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15th June 1979

*Dear Bryan,*

COMPREHENSIVE TEST BAN: PRIME MINISTER'S  
MEETING WITH DR FRANK PRESS

At the suggestion of President Carter, Dr Frank Press, his Scientific Adviser, is calling on the Prime Minister on Monday, 18th June at 3 pm for a briefing on Comprehensive Test Ban issues.

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2. I attach two papers by MOD scientists covering those technical questions on which the Prime Minister has expressed particular interest:
    - a. the maintenance of the nuclear weapons stockpile under a CTBT; and
    - b. the technology of evasion.
  3. In our view there is likely to be little technical incentive for the Soviet Union to attempt to conduct clandestine tests under a three year treaty. The risks of being discovered (which are not confined to seismic means) would be likely greatly to outweigh any technical advantage they might hope to gain. Clandestine testing by the Soviet Union during a three year treaty would be unlikely to disturb significantly the nuclear balance to the disadvantage of the West.
  4. The papers do not attempt to assess the balance of advantage as between, on the one hand, the risks which have always been recognised to be inherent in a fully comprehensive test ban, ie without a threshold, and, on the other, the political and non-proliferation benefits which may flow from such a ban, even if of limited duration. These benefits are discussed in the Foreign and Commonwealth Secretary's minute of 23rd May to the Prime Minister.
- /5. ...

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5. Dr Frank Press's technical speciality covers evasion technology and CTB monitoring. He will, however, no doubt be ready to elaborate on the range of factors, political as well as technical, underlying the President's support for the conclusion of a CTBT. The Prime Minister might wish to establish with him how the President assesses the risks, whether he sees future improvements in verification capabilities reducing these risks and what he sees as the benefits of a treaty along the lines of that currently under negotiation.

6. The Americans have not yet responded to the recent Ministerial decision on National Seismic Stations (NSS). The Americans were told that the UK would be unwilling to pay for more than one NSS but that if the Americans could find some way of providing the necessary funds then Ministers would be prepared to accept up to four NSS on British territory. We have no indication that Dr Frank Press will be in a position to give an answer on this.

7. I am sending copies of this letter to George Walden (Foreign and Commonwealth Office), Martin Vile, Sir Clive Rose and Dr R Press (Cabinet Office).

Yours sincerely  
*John Gutteridge*  
PP (R L L FACER)  
Private Secretary

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## NUCLEAR WEAPON STOCKPILE MAINTENANCE

Modern British and American nuclear warheads are produced to very close engineering tolerances with a wide range of accurately specified materials, some of which are very reactive chemically and/or radioactive. To economise in both warhead size and weight, the designs are marginal in the sense that a minor degradation in the performance of a warhead component could cause the warhead to fail completely. It is therefore vital that any ageing effects in warheads in storage, e.g. due to corrosion, should be detected promptly and, where assessed as significant, corrected. To this end, stockpiled warheads are returned from the Services on a regular sampling basis for detailed examination and assessment.

2. When this surveillance programme detects an ageing effect, the causes and the consequences for warhead functioning are estimated by warhead designers and, where necessary, remedial measures are proposed. Because of the marginal characteristics of warheads, only trivial changes in design or material specification can be validated without any form of testing. Somewhat larger changes can be accepted based on a combination of the experience of warhead designers, laboratory experiments and computer simulations. Experience has shown that other more drastic modifications can be required and these can only be confidently introduced after they have been proven by underground nuclear testing. It is rare that a remedy for a stockpile warhead defect requires a special nuclear proving test; the proposed modification can almost always be validated, or faulted, by including it in an underground test device detonated for some other purpose.

3. A Comprehensive Test Ban has two direct effects on the current procedures for maintaining stockpile serviceability. Clearly it precludes a nuclear test to prove a proposed design modification to correct a detected fault. But it also withdraws from the warhead designers the ability to demonstrate their continuing professional competence and this undermines the confidence with which they can advise on all technical warhead matters. The competence of the designers is essential for producing confident assessments of the results of stockpile surveillance.

4. Taking the above into account, UK and US warhead designers have advised that the risks to the viability of warhead stockpiles are acceptably small for a CTB of strictly three years duration. In this period, the probability of finding an ageing fault demanding an underground nuclear test before a correction could enter into Service is small. And, even if such a test were required, it could be carried out immediately after the three year period now envisaged for the CTB Treaty without, in most cases, having caused in the meantime an unacceptable drop in overall operational nuclear capability. To

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ensure that this option is kept open it would be necessary, during the CTB, to maintain a readiness to resume testing. The remote possibility of having to test during the three year period of a Treaty because operational capabilities would otherwise be seriously affected, would be protected by the "Supreme National Interest" provision in the Treaty.

5. As far as the competence of weapon establishments is concerned, this could be maintained at an acceptable level over a three year period providing they pursue sufficiently interesting programmes to retain their present staffs and to exercise their skills on warhead-related work short of full-scale nuclear testing. Such "safeguards" programmes have been drawn up in both the UK and US and they include experiments which would give very small nuclear yields of up to 100lb (the so-called "permitted experiments") but which are not nuclear weapon tests. These experiments would include work on inertial confinement fusion (ICF) which could lead to a greater understanding of weapon physics and to nuclear weapon effects simulations; the simulation of warhead implosions to normalise computer codes for warhead design; and safety experiments where zero yield would be expected but where yields of some tens of pounds could occur. However the experiments would not serve the development of new warhead designs but it cannot be excluded that they may be more valuable than can now be envisaged. Co-operation between the UK and the US on safeguards programmes would clearly be mutually beneficial.

6.. On the basis of present technical knowledge and experience the risk to the stockpile would increase the longer the Treaty were extended beyond three years. Without UK testing there is bound to be a progressive decline in confidence in the serviceability of the stockpile. And in the long run there appears to be no prospect of maintaining the essential competence of weapon laboratories without a freedom to conduct nuclear weapons tests at a few kilotons yield.

7. It is not possible to be precise about the Soviet appreciation of their stockpile maintenance problem. The indications are that they may find it less acute than the West for two main reasons. First because the payload capacity of their missiles is so much larger, their warhead designs may be less sophisticated and hence less prone to significant ageing faults. Second, they would have no difficulty in retaining the staffs in their weapon laboratories although with a declining level of competence. However in a time-scale longer than that appropriate to the West, their nuclear capability would inevitably decline.

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CTB EVASION TECHNOLOGY

It is technically impossible to verify completely that the terms of a truly comprehensive test ban are not being evaded. There will always be a detection threshold below which a country could cheat without a real risk of being found out. The seismic monitoring network already deployed by the Americans is proven to detect, with 90% confidence, Soviet nuclear tests conducted in close contact with hard rock, at yields in excess of 800 tons. It is estimated that the improvements planned for the US network and the addition of National Seismic Stations (NSS) in the Soviet Union would reduce this threshold to about 300 tons.

2. The capability of seismic networks is less against explosions conducted in soft rock by a factor of about 10, i.e. for the current and planned networks the detection thresholds would be about 8 kilotons and 3 kilotons respectively. Three measures by which monitoring capability could be reduced further have been suggested. The most straightforward of these rests on de-coupling the energy from an underground explosion from its geological environment. From theoretical studies, high explosive simulations and one full scale US nuclear experiment, it is estimated that the seismic signal from a nuclear device detonated underground in a large cavity could be up to about 100 times less than that generated by the same device detonated underground in close contact with the surrounding hard rock. A spherical cavity of about 100m diameter would be needed to de-couple a 10 kiloton explosion so that its seismic signal appeared to have originated from an explosion close-coupled in hard rock of down to 100 tons yield.

3. Cavities of up to 100m diameter, or perhaps somewhat greater, can be created in, for example, salt dome formations either by a large nuclear explosion or by conventional engineering techniques. This theoretically offers the opportunity for undetected clandestine testing up to a few tens of kiloton yield. To reduce this possibility, the US has proposed that some NSS should be located in those areas of the Soviet Union where salt dome formations are found. Moreover, the US satellite capability would have a chance of detecting the surface preparations for a de-coupled test if one were attempted.

4. The overall assessment is that the Russians would be unlikely to cheat under a 3 year Treaty. But if they decided to do so, they would have to set a limit on the yield they could use taking into account the uncertainties about the capabilities of the monitoring system deployed against them and the safety factor required to be sure of escaping detection. With this in mind, it is assessed that the Russians would not seek to test above a few kilotons, perhaps 10 kilotons at maximum, even with the use of de-coupling. However, there is evidence of Soviet work on detonating nuclear explosives in large cavities. More detailed Intelligence information on this can be provided separately.

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5. The two other less practical evasion techniques rely on either simulating an earthquake signal by a specially timed series of nuclear explosions or hiding the signals from a single nuclear explosion in that from an earthquake. The first of these possibilities should present no great problem to a seismic verification network which includes broad-band seismometer stations. The alternative earthquake scenario poses greater verification difficulties but equally imposes major constraints on a clandestine test operation. The test would have to be staged in a seismically active area (there are such areas in the Soviet Union) and would have to be carried out at a time when an appropriately timed and located earthquake of sufficient magnitude occurred. Such earthquakes occur, on average, in seismically active regions a few times a year, but at wholly unpredictable times. If the operational uncertainties were accepted for tests of perhaps up to a few kilotons, then this evasion technique would defeat the seismic verification network. But the general assessment is that in the unlikely event of evasion being planned, de-coupling rather than hide-in-earthquake would be preferred.

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