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UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P.O. BOX 503
~~LOS ALAMOS, NEW MEXICO~~ 87544

NOV 30 1979

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November 26, 1979

[redacted] DOE b(3) b(6)
Sandia Laboratories
P. O. Box 5460
Albuquerque, NM 87115

Dear [redacted] DOE b(3) b(6)

I am forwarding the attached draft as a "strawman" for comment. I believe it is necessary that we reach a unified position on such an important issue.

Very truly yours,

[redacted] DOE b(3) b(6)

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Department of Energy Declassification Review	
1st Review Date: 7.27.11	Determination: [Circle Number(s)]
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Name: Roy Lee 11563	2. Classification Changed To:
2nd Review Date: 9/27/12	3. Contains No DOE Classified Info
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Name: [illegible signature]	5. Classification Cancelled
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DRAFT

22 SEPTEMBER 1979 EVENT

by

[redacted]

ITO [redacted]

DOE b(3) b(6)

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ITO-79-155

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22 SEPTEMBER 1979 EVENT

SUMMARY AND CONCLUSIONS

OGA b(1), b(3) DOE b(1)

[redacted] The exact location has not yet been determined, but it was somewhere within a large area that includes South Africa, the South Atlantic Ocean, the South Indian Ocean, and a large portion of Antarctica (see Fig. 1).

[redacted]

DOE b(1)

BHANGMETER SIGNAL

DOE b(1)

[redacted]

OGA b(1) b(6)

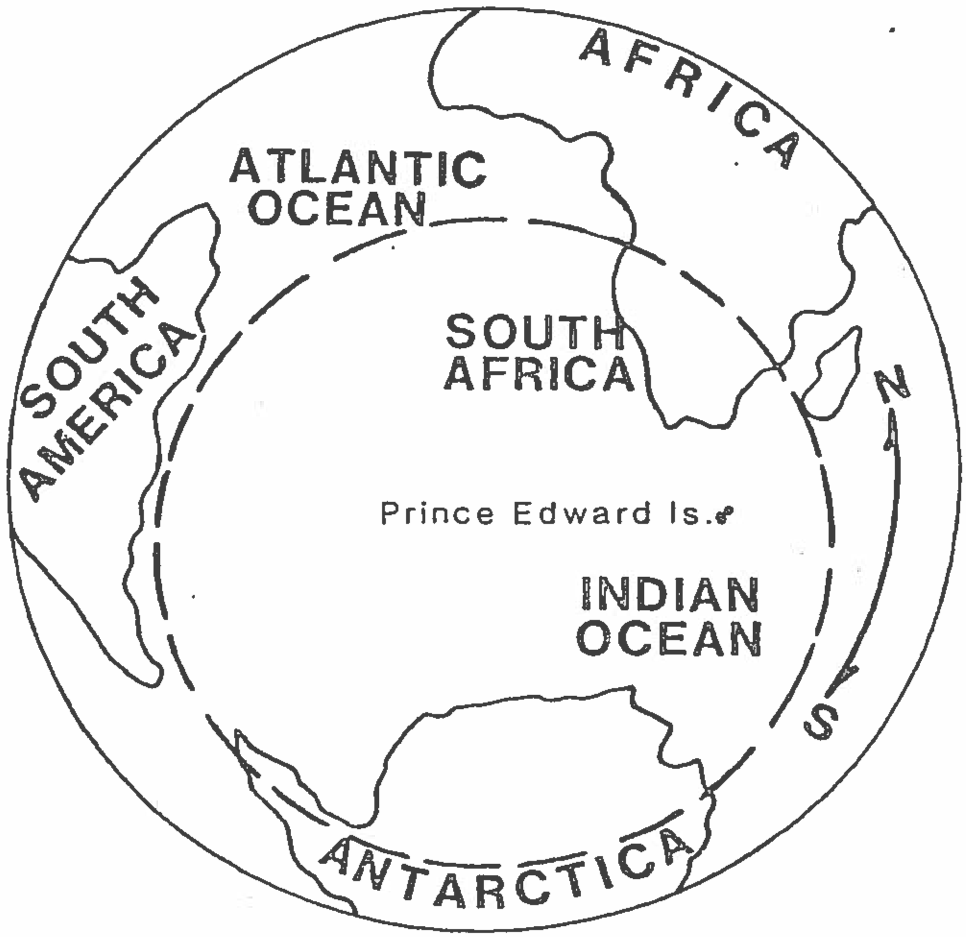

FIG. 1. FIELD OF VIEW CONSIDERED FOR THE NUCLEAR EVENT

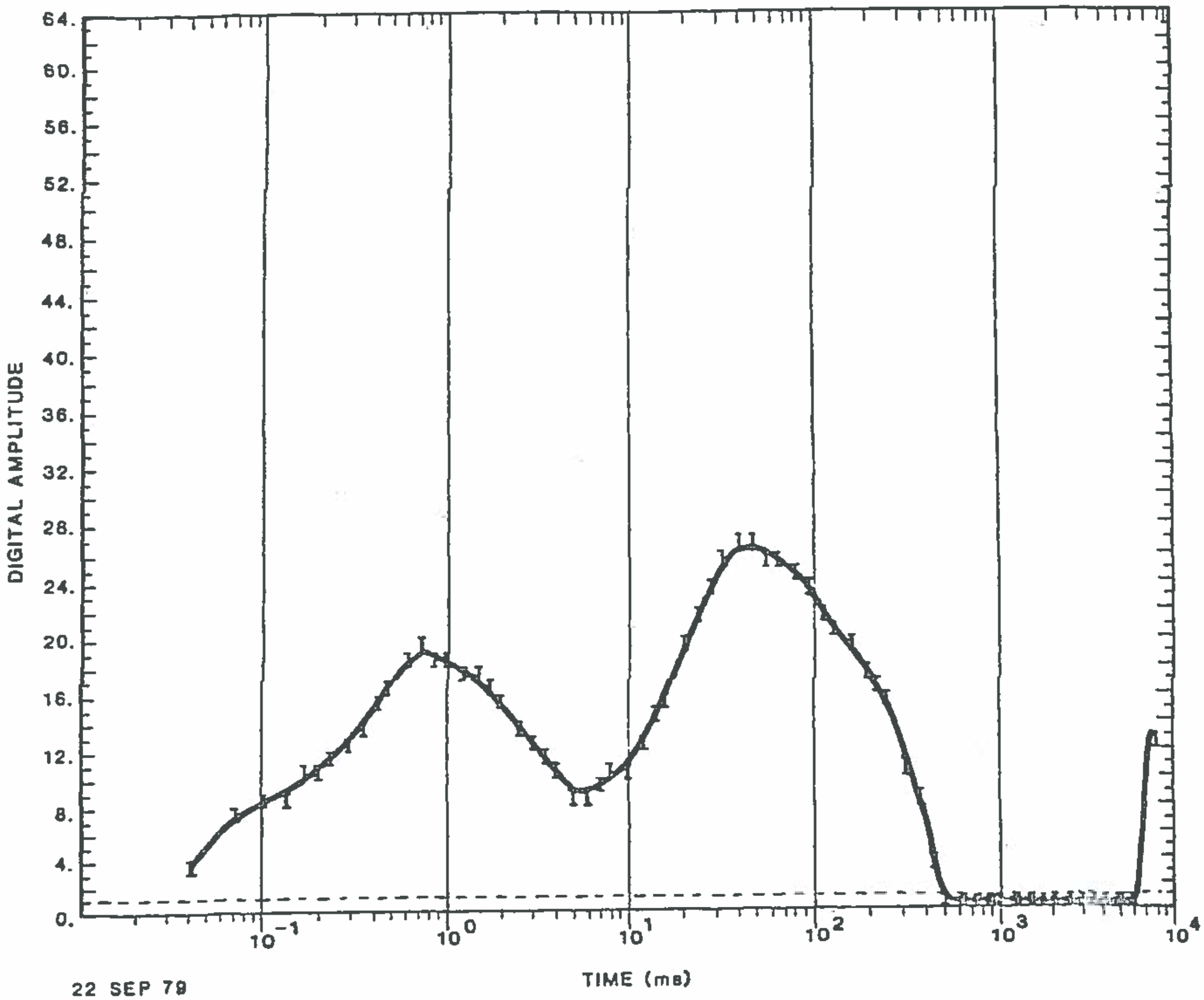

FIG. 2. BHANGMETER OPTICAL TRACE NO. 1 FROM [redacted]

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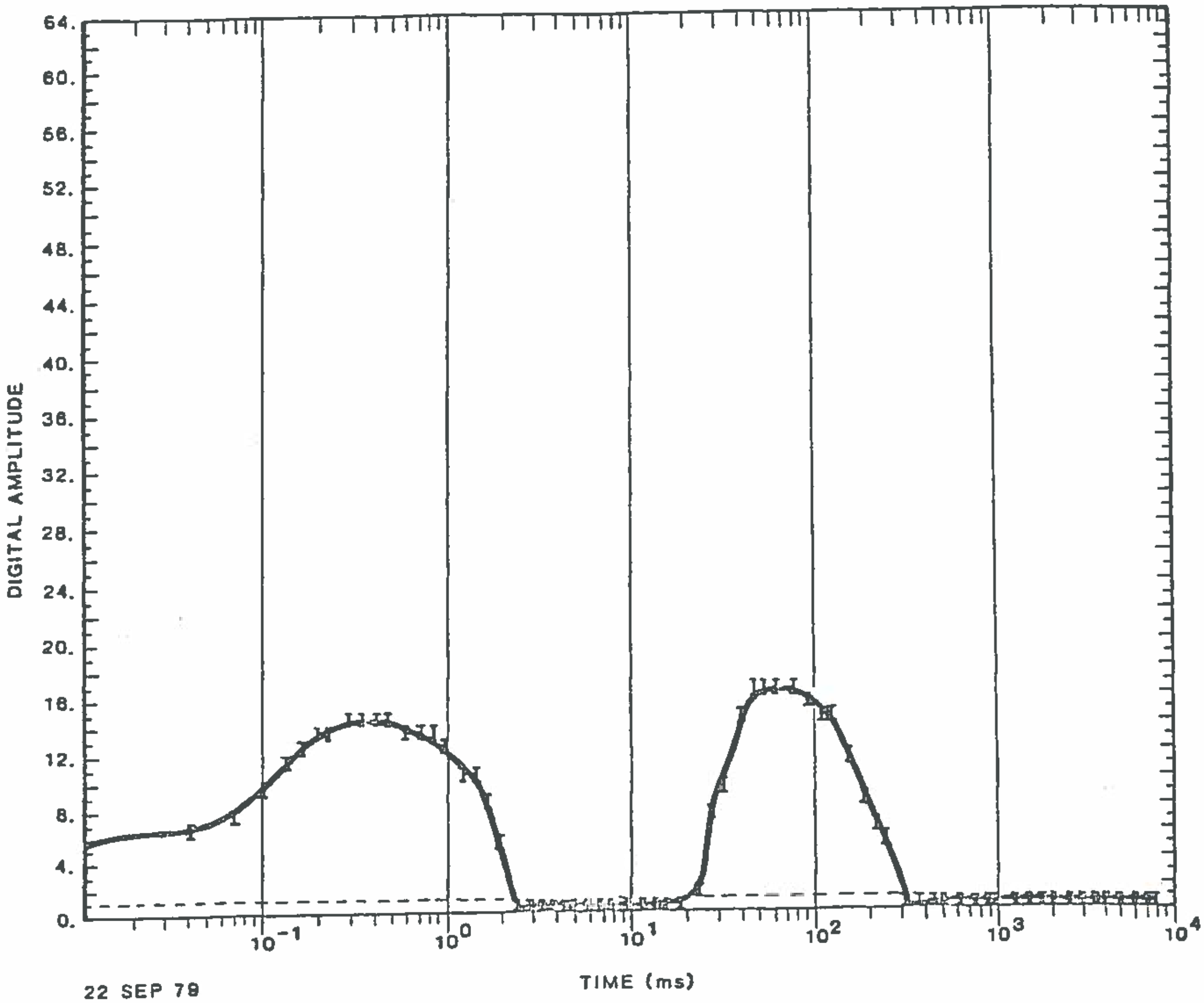

FIG. 3. BHANGMETER OPTICAL TRACE NO. 2 [redacted]

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TRAVELING IONOSPHERIC DISTURBANCE (TID)

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An ionospheric electron density profile was being measured from 0430 to 1130 GMT on 22 September 1979 from the Arecibo Ionospheric Observatory in Puerto Rico. The data indicated a TID that could have resulted from a large atmospheric nuclear explosion. The TID passed over Arecibo between 0545 and 0715 GMT with a south to north velocity component of 275 $\pm$ 75 m/sec. The east to west velocity component is not known. The TID, which was at an altitude of between 180 and 270 km, peaked at 0630 GMT.

Arecibo observations of TIDs are common. However, almost all of them are produced by magnetic storms in polar regions and propagate from north to south. TIDs traveling south to north and east to west are very unusual, but could be produced by nuclear explosions, earthquakes, or severe thunderstorms. TIDs, from previous atmospheric nuclear explosions over Novaya Zemlya, have been detected at distances greater than 4000 km.[1,2] Propagation velocities for different modes from the Novaya Zemlya tests were 630 m/sec, 430 m/sec, and 260 m/sec. If the major peak of the TID seen at Arecibo (at 0630 GMT) corresponds to one of these modes, the distance from Arecibo to the nuclear event was either 12,700 km, 8700 km, or 5300 km. [redacted]

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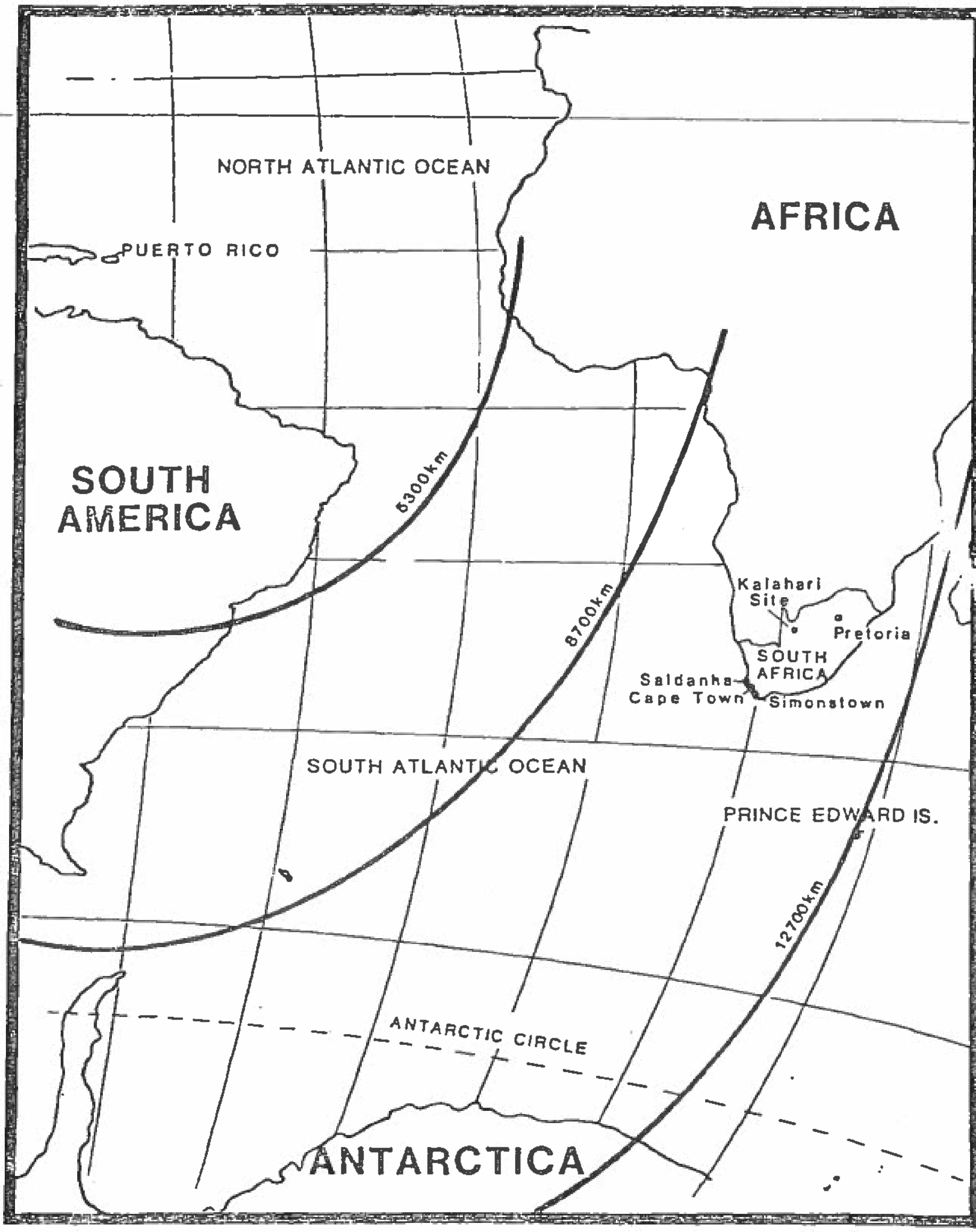

FIG. 4. AREA OF INTEREST

NUCLEAR DEBRIS

[redacted] DOE b(1)

The Institute director described the rise in radioactive fallout as the kind one would expect from a small but recent atomic explosion in the atmosphere. [redacted] DOE b(1) he analysis proved negative; there was no radioactive debris in the rainwater.

COVERT NUCLEAR WEAPONS DEVELOPMENT PROGRAM

[redacted] DOE b(1)

DOE b(1)

[redacted]

[redacted]

OGA b(1) b(6)

[redacted]

Before a country can enter into a nuclear weapons development program, some of its scientists would require a fairly high level of competence in a number of well-documented scientific techniques. Among these are nuclear criticality studies in which predictions of the critical mass for specific geometries and enrichments of fissile materials are determined. [redacted]

DOE b(3)

After these techniques are fully understood, the next step in a development plan would involve a full-yield test of a nuclear weapon. If the full-yield test were to be in the expected 10- to 20-kt range, the US would undoubtedly recognize the occurrence of such a test. However, if the country didn't want its nuclear weapons capability known to the world, it could take an intermediate step to satisfy its needs while maintaining the secrecy of its success. This step would involve the underground testing of very low-yield nuclear devices, from zero to a few-hundred tons of nuclear yield. The zero-yield test would be one in which the total yield was only that from the high explosive (HE) of the device, i.e., no yield would be derived from the fissile material in the device.

This type of program would require 10 to 20 test holes, depending on the number of intermediate tests desired. The first test would involve a device that includes the complete HE system, but only a small amount of the fissile material, so that a nuclear yield of zero is guaranteed. Each succeeding test would involve a slight increase in the ratio of fissile material to inert* material. This slight increase in the ratio is determined from the diagnostic measurements of the previous test(s).

The nuclear yield of a test device can be obtained from the rate of its neutron-output, which is proportional to the measured rate of its gamma output. Because the increase in fissile material is so slight from a zero-yield device to one in which a nuclear yield is obtained, it is extremely important to have a strong background of neutrons. In the first experiments, this high level of neutrons can be provided to the test device from a

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*The material is inert in the sense that it will not contribute to an appreciable fission yield.

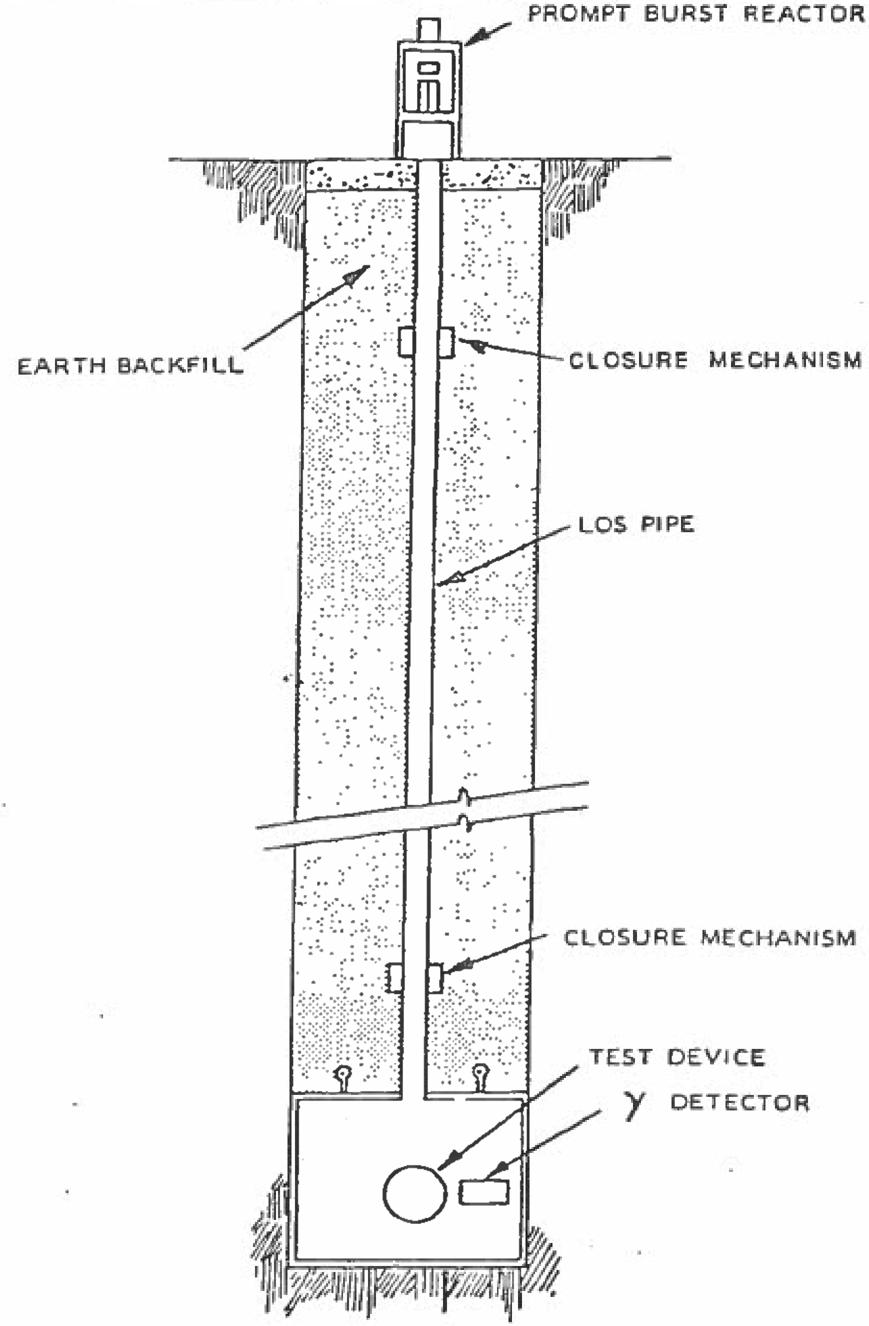

FIG. 5. PROFILE OF TEST GEOMETRY FOR NEAR-ZERO YIELD NUCLEAR TESTS

prompt burst reactor (PBR). The PBR would be located at the surface of the ground and would be connected to the test device with a line-of-sight (LOS) pipe (see Fig. 5). Because the expected yield from the first few experiments would essentially be only from the HE (probably >50 kg), the test hole depth required would be about 15 m.

When nuclear yields of a few tenths of a kilogram have been detected by instrumentation from a test device, the measurement of the neutron-output rate will be sufficiently above background such that the PBR will no longer be required as a neutron source. A pulsed neutron source (Zipper) in the proximity of the test device can then be substituted for the PBR (see Fig. 6). As the total yield increases from one test to the next, the required depth of the test hole increases. Since the PBR is no longer required, the LOS collimation to the surface is no longer necessary.

After nuclear yields have been achieved, another technique for determining the nuclear yield can be used. The gaseous debris from the nuclear explosion could be valved to a gas-trap container located above ground for quick recovery after the test (see Fig. 7). The gas-trap container could be designed to allow sampling without radioactive contamination of the nearby environment. Radiochemical analysis of this debris gives an independent check on the nuclear yield. Upon completion of these analyses, the radioactive material, equipment, and gaseous debris samples must be disposed of properly; this could be done by merely burying this material in some nearby area.

The data from the first 10 to 20 tests should be sufficient for extrapolation to the full-yield nuclear test. However, extrapolation over a large yield range is reason for concern.

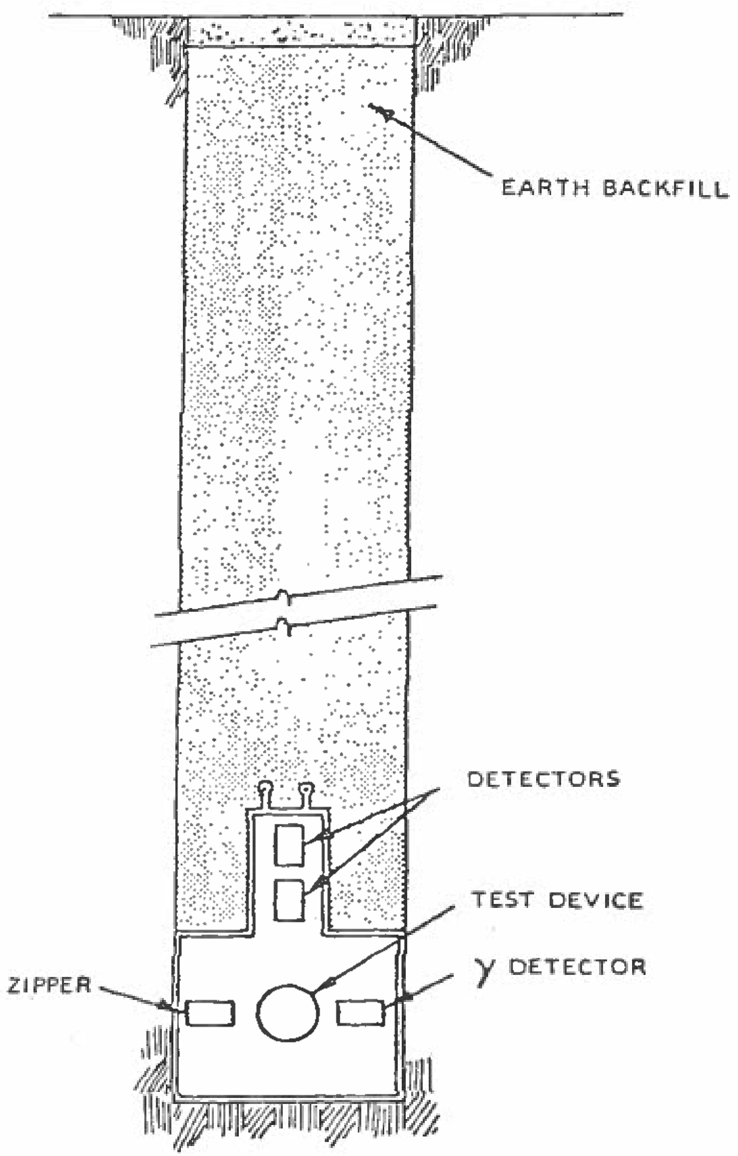

FIG. 6. PROFILE OF TEST GEOMETRY FOR VERY LOW YIELD NUCLEAR TESTS

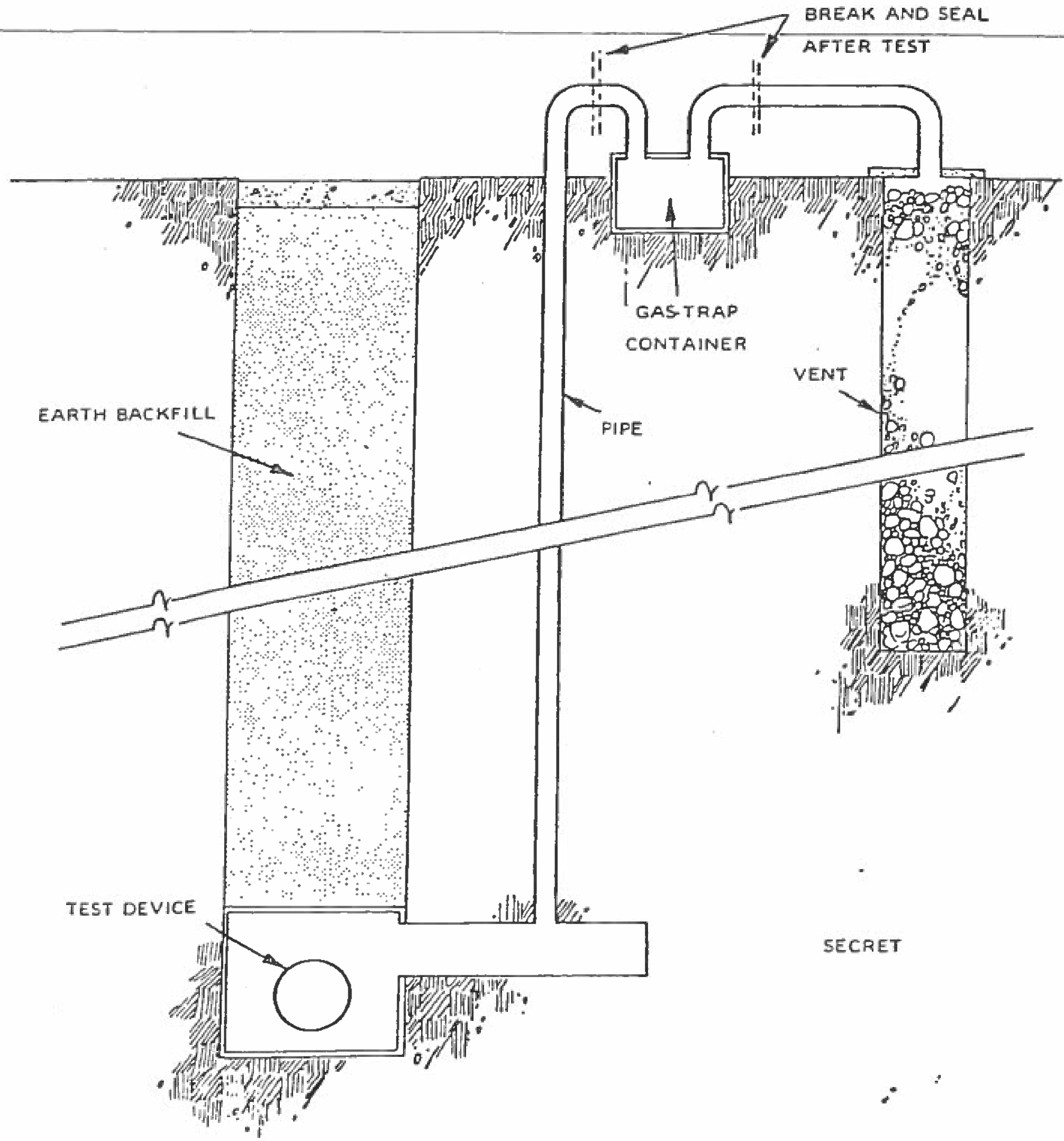

FIG. 7. PROFILE OF TEST GEOMETRY FOR ABOVE GROUND SAMPLING

Hence, it would be reasonable to obtain one or two data points at a few-hundred-tons nuclear yield, a yield that is still teleseismically undetectable. The depth of burial for this yield would be between 75 and 100 m.

[redacted] Whether the country has this amount of fissile material and whether it can afford to expend this much material for testing would have to be weighed against their desire to continue to appear as a non-nuclear-weapons state. The fissile material is actually <u>not</u> lost to the country because it is "in storage" underground in the vicinity where it was tested in a nuclear device. It would be well worth the country's cost to recover this fissile material.

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[redacted] For example, one country could supply the fissile material and some nuclear expertise in exchange for the use of another country's test site. [redacted]

b(1)

After having stockpiled a few nuclear devices, the growing concern of just how accurate the extrapolation data is, from a few-hundred tons of nuclear yield to 10 or 20 kt, could tempt the country to test at a significantly higher yield (perhaps 1-2 kt or even the full yield of 10-20 kt). In order to maintain the profile of a non-nuclear weapons country, the next nuclear test would have to be conducted outside the country. If the country had access to an island, the nuclear test operation could be prepared there. The nuclear test device could then be mounted on a barge and towed on the ocean to a distance consistent with obtaining the necessary test diagnostics from the island.

[redacted]

OGA b(1) b(6)

CIRCUMSTANTIAL EVIDENCE

[redacted]

OGA b(1) b(6)

The Prince Edward Islands, 1200 miles SE of Cape Town, belong to South Africa and are uninhabited. The two islands that form the Prince Edward Islands are Marion Island (the larger) and Prince Edward Island. Marion Island, 13 miles long by 8 miles wide, has a meteorological station. Prince Edward Island, just NE of Marion Island, has a circular shape and is 5 miles in diameter. The island rises to 2370 ft. Either of these uninhabited islands would make an excellent choice for an instrumentation location for a covert nuclear event occuring over the ocean. [redacted]

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Additional circumstantial evidence implicating South Africa comes from recent statements made by Botha, the South African Prime Minister of Foreign Affairs. On 25 September 1979, Botha told a provincial congress of the ruling National Party that,

> "South Africa enemies might find out that we have military weapons that they do not know about."

On 24 October 1979, before the US public disclosure of the Bhangmeter indication of the nuclear event, Botha spoke at an anniversary dinner attended by past and present members of the South African Atomic Energy Board. He reportedly paid tribute to the South African research scientists who have been engaged in secret work of a strategic nature. He said,

> ". . . that for security reasons, their names could not be mentioned and that they would never gain the recognition in South Africa or abroad that they deserve."

[redacted]

OGA b(1) b(6) DOE b(1)

[redacted]

OGA b(1) b(6)

DOE b(1)

REFERENCES

1. Row, Ronald V., "Acoustic-Gravity Waves in the Upper Atmosphere Due to a Nuclear Detonation and an Earthquake," Journal of Geophysical Research, Vol. 72, No. 5, p. 1599, 1 March 1967 (U).

2. Harkrider, David G., "Theoretical and Observed Acoustic-Gravity Waves from Explosive Sources in the Atmosphere," Journal of Geophysical Research, Vol. 69, No. 24, p. 5295, 15 December 1964 (U).

3. [redacted]

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b(1)
b(6)

DOE
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