their report does not address the broader national security implications of the possible outcomes defined in the legislation. The Committee was in unanimous agreement, however, that for any controls regarding warhead demilitarization or special nuclear material production, maintenance of an effective and modern nuclear deterrent must not be compromised.

Sincerely,

GEORGE BUSH



The Secretary of Energy
Washington, DC 20585

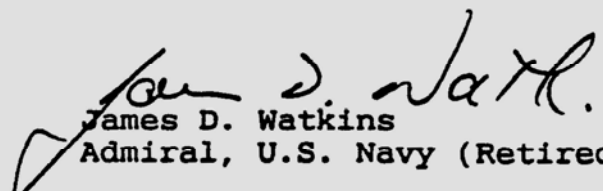
June 27, 1991

MEMORANDUM FOR THE PRESIDENT

SUBJECT: Transmittal of Report entitled "Verification of Nuclear Warhead Dismantlement and Special Nuclear Material Controls"

I am pleased to submit to you a report entitled "Verification of Nuclear Warhead Dismantlement and Special Nuclear Material Controls." This report was prepared under section 3151 of the National Defense Authorization Act for Fiscal Year 1991, Public Law 101-510, which requires a description of the on-site monitoring techniques, inspection arrangements, and national technical means that could be used by the United States to verify Soviet dismantlement of nuclear warheads, a ban on future production of plutonium and highly enriched uranium, and the end use or ultimate disposal of plutonium and highly enriched uranium recovered from dismantled warheads.

Section 3151 specified the preparation of an unclassified report with classified appendices, as necessary. In order to come as close as possible to meeting the statutory due date, it became clear that a classified report with an unclassified executive summary would be a satisfactory alternative. The executive summary was prepared by the Technical Advisory Committee on Verification of Fissile Material and Nuclear Warhead Controls, chaired by Ambassador C. Paul Robinson. You delegated the authority to establish this advisory committee to me on April 10, 1991. The advisory committee also reviewed, edited and approved the material in the classified report.


James D. Watkins
Admiral, U.S. Navy (Retired)

C. Paul Robinson

Director
Systems Analysis

Sandia National Laboratories

Albuquerque, New Mexico 87185

JUN 13 1991

The Honorable James D. Watkins (S-1)
Secretary of Energy
Forrestal Building, Room 7A257
Washington, DC 20585

Dear Mr. Secretary:

As chairman of your Technical Advisory Committee on Verification of Fissile Material and Nuclear Warhead Controls and on behalf of the members of that Committee, I am pleased to present here the report requested by the Congress under Section 3151 of the National Defense Authorization Act for Fiscal Year 1991.

Due to the short time-frame for preparation of this substantial report, we began with a classified report that was drafted by staff of the DOE national laboratories, working in conjunction with your Office of Arms Control in Defense Programs. The TAC reviewed that material; and, after considerable discussion, we then independently prepared an unclassified Executive Summary, which covers what the committee identified as the key issues. From that base, the TAC worked with the authors to reshape the focus of the original report to fit the committee's views as to the treatment of the important issues.

Thus, we have come up with an overall report that provides an in-depth coverage of the subject of verification of potential agreements on warhead dismantlement and special nuclear materials control and disposition, while also providing a top level view of the issues that can serve as a basis for discussion between the Executive and Legislative branches.

The members of the Technical Advisory Committee take full ownership of the Executive Summary of the report, which we believe will receive most of the attention within the Congress and in wider discussions. We also have reviewed, edited, and approved the material in the remainder of the report to ensure that it is technically correct and apropos to the assigned issue.

In short, I believe we have produced a report that both you and the President can take pride in.

Let me add that the committee feels deeply indebted to the members of your staff and the laboratory experts who prepared the

JUN 13 1991

initial material and worked with us to achieve this final product. In particular, Dr. Jim Fuller of the Office of Arms Control deserves enormous credit for his outstanding work in leading the work of the lab experts, in supporting the work of the TAC, and in technical preparation of the document. Your people have all done a most professional job.

I am also pleased that we were able to meet the June 14 deadline for completion of this effort. It has been a pleasure for all of us to serve in this undertaking, and we stand ready to support you in the future on these important and challenging issues.

Most sincerely,

C. Paul Robinson

**TECHNICAL ADVISORY COMMITTEE ON
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CONTROLS**

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Ronald Ewing

Dr. Harry Groh

Dr. Ted Gold

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Hicks and Associates

President, Mason & Hanger Corporation

Sandia National Laboratories

Co-Director, Stanford Linear Accelerator

Past President, Union Carbide, Nuclear Division

REPORT TO CONGRESS

VERIFICATION OF NUCLEAR WARHEAD DISMANTLEMENT AND SPECIAL NUCLEAR MATERIAL CONTROLS

JULY 1991

EXECUTIVE SUMMARY

A. INTRODUCTION

This report has been prepared in order to meet the requirements of Section 3151 of the National Defense Authorization Act of 1991, which mandates a report to the Congress on the onsite monitoring techniques, inspection arrangements, and national technical means of verification (NTM) that the United States could use to verify the actions of other nations with respect to

- Dismantlement of nuclear warheads in the event that a future agreement between the United States and the Soviet Union should provide for such dismantlement to be carried out in a mutually verifiable manner
- A mutual United States-Soviet ban, leading to a multilateral, global ban, on the production of additional quantities of plutonium (Pu) and highly-enriched uranium (HEU) for nuclear weapons
- The end-use or ultimate disposal of any plutonium and highly enriched uranium recovered from the dismantlement of nuclear warheads.

B. CONTEXT

This report addresses onsite monitoring techniques, inspection arrangements, and national technical means of verification that *could* be used to attempt to monitor compliance if a decision to pursue such arms control measures were made. The status, role, potential use, and possible further development of these verification techniques and inspection arrangements are examined. The report also identifies other impacts including the risk of compromising sensitive, nuclear-weapon-related information. The short-hand term *SNM* (special nuclear material) is generally used throughout the report to designate fissile material, such as Pu or HEU, which can be used to build nuclear weapons.

This report does not address the policy issue of whether it would be in the US national security interest to seek agreements with either the Soviet Union or other nations that would require the dismantlement of nuclear weapons, the disposition of the returned nuclear materials, and/or controls on the production of plutonium or highly-enriched uranium that could be used to build additional nuclear weapons. That issue can only be decided on the basis of strategic, military, and political judgements, including a net assessment of the objectives and capabilities of other nations relative to US security, which lie beyond the scope of this report.

The effectiveness of the verification methods, which would be used to verify compliance with potential agreements in warhead dismantlement or material production controls, are but one factor in that assessment. The overarching question is whether such agreements would support US national security interests, even if all parties were in full compliance with such agreements. In addition, all potential routes to produce nuclear materials and assemble them into nuclear weapons would need to be addressed, as well as the effectiveness of our ability to verify such activities.

Assessing the adequacy of potential verification measures is extremely difficult. Standards for verification would depend not only upon the objectives and the details of specific agreements, but also upon their geopolitical context. The relationship with the Soviet Union; the degree of openness of Soviet society; and the two sides' nuclear force postures, including number and type of weapons and delivery vehicles, total amount of SNM, and size of research, development, and testing programs, and production and material processing complexes would be among the factors that influence verification standards. Therefore, the adequacy of verification measures can be discussed here only in very broad and general terms.

Verification for compliance purposes goes beyond onsite monitoring techniques, inspection arrangements, and NTM, necessarily including information from all intelligence sources, and the political judgments that are made on the basis of this information. This report, in keeping with the Congressional charter, emphasizes the technical monitoring and NTM techniques, and does not address in detail vulnerability of verification technology to cheating, potential cheating scenarios, etc.

If a proposed agreement provides for dismantlement of specified numbers of weapons or for specified reductions of SNM inventories, the following verification issues would need to be addressed

- Actual and appropriate nuclear weapons are dismantled
- Nuclear materials recovered from dismantled weapons are not used for prohibited purposes
- Prohibited existing facilities are shut down
- Allowed production and processing facilities are not used to produce prohibited materials or warheads
- Clandestine/prohibited production and processing facilities do not exist.

While agreements on warhead dismantlement or on limits on production of SNM for weapons might be viewed as arms control measures in their own right, it would be better to view them as supplements to support arms control measures that would control the numbers of warheads and/or delivery vehicles. The reason is that it would be difficult to significantly reduce the uncertainty in knowledge of total Soviet SNM and warhead inventories with present or foreseeable verification techniques and arrangements.

If one would seek to impose limits on *total* numbers of warheads, and *total* weapon SNM stockpiles, then knowledge of the total SNM that could possibly be used for weapons would be essential. SNM of, or near, weapons-quality is also used for other purposes, including breeder reactors, research reactors, and submarine power plants. The importance of the uncertainty in our knowledge of the total SNM stockpile inventory would increase as the size of the weapons stockpiles were decreased.

There are significant asymmetries between the US and Soviet nuclear warhead material production and processing infrastructures. In general the Soviet infrastructure is considerably larger and has more redundancy. This asymmetry would place a much greater burden on US verification of Soviet nuclear activities than vice versa. The negotiation of treaties including measures for warhead destruction and SNM controls could (and, from a US perspective, should seek to) redress these asymmetries. An incentive for the Soviets to close such facilities is the fact that many of these facilities are old and environmentally hazardous.

Aside from the summary and introductory discussions, the main body of this Report to Congress is divided into a section covering general verification measures, and then three sections covering the primary topics of interest: verification of dismantlement, SNM controls/cutoff, and material disposition.

C. NTM, ONSITE MONITORING TECHNIQUES, AND INSPECTION ARRANGEMENTS

The utility and effectiveness of inspection arrangements, onsite monitoring techniques, and NTM would be highly dependent on the objectives and specifics of a negotiated agreement and the degree of detail of the corresponding verification protocols. The key observations from this portion of the report are listed below.

- For some of the verification tasks associated with warhead dismantlement and SNM control (for example, monitoring declared stocks, warhead dismantlement, facility shutdown, and activities at permitted facilities) onsite inspection would play a dominant role, with NTM playing a lesser role. However, even the full suite of NTM, inspection arrangements, and onsite monitoring techniques probably could not provide verification of total SNM quantities or the absence of clandestine production facilities without a significant margin of error.
- While simple techniques (such as visual monitoring or chain-of-custody) can suffice for some verification tasks, more complex monitoring techniques (such as active interrogation of treaty-

limited items [TLIs]), some of which have yet to be developed, would be required for other tasks.

- Warhead dismantlement and material production have some unique, externally observable signatures useful in other monitoring efforts. However, these signatures have limited value in monitoring by national technical means. NTM could aid in monitoring some changes in the status of declared facilities, particularly those declared to be inactive. However, the detection and identification of undeclared SNM and weapon-associated sites through NTM could not be relied upon at present and the prospects for developing such detection and identification capabilities in the future are low.
- It is important that specific treaty provisions should be negotiated with adequate knowledge of the limitations of the inspection and monitoring techniques that would be employed.

D. VERIFICATION OF NUCLEAR WARHEAD DISMANTLEMENT

The warhead dismantlement process can be represented as three separate processes from a verification point-of-view.

1. Warhead Identification - confirmation that the unit to be dismantled, in fact, is or contains a nuclear warhead (and perhaps a specific type of nuclear warhead) rather than a surrogate.
2. Chain-of-Custody - verification that the unit identified as containing a warhead remains intact during transport from the site where identification took place to a dismantlement site and during any temporary storage. There must be assurance that the warhead was not removed and replaced by a surrogate during the transport and any temporary storage process.
3. Dismantlement - disassembly of the warhead-containing system to the degree required.

The key observations concerning verification of warhead dismantlement are as follows.

- From a narrow technical perspective, verification of the dismantlement of nuclear warheads could be accomplished with high confidence, however, there are costs and risks involved in the process of verifying dismantlement, particularly the risks of disclosing sensitive information. Such disclosures could reveal potential vulnerabilities of our nuclear forces or reveal design information that could be used by others to develop or improve their own nuclear weapons.

- Determining the initial number of warheads that a side possesses at the time an agreement would enter into force would be an extremely difficult problem due to the ease of concealment and the paucity of external observables. This would apply to both warheads of a particular type and to total stockpiles. Uncertainties in initial inventories would become more important as the size of the warhead stockpiles decrease.
- SNM and nuclear weapons emit characteristic radiation which could be used as the basis for detecting the presence of these materials and their quantities under onsite inspection arrangements. It might be possible to develop techniques that offer improvements in warhead identification with reduced risks of disclosing sensitive information.
- Chain-of-custody arrangements offer the possibility of verifying dismantlement with a lower risk of divulging sensitive information. Portal-perimeter monitoring techniques might be applied to warhead dismantlement facilities in order to avoid the intrusiveness of direct monitoring of the dismantlement process. Inspection arrangements that use a combination of tagging and random selection of warheads for further monitoring might reduce monitoring costs and also limit intrusiveness. For these possibilities, evasion scenarios must be carefully and thoroughly evaluated.
- In order to segregate new warhead production functions from dismantlement functions, modified or dedicated facilities, as well as new processes or procedures for carrying out warhead dismantlement in onsite inspection regimes, might have to be provided.
- The verified destruction of the non-nuclear parts of the dismantled warheads would have little arms control significance, since these parts could be reconstituted in a clandestine manner with only modest efforts and costs.

E. VERIFICATION OF SNM PRODUCTION CONTROLS/CUTOFF

Special nuclear materials are produced to serve both military and civilian needs. It is assumed that any agreement to control or ban the production of SNM for use in nuclear weapons would be designed in such a way as to permit other uses. The key observations from this section of the report are listed below.

- It would be extremely difficult to verify, without a significant margin of error, the size of the SNM stockpile that a side possesses at the time an agreement would enter into force. The resulting uncertainty would likely become more important as the total SNM stockpile decreases. Furthermore, monitoring techniques would be unable to effectively reduce this uncertainty

due to the ease of concealment, the lack of external observables, and the difficulty of determining the performance of past operations.

- An integrated civilian/military material production complex, such as in the Soviet Union and other countries, would complicate the verification of the initial inventories of material available for weapons.
- In any agreement to limit production of SNM, verification would require monitoring of appropriate elements of the civilian fuel cycle.
- Tritium production reactors would also need to be monitored to foreclose the possibility of prohibited Pu production. Similarly, all other production and use of SNM (e.g., naval fuel, research reactors, breeders, and as tritium reactor fuel) would need to be monitored.
- It would be very difficult to detect and identify production from undeclared enrichment plants. Although detection of undeclared reactors would be somewhat less difficult, it would not be assured.
- The potential of new technology, such as laser isotope separation of uranium and Pu, or modern centrifuge enrichment, would open up significant new opportunities for SNM production with minimal observables.
- Possible benefits that would arise from the monitoring of SNM and related facilities include opportunities for onsite presence at the correspondingly larger number of Soviet facilities as well as a strengthening of commitments to the Non-Proliferation Treaty (NPT).

F. VERIFICATION OF SNM DISPOSITION

The disposition options for SNM recovered from warhead dismantlement include its reuse in weapons programs; use for naval or space reactors; use in commercial reactors; monitored storage; and irretrievable disposal. The SNM returned from dismantled weapons has substantial value that would represent major cost savings if these materials could be used in permitted programs, such as to fuel commercial power reactors. The key observations from this section are provided below.

- Most disposition options would be reversible at some cost.
- Blending highly-enriched uranium with appropriate amounts of depleted uranium would significantly reduce the weapon utility of such material, such that it would require re-enrichment along with those attendant costs. However, additional enriched

uranium would then have to be produced in order to provide material for permitted uses, such as naval reactors.

- The weapon utility of Pu can be significantly reduced by adding highly radioactive material (*denaturing*) which would require subsequent reprocessing in shielded facilities to remove the added material in order to reuse it in weapons. Although this denatured plutonium would be difficult to handle, it could be purified for reuse in existing reprocessing plants, at a lower cost than for producing new plutonium. Other less reversible processes for preventing plutonium reuse might be developed, such as incorporation in a glass matrix, that would increase the costs for recovery and reuse.
- Material disposition options that would return SNM to non-weapons programs (commercial and defense) would transfer the need to monitor the material to those other programs, which would enlarge the monitoring tasks and introduce concerns regarding protection of sensitive information.
- Long-term storage of material would likely be possible to monitor using standard safeguards technologies. However, the form and location of the material would be a critical parameter since some forms (full-up weapons systems or intact components, for example) would easily be returned to their military function with minimal cost and time penalties, to facilitate a breakout.

G. MULTILATERAL CONSIDERATIONS

The potential for multilateral involvement in warhead and material control regimes includes some additional considerations. These are summarized below.

- The allowed margin of error in determining the size and disposition of weapons or SNM stockpiles would depend on the specific parties involved and the degree of maturity of their nuclear weapons programs, and of course whether these parties even had such programs.
- US obligations under the Non-Proliferation Treaty would need to be considered if inspectors from proliferant or non-nuclear weapon states would be involved in the inspection of US nuclear weapon facilities. The level of intrusiveness of verification arrangements would become more important if it compromised design information or other weapon technologies.
- Potential positive impacts would include a reinforcement of international perception of the intent of the treaty parties to abide by Article VI of the Non-Proliferation Treaty.

