

Panel - Dr. Bacher - NT Policy  
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Mr. President:

As you know, the inspection of unidentified underground events probably constitutes the most difficult problem facing the present Geneva negotiations. Technical developments since the Conference of Experts last summer have substantially increased the complexity of this problem. Experience with underground tests at Hardtack II indicated that there would be a greater number of unidentified events which could be suspected of being nuclear explosions than had been estimated last summer. There was also evidence that one of the underground tests at Hardtack II had been seismically decoupled by a factor of around 10. More recently theoretical studies have indicated that it may be possible by means of large underground holes to decouple nuclear explosions by still much larger factors.



A Panel under Dr. Bacher has recently examined the inspection problem and attempted to estimate the probability of identifying the violation of a test cessation agreement in the face of various levels of on-site inspection. The Panel found that the probability of identifying a violation did not depend very strongly on whether we chose a quota approach to on-site inspection or the principle of inspecting an agreed upon percentage of unidentified seismic events since the uncertainties in the total number of seismic events is small compared with the other uncertainties. The probability of identifying the violation does depend

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of course, strongly on the total number of inspections carried out.

As background to the Bacher Panel findings, I would like to discuss this first chart which shows the probability of identifying nuclear tests using simple assumptions applied to this problem in the past. This chart assumes that all tests will have the same coupling as was observed with the first underground Nevada test, the so-called Rainier shot. It also assumes that an inspection team which arrives in the area of an unidentified event is certain to detect the violation if it has taken place. It is clear that only if a very large number of inspections are carried out, could there be a significant probability of identifying a single underground test in the range of one-half or two kilotons. Although this graph is based on new Hardtack II data, it is essentially in agreement with the conclusion reached in Geneva last summer. The Geneva system was considered to be effective above 5 kilotons but would lose effectiveness rapidly below 5 kilotons.



The second chart sets forth examples presented by the Bacher Panel on the basis of a much more sophisticated analysis. This assumes that a factor of 10 decoupling is possible, which would mean that a 5 kiloton shot would look like 0.5 kilotons to the system. A single Nevada Hardtack shot of very small yield, only 50 tons, was apparently decoupled by a factor of about 10 for reasons that we do not yet fully understand. This analysis also makes allowance for an intelligence contribution in

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the selection of events for inspection. This would be possible under the Soviet approach to a quota system in which each participant would choose the events it wishes to inspect. The use of intelligence clearly aids the inspection system; however, it is extremely difficult to place a numerical value on this intelligence contribution and the Panel emphasized the arbitrary nature of this estimate.

The Panel also attempted to assess the probability that a team of inspectors arriving in an area of a suspected event would actually be able to prove that a violation had occurred. Clearly, if a nation attempted to evade the agreement, it would make every possible effort to hide its activities from the possible visit of the inspection team. The difficulty in arriving at a quantitative evaluation was recognized and the estimates provided by various Panel members vary rather widely. For the calculation represented in the chart, the Panel used probabilities of identification which varied from one chance in 50 for small tests to one chance in two for shots of 50 kilotons. Finally, since a meaningful weapons development program would require a series of tests, the Panel calculated the probabilities of detecting at least one shot out of a series, as shown.

On the basis of this rather elaborate analysis, you will observe, Mr. President, that a substantial probability of identifying at least one event out of a series is only achieved for weapons with yields above

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20 kilotons, unless one goes to a rather large number of inspections. The probability of identifying at least one out of a series below 5 kilotons is negligible unless we inspect all of the seismic events above 0.5 kiloton that occur in the Soviet Union, namely 1715 per annum.

The probability of an inspection team identifying a nuclear event, once it has arrived on the site represents the most controversial factor in the Bacher Panel analysis. Therefore, we have prepared a third graph which illustrates the probability of identifying a single event if decoupling is possible but the probability of the inspection team identifying a violation is assumed to be unity. This is clearly an unrealistic assumption since no member of the Panel considered that there could be certainty of success in identifying an event. In this case one has again significant probability of identifying evasion down to 5 kilotons and the probability of identification drops very rapidly for yields below 5 kilotons unless one conducts a large number of inspections.

All this is based on the assumption that the detection system receives a seismic signal on which to base an inspection. As you know, theoretical calculations have indicated that it is possible in principle to decouple underground explosions by very large factors -- 200 is the most recent figure mentioned -- by conducting a nuclear test in a very large cavity, the so-called Latter Hole. A decoupling factor of 200 means that a 100 kiloton nuclear test would be equivalent seismically to



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0.5 kilotons. Since an improved Geneva system would not even detect seismic events below the 0.5 kilotons it would not register tests of less than 100 kilotons when decoupled by a factor of 200. The concept has stood up under continued theoretical examination and the Bacher Panel found no reason to question that such decoupling is possible in principle. The Panel recognized that it is not known that holes large enough to accommodate weapons of the order of 100 kilotons can be constructed or that the decoupling can be achieved under actual geological conditions. Certainly an effort to construct a Litter Hole for large yield tests will constitute an extremely large engineering project.

To sum up, the present knowledge of seismic detection of underground tests and of means of evasion, is inadequate to assess quantitatively the effectiveness of a monitoring system as envisaged in the Geneva Experts Conference.

July 23, 1959

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