OCCASIONAL REPORT

ASSESSMENT OF THE SAFETY OF US NUCLEAR WEAPONS AND RELATED NUCLEAR TEST REQUIREMENTS

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This brief report was prepared in response to a letter of 17 July 1990 by Honorable Dante B. Fascell, chairman of the House Committee on Foreign Affairs, requesting an assessment of the safety of US nuclear warheads with particular attention to the extent to which additional nuclear explosive tests might be needed to further improve their safety. Chairman Fascell's letter contained five questions concerning this issue that I have attempted to answer as follows:

QUESTION 1: ARE OUR NUCLEAR WEAPONS SAFE?

The safety record of our nuclear weapons has been remarkably good. The nuclear safety record of our nuclear weapons has been perfect. In the 45-year history of nuclear weapons there has never been an accident which produced any nuclear yield. There have been only two accidents in which the high explosive (HE) contained in the nuclear warhead detonated; the 1966 accident in Palomares, Spain, and the 1968 accident in Thule, Greenland, both involving B-52 aircraft. These detonations would probably not have occurred if the warheads had contained insensitive high explosive (IHE) instead of conventional HE, and could not have occurred had it been the practice not to allow nuclear weapons to be airborne in peacetime.

As you know, questions have recently been raised concerning the safety of three of our Artillery Fired Atomic Projectiles (AFAPs); the W-48, W-79, and W-82. These projectiles do not entirely satisfy existing requirements for nuclear safety. They can be rendered safe by means of a retrofit that does not necessitate further nuclear tests. In the meanwhile, it is my understanding that they have been rendered safe by other effective means. In the longer

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term, given the reunification of Germany and the demise of the Warsaw Pact, it seems likely that our overseas AFAPs can be returned to the US and placed in storage.

Questions have also been raised concerning the safety of the SRAM-A, with the result that it has been removed from alert aircraft pending a safety review. It is intended that the SRAM-A warhead (W-69) be replaced with the SRAM-II warhead (W-89) currently under development, a modern warhead that employs insensitive high explosive (IHE) and enjoys special fire-resistant features. I believe that the perceived safety problem with the W-69 could, if deemed necessary, be fixed by retrofit without requiring a nuclear test. An alternative to retrofit would be to keep the SRAM-A off of SAC alert aircraft and out of harm's way until it can be replaced and retired.

There has been some criticism of the fact that the W-88 warhead for the Trident II D-5 missile does not employ IHE. It is clear that the safety of the D-5 missile would be improved if the W-88 warheads were replaced with warheads employing IHE. Safety tests that have been conducted to date suggest that while such improvement is not without merit, it is not necessary to meet current safety requirements.

More than half of the nuclear weapons currently in the stockpile were designed twenty years ago or more, and do not have some of the important electrical, nuclear, and plutonium-dispersal safety features of modern weapons. This is not to say that they are unsafe, but clearly their safety is not up to modern standards. The majority of these old-timers are due for retirement without replacement. Of those that will be replaced, the majority will be replaced by modern warheads already in stockpile. Those remaining will be replaced with weapons currently under development, these latter requiring only a modest number of nuclear tests before being ready for production.

The safety of the existing stockpile needs improvement. But with an appropriate schedule of retirement, retrofit, and replacement of older weapons with the more modern weapons currently in stockpile or under development, the safety of the US stockpile will be well-assured; particularly so if the transport of nuclear weapons by air in peacetime is prohibited.

QUESTION 2: DO WE NEED TO INCREASE THE NUMBER OF NUCLEAR TESTS WE CONDUCT TO ENSURE THE SAFETY OF OUR NUCLEAR ARSENAL? OR, DO WE NEED TO INCREASE THE NUMBER OF NUCLEAR TESTS WE CONDUCT ONLY FOR THE RELEVANT PROGRAMS IN QUESTION?

No significant increase beyond the modest number of nuclear tests required by weapons currently under development is needed to ensure the safety of our nuclear arsenal.

With respect to those nuclear weapon systems whose safety has been recently called into question, effective corrective measures can be or have been taken that do not require any significant increase in nuclear tests: The AFAPs are now one-point safe.* SRAM-A will presumably be replaced by SRAM-II. Should a decision be made to replace the W-88 warheads in the D-5 missile, which does not seem likely at this time, a replacement could be made that would require no more than one or two additional nuclear tests. A further decision to replace the 3rd stage propellant in the D-5 missile with a less-hazardous, non-detonatable variety would require missile tests, but no nuclear tests.

QUESTION 3: ARE THERE WAYS TO DEAL WITH THE WARHEAD SAFETY QUESTION OTHER THAN THROUGH NUCLEAR TESTING?

There are a number of ways. Improvements can be made in the conditions and operating procedures associated with the storage, transport, and deployment of the weapons. For example, the transportation of nuclear weapons by air could be prohibited in peacetime, as well as their deployment aboard alert aircraft that are in close proximity to operating runways. Aircraft carrying nuclear weapons present the greatest risk of a serious nuclear accident because an airplane or helicopter crash will subject the nuclear warheads to both violent impact and intense heat of burning missile propellant and jet fuel. Should US land-based nuclear weapons be withdrawn from all overseas bases not directly accessible by sea, air transport of these weapons would not be needed.

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* The condition known as "nuclear one-point safety" is satisfied if, given the detonation of the warhead's HE has taken place at any one point, there is less than one chance in a million of obtaining a nuclear yield exceeding that equivalent to four pounds of TNT.

QUESTION 4: SHOULD WE ADD INSENSITIVE HIGH EXPLOSIVES TO ALL OUR NUCLEAR WEAPONS? IF SO, WHY?

It has been modern practice to employ IHE in all nuclear bombs and missiles that are deployed aboard aircraft because of the possibility of severe impact and fire stated above. It has not been the practice to employ IHE in the warheads of submarine-launched ballistic missiles (SLBMs), one reason being the less hazardous, more benign environment they enjoy. These practices are consistent with the accident record. There have been several aircraft accidents in which fire and impact have led to some dispersal of plutonium, an extremely hazardous radioactive material. There have been no accidents with SLBMs that have resulted in plutonium dispersal of which I am aware. The current exemption of SLBM warheads from the requirement to use IHE carries with it, however, an obligation to observe correspondingly more stringent precautions in the handling, loading, and deployment of these warheads.

None of the many types of nuclear weapons that entered the stockpile prior to 1979 are equipped with IHE. However, with the exception of three ICBM types [Minuteman II (W-56), Minuteman III (W-62, W-78)] and one SLBM type [Trident I C-4 (W-76)], all of these older weapons will be either retired, or replaced with modern weapons equipped with IHE. This program of retirement and replacement will accomplish the result of adding IHE to all our nuclear weapons (with the exception of the four types noted above and the W-88) in the normal course of events. No additional nuclear tests will be needed beyond the modest number required by weapons currently under development.

A means of improving nuclear weapon safety that does not involve the use of IHE and does not require nuclear tests is to upgrade the arming, fusing, and firing (AFF) components of our older nuclear warheads to meet modern requirements of electrical safety. These components are sufficiently external to the nuclear package that changes in them can be made without influencing the nuclear performance of the warhead, so that nuclear explosive tests are not needed.

The pace at which the safety of the stockpile is brought up to modern standards could be increased by accelerating the retirement of those weapons that are not planned to be replaced, and by increasing the electrical and nuclear safety of those weapons scheduled for replacement by means of

retrofits that would require few if any nuclear tests. During the interval of time before replacement or retirement, an effective means of assuring the nuclear safety of these older weapons would be to equip them with mechanical safing. Such means can assure safety with respect to detonation at a single point (one-point safety) or at any number of points (multi-point safety), and have been in successful use for more than twenty years.

QUESTION 5: WHAT ADVANTAGES ARE THERE TO RECONFIGURING OUR NUCLEAR TESTING PROGRAM SO THAT INSTEAD OF MATCHING SPECIFIC WARHEADS TO SPECIFIC DELIVERY VEHICLES, WE MAKE OUR WARHEADS MORE INTERCHANGEABLE WITH OUR DELIVERY VEHICLES? HOW COSTLY IS THIS? WOULD THE NEED TO CONDUCT NUCLEAR TESTS BE REDUCED IF WE RECONFIGURED OUR NUCLEAR TESTING PROGRAM IN THIS WAY?

Existing nuclear warheads can be repackaged and incorporated into new delivery vehicles for which they were not originally designed, provided that they will not be required to cope with unacceptably more-stressing conditions in their stockpile-to-target sequence (STS). In this sense they are already interchangeable. The W-84 and W-85 warheads that have been salvaged from the Ground-Launched Cruise Missiles (GLCMs) and the Pershing II IRBMs eliminated by the recent treaty banning intermediate range nuclear missiles are examples of warheads with modern safety features that could be repackaged for use in other weapon systems. The same would be true of many other types of weapons in the current stockpile.

In addition to repackaging existing warheads for use in new delivery vehicles, it is possible to retrofit existing warheads, or to modify warheads in development, for use in existing delivery vehicles other than those for which the warheads were originally designed. An example of the latter possibility would be to modify the SRAM II W-89 warheads so that they could replace the W-88 warheads now deployed in the Trident II D-5 missile. The D-5 missile would then enjoy the advanced safety features of the W-89 warhead without requiring significant alteration itself.

Repackaging or retrofitting an existing warhead for a new application eliminates the costs associated with designing, engineering, developing, and

testing a new warhead. Depending on the circumstances, production costs may also be reduced. Repackaging or retrofitting therefore can reduce both the cost and the number of nuclear tests that are needed to field new weapon system capability.

The constraints imposed by restriction to an existing warhead, as opposed to the greater flexibility afforded by a new warhead, are the price one must pay for these savings in cost and reductions in nuclear tests. The cost-benefit comparison will of course be strongly influenced by the difficult-to-quantify benefits of a reduction in nuclear testing.

SUMMARY AND CONCLUSIONS

The safety of the existing stockpile of nuclear weapons needs improvement. But with an appropriate schedule of retirement, retrofit, and replacement of older weapons with the more modern weapons currently in stockpile or under development, the safety of the US stockpile will be well-assured. No significant increase beyond the modest number of nuclear tests required by weapons currently under development is needed to accomplish this result.

The safety of nuclear warheads could be still further improved by utilizing the concept of "separate components" in which the warhead's plutonium and HE are physically separated from each other until the warhead is to be armed. Such a design would virtually eliminate the possibility of plutonium dispersal and would also ensure nuclear safety. Implementation of these safety benefits, however, would be a major and protracted undertaking requiring a very large number of nuclear tests. The cost-benefit aspect of such an undertaking is questionable in view of both the performance penalties that would be paid and its strongly adverse implications for nuclear arms control.

A recurrent theme of this assessment has been the improvement in the safety of our nuclear weapons that would result if their transport by air or their deployment aboard aircraft in close proximity to operating runways were prohibited in peacetime. Given the relaxation in tensions between the US and the USSR, I believe that such safety measures deserve serious consideration.