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THE TEST BAN AND NUCLEAR PROLIFERATION

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PREPARED BY:

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[redacted]

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A series of questions were generated recently within the intelligence community on the subject of nuclear weapon development by Nth country signatories to the Test Ban Treaty, in an effort to determine what practical effects, if any, the treaty would have on a country determined to develop a weapon on the one hand, and observe the treaty's provisions on the other. [redacted] The laboratories' answers to these questions seemed to us to be of sufficient interest to warrant wider distribution. The questions were referred to the weapons laboratories of the Atomic Energy Commission.

Four general considerations relevant to the proliferation question were noted at the outset:

1. The fact that many fundamental principles have been established -- and their existence has become international knowledge -- reduces substantially the scientific and technological effort an Nth country must invest in a weapons program.

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2. The state of the art in certain technologies critical in the development of nuclear weapons is now more than adequate to meet the needs of an elementary weapon program; the accomplishments of the last few years in electronics, hydrodynamics and nucleonics being particularly relevant. Much of the hard-won data -- nuclear cross sections -- are now readily available in handbook form.

3. Numerical modeling and machine computation are now fundamental tools that any nation's scientific community can apply to weapon design problems as a substitute for considerable physical experimentation.

4. Physical and military weapons effects are publicly available in enough detail to obviate a large class of full-scale atmospheric tests.

Specific questions of geologic, geographic and other physical limitations on underground testing, costs of underground testing, deficiencies in diagnostic data, and test requirements for a weapon of reasonable size and weight were examined with the following results:

Geologic or Geographic Limitations on Underground Testing

There are almost certainly no geographic, geologic, or physical factors that would preclude underground testing, if

the testing nation is sufficiently determined in its objective to accept certain test hazards believed to be negligible but not so proven. Ground water contamination and the triggering of unstable seismic anomalies are two examples of a priori considerations which are seemingly dismissable on the strength of current evidence. These can not be assumed major deterrents to a testing program.

Costs of Underground Testing

The cost of underground testing is not likely to be a deterring factor in a national decision to develop nuclear weapons, even though for many nations underground testing may be the only option open to them. [redacted] Further, since for any of these nations the initial supply of fissionable material would almost certainly be limited, underground testing affords a means of critical material recovery in the event of one or more initial failures.

The number one consideration in excavating at minimum expense and difficulty for underground testing is probably the

desirability for obtaining a dry hole. [redacted] for example, the water table is undoubtedly high in some areas, requiring the sealing off of vertical holes to insure dryness and thereby somewhat increasing the expense. Both nations, however, have rather remote mountain areas in which tunneling could conceivably be done cheaper. [redacted]

Instrumentation and Diagnostic Data

The need for diagnostic measurements is perhaps even less a deterrent. There are no valid grounds for an assumption that above ground experience is prerequisite to underground instrumentation. While sophisticated weapons require compilcated diagnostics, the hard core requirements of simple weapons -- yield, neutron multiplication rate, transit time -- could be measured fairly readily by a competent weapon development team. It can not reasonably be supposed that providing underground instrumentation adequate for obtaining these data would be an important obstacle.

Unclassified reports and journal articles related to Project Plowshare tests and shots announced for worldwide

seismic r ording purposes are probably adequate to afford sufficien yield/depth-of-burial data to permit a beginning nation to nsure shot containment. A conservative approach to depth- -burial would tend to increase the initial excavatio or tunneling cost. Actual yield measurement could be accomp ished to an accuracy of 20 percent or better.

Test Requirements for a Usable Weapon

It must be expected that any nation interested in nuclear weapons would have available a rough cataloguing of U. S. types as to weight, external dimensions, and approximate yield. This information can be obtained from photographs of U. S. missile systems and externally carried bombs. The implosion principle is widely known as are the energy characteristics of suitable explosives and the critical masses of fissionable materials. A conservative choice for initial weapon development would be an implosion system (for economy) in a size deliverable by a light or medium bomber with a yield of a few tens of kilotons. Above ground non-nuclear experiments in conjunction with computer analysis can be used to obtain satisfactory data for the fissionable material available (using very small samples), to design implosion or gun assemblies, and to test initiation devices. With this background and close

attention to hardware it is not unreasonable to expect a high probability of success on the first shot. One more, perhaps two more shots, would probably be judged desirable.

Weapon Design

Even modest intelligence efforts could obviate many false starts in weapon design. One illustration from a technical manual, for example, could prescribe initial direction for almost all phases of a weapon development effort. [redacted]

Barring intelligence acquisition of fairly complete production drawings and specifications for a suitable weapon, it seems mandatory that at least one test shot be conducted on any system likely to be designed and constructed. The possibility of an Nth nuclear nation emerging without a single nuclear test seems very remote unless that nation will be satisfied with a small and expensive capability, from a nuclear materials point of view.