NUCLEAR TESTING

Summary and Conclusions

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JSR-95-320 - *Exec. Summ.*

August 1, 1995

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SUMMARY AND CONCLUSIONS

(U) We have examined the experimental and analytic bases for understanding the performance of each of the weapon types that are currently planned to remain in the U.S. enduring nuclear stockpile. We have also examined whether continued underground tests at various nuclear yield thresholds would add significantly to our confidence in this stockpile in the years ahead.

(U) Our starting point for this examination was a detailed review of past experience in developing and testing modern nuclear weapons, their certification and recertification processes, their performance margins,¹ and evidence of aging or other trends over time for each weapon type in the enduring stockpile.

Conclusion 1:

(U) The United States can, today, have high confidence in the safety, reliability, and performance margins of the nuclear weapons that are designated to remain in the enduring stockpile. This confidence is based on understanding gained from 50 years of experience and analysis of more than 1000 nuclear tests, including the results of

¹Defined as the difference between the minimum expected and the minimum needed yields of the primary.

approximately 150 nuclear tests of modern weapon types
in the past 20 years.

(U) Looking to future prospects of achieving a Comprehensive Test Ban Treaty (CTBT), a stated goal of the United States Government, we have studied a range of activities that could be of importance to extending our present confidence in the stockpile into the future. We include among these activities underground experiments producing sub-kiloton levels of nuclear yield that might be permitted among the treaty-consistent activities under a CTBT.

(U) Three key assumptions underlie our study:

1. (U) The U.S. intends to maintain a credible nuclear deterrent.
2. (U) The U.S. remains committed to the support of world-wide non-proliferation efforts.
3. (U) The U.S. will not encounter new military or political circumstances in the future that cause it to abandon the current policy — first announced by President Bush in 1992 — of not developing any new nuclear weapon designs.

Conclusion 2:

(U) In order to maintain high confidence in the safety, reliability, and performance of the individual types of

weapons in the enduring stockpile for several decades under a CTBT, whether or not sub-kiloton tests are permitted, the United States must provide continuing and steady support for a focused, multifaceted program to increase understanding of the enduring stockpile; to detect, anticipate and evaluate potential aging problems; and to plan for refurbishment and remanufacture, as required. In addition the U.S. must maintain a significant industrial infrastructure in the nuclear program to do the required replenishing, refurbishing, or remanufacturing of age-affected components, and to evaluate the resulting product; for example, the high explosive, the boost gas system, the tritium loading, etc. Important activities in a stockpile stewardship program that will sustain a strong scientific and technical base, including an experienced cadre of capable scientists and engineers, are described in the body of this study.

(U) The proposed program will generate a large body of technically valuable new data and challenging opportunities capable of attracting and retaining experienced nuclear weapons scientists and engineers in the program. This is the intent of DOE's currently planned stockpile stewardship program.² For the success of this program, the management of the three weapons laboratories (LANL, LLNL, SNL) must motivate, support, and reward effort in an area that has lost some of its glamor and excitement in the

²See the 1994 JASON Report JSR-94-345 on "Science Based Stockpile Stewardship".

absence of new nuclear design and test opportunities.

(U) Nevertheless, over the longer term, we may face concerns about whether accumulated changes in age-affected weapons components, whose replacements might have to be manufactured by changed processes, could lead to inadequate performance margins and reduced confidence in the stockpile.

(U) Enhancements of performance margins will add substantially to long-term stockpile confidence with or without underground tests. To cite one example, we can adjust the boost gas fill or shorten the time interval between fills. (This is discussed more fully in the classified text.)

Conclusion 3:

(U) The individual weapon types in the enduring stockpile have a range of performance margins, all of which we judge to be adequate at this time. In each case we have identified opportunities for further enhancing their performance margins by means that are straightforward and can be incorporated with deliberate speed during scheduled maintenance or remanufacturing activities. However greatest care in the form of self-discipline will be required to avoid system modifications, even if aimed at "improvements", which may compromise reliability.

(U) This brings us to the issue of the usefulness, importance, or necessity of reduced-yield (less than 1 kiloton) underground tests for maintaining

confidence in the weapon types in the U.S. stockpile over a long period of time.

(U) For the U.S. stockpile, testing under a 500 ton yield limit would allow studies of boost gas ignition and initial burn, which is a critical step in achieving full primary design yield. The primary argument that we heard in support of the importance of such testing by the U.S. is the following: the evidence in several cases and theoretical analyses indicate that results of a sub-kiloton (~ 500 tons) test of a given primary that achieves boost gas ignition and initial burn can be extrapolated to give some confidence in the yield of an identical primary with full boosting. Therefore, if a modified or remanufactured primary is introduced into the stockpile in the future to correct some aging problem, such tests on the modified system would add to confidence that the performance of the new primary is still adequate.

(U) It follows from this argument that the utility to the U.S. of testing at yields of up to approximately 500 tons depends on such tests being performed on a continuing basis and yielding reproducible results. If they are permitted only for a few years, such tests could add to the theoretical understanding of the boosting process and the reliability of the computer-codes that attempt to describe it, but would not contribute directly to the reliability of the weapon in the enduring stockpile in view of the possible manufacturing changes made at a later date. To gain evidence as to whether long-term changes in age-affected weapons components have any impact on boost-performance the tests would have to be made with the remanufactured weapons themselves.

Conclusion 4:

(U) In order to contribute to long term confidence in the U.S. stockpile, testing of nuclear weapons under a 500 ton yield limit would have to be done on a continuing basis, which is tantamount to remaking a CTBT into a threshold test ban treaty. While such ongoing testing can add to long term stockpile confidence, it does not have the same priority as the essential stockpile stewardship program endorsed in Conclusion 2, nor does it merit the same priority as the measures to enhance performance margins in Conclusion 3. In the last analysis the technical contribution of such a testing program must be weighed against its costs and its political impact on the non-proliferation goals of the United States.

Conclusion 5:

(U) Underground testing of nuclear weapons at any yield level below that required to initiate boosting is of limited value to the United States. However experiments involving high explosives and fissionable material that do not reach criticality are useful in improving our understanding of the behavior of weapons materials under relevant physical conditions. They should be included among

treaty consistent activities that are discussed more fully in the text.

(U) This conclusion is based on the following two observations.

- (U) [a)] So-called hydronuclear tests, defined as limited to a nuclear yield of less than 4 lbs TNT equivalent, can be performed only after making changes that drastically alter the primary implosion. A persuasive case has not been made for the utility of hydronuclear tests for detecting small changes in the performance margins for current U.S. weapons. At best, such tests could confirm the safety of a device against producing detectable nuclear yield if its high explosive is detonated accidentally at one point. We find that the U.S. arsenal has neither a present nor anticipated need for such re-confirmation. The existing large nuclear test data base can serve to validate two- and three-dimensional computational techniques for evaluating any new one-point safety scenarios, and it should be fully exploited for this purpose.
- (U) [b)] Testing with nominal yields up to a 100-ton limit permits examination of aspects of the pre-boost fission process. However, this is at best a partial and possibly misleading performance indicator.

(U) An agreement to limit testing to very low yields raises the issue of monitoring compliance. We have not made a detailed study of this issue, but note the following: Cooperative, on-site monitoring would be necessary, and relevant measurements, including for example neutron yields, could be made without compromising classified information on bomb designs.

(U) We have reviewed the device problems which occurred in the past and which either relied on, or required, nuclear yield tests to resolve.

Conclusion 6:

(U) For the weapon types planned to remain in the enduring stockpile we find that the device problems which occurred in the past, and which either relied on, or required, nuclear yield tests to resolve, were primarily the result of incomplete or inadequate design activities. In part, these were due to the more limited knowledge and computational capabilities of a decade, or more, ago. We are persuaded that those problems have been corrected and that the weapon types in the enduring stockpile are safe and reliable in the context of explicit military requirements.

(U) Should the U.S., in the future, encounter problems in an existing stockpile design (which we do not anticipate at present) that are so serious as to lead to unacceptable loss of confidence in the safety, effectiveness, or reliability of a weapon type, it is possible that testing of the primary at full yield, and ignition of the secondary, would be required to certify a specified fix. Useful tests to address such problems generate nuclear yields in excess of approximately 10 kT. DOE's currently planned enhanced surveillance and maintenance program is intended to alert us to any such need that may arise. A "supreme national interest" withdrawal clause that is standard in

any treaty to which this nation is a signatory would permit the U.S. to respond appropriately should such a need arise.

Conclusion 7:

(U) The above findings, as summarized in Conclusions 1 through 6, are consistent with U.S. agreement to enter into a Comprehensive Test Ban Treaty (CTBT) of unending duration, that includes a standard "supreme national interest" clause. Recognizing that the challenge of maintaining an effective nuclear stockpile for an indefinite period without benefit of underground tests is an important and also a new one, the U.S. should affirm its readiness to invoke the supreme national interest clause should the need arise as a result of unanticipated technical problems in the enduring stockpile.