12 April 1945

HAZARDS OF TRINITY EXPERIMENT

Section I - Hempelmann

A self appointed committee consisting of R.R. Wilson, E. Segre, J. Hirschfelder, R. Watts and L.H. Hempelmann met on two occasions to consider the hazards related to the tests at Trinity. At the second meeting, Mr. Bainbridge, Mr. Williams and Mr. Moon were also present. Thus far, the hazards which have been considered are limited to the immediate dangers to personnel on the site and in surrounding areas from blast, fragments, radiation, radioactive ~~poison~~ fume, heat and visible light. The dangers to individuals entering contaminated areas after the shot and the medical legal complications of the shot have not been considered thoroughly as yet. Neither has the case been considered where the energy of the explosion exceeds all expectations and results in an activation of the nuclei of the tamper material. The dangers from ozone and No have not been calculated. All calculations have been made in such a way as to determine the worst possible conditions.

The immediate purpose of considering hazards at this time is to enable us to draw up a plan of monitoring the experiment so that construction of health monitoring instruments can begin. This plan is presented in Section II by R. Watts. Although this organization will undoubtedly be changed considerably, the type of monitoring instruments is probably not subject to change.

The calculations for the immediate hazards follow:

(1) Blast: It has been calculated by Hirschfelder that for a 10,000 ton explosion the blast wave at the shelters (10,000 m) will be 0.2 p.s.i. Even in the case of a 100,000 ton explosion the pressure at the shelters will not exceed 0.5 p.s.i. According to Penny and Marley the personnel in the shelters will not be endangered even by the latter blast wave.

(2) Fragments: It has been calculated by Zimmerman, (reference memorandum to Bainbridge, 2 October 1944) that the danger from fragments would be maximum in the case of a relatively small explosion of 50 to 500 tons. In this case, a fragment with a range of 10,000 yards would have to have an initial weight of from 230 to 500 lbs. A fragment of such size would only result in the case of a non-symmetrical explosion using Jumbo. Even here the maximum would probably be less than 10,000 yards.

(3) Heat accompanying blast wave: According to Hirschfelder, the rise in temperatureproduced by the blast wave will probably not exceed 10 degrees at 10,000 yards.

(4) Light: At 10,000 yards the ball of fire from a 10,000 ton explosion will have the luminosity of about 30 suns for less than 1 millisec; the average luminosity for 1 second will be one sun. At a distance of the nearest town (approximately 20 miles) the luminosity will be completely without danger to people who may be looking in the direction of the ball of fire.

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SECRET

(5) Radiation Hazards: Weisskopf's maximum estimate of gamma radiation is 2000 R at 600 meters and 10^{-26} R at 10,000 meters. At the latter distance the neutron flux would be less than one neutron per square cm.

(6) Radioactive Materials: The worst possible hazard from radioactive dusts would seem to be one in which the explosion is of sufficient energy to only get the material in the form of a cloud of fine dust. In this case, assuming that there would be a 5 degree angle of spread of the cloud, the initial 5 kg. of 49 would be contained in 3000 ft (cubic) six miles from the zero point. Assuming that the dust is uniformly distributed throughout this volume, each litre will contain .006 micrograms of active material. Assuming that one microgram is a dnagerous amount of 49 and that the respiratory rate is 20 litres/minute, the cloud of dust would be dangerous at the shelter to breathe for more than 8 minutes. This hypothetical case would necessarily mean that the danger would be temporary since the dust cloud would drift by the shelters. If the dust cloud should drift to the nearest town (20 miles away) its volume would be 3×10^{13} litres which would mean about 10^{-4} micrograms of active material per litre; the cloud would then be dangerous to breathe for more than 500 minutes. This too, would represent only a temporary condition unless some form of precipitation might result in the deposition of the entire cloud on the town.

The dangers from fission products would probably be considerably less than from alpha particles since they would be formed only by a more efficient explosion, which would result in the cloud of dust being carried higher into the air by a ball of fire and better dilution in air. Assuming that the beta and gamma fission fragments were formed in a cloud similar to that described above the maximum radiation intensity in the cloud at 10,000 meters would be approximately 2×10^{8} R/min.

Plan for monitoring the experiment for the hazards described follows in Section II. Although the medical legal aspects of the problem have not been considered, it is planned to get permanent records of the measurements in the shelters as well as in the town for future reference.

Kenneth Hickman — Chamber of Commerce
U. of Rochester

Heat

Notify Mitchell

Schaffer. Tanks, Where are they
How many

36

R 123782

12 April 1945

HAZARDS OF TRINITY EXPERIMENT

Section II - R. Watts

Plan of Operation for Health Group -

(1) Instruments necessary : A. At Shelters
B. At towns
C. In mobile units and tanks

(2) Description of Instruments:

a. Proportional Alpha counters.
b. Recording gamma meters.
c. Roentgenometers
d. Survey meters
e. Air Filters

(3) Number of Instruments needed -

(4) Number of Instruments available -

(5) Organization

(6) Communications

(7) Transportation

(8) Personnel needed.

I. Instruments necessary:

It has been shown from Section I that the radiation hazards from the test shot are serious in the following order:

a. Airborne Alpha Contamination
b. Airborne fission products
c. Gamma and beta radiations.

The map on page is largely self-explanatory. Each location is marked with the instruments which will be placed there for monitoring purposes.

A. The shelters A,B and P will contain, Base camp

1) one proportional alpha counter (for measuring airborne contamination)
2) one Recording gamma meter
3) One Roentgenometer .1 - 300r?
4) One G-M Survey Meter .001-.02/hr
5) Sufficient gas masks for all personnel.

Cut out if difficulty

Should use 2

B. It is planned to monitor each town by,

1) one alpha air filter. -10 hr
2) one Recording gamma meter. need 20

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Blumps

C. Each mobile unit will contain,

1) one alpha proportional counter
2) one Roentgenometer
3) one G-M Survey Meter.

Gas masks

II. Description of Instruments:

a. Proportional alpha counter for measuring airborne contamination. No instrument has been developed as yet which will give an instantaneous reading of the alpha activity of the air. We are at present attempting to develop an instrument which will be able to warn personnel of levels of activity which would be dangerous to breathe over a period of 100 minutes. Such an instrument must be small and rugged enough to be portable; it must be non-microphonic and able to detect about 100 c.p.m. per litre of air. It is planned to use a thin windowed methane chamber to avoid microphonics and to build a four stage battery operated amplifier with headphones. The filaments will draw 200 m.a; the total load will be 0.8 m.a.

b. Recording Gamma Meter:

This instrument has been developed; four have been constructed and in operation. They have the following essential parts:

1) one H.V. Battery Supply for the G.M. tube.
2) one thin wall metal G-M tube.
3) one 3 stage battery operated integrating circuit.
4) one Esterline-Angus 0-1 ma recorder. Battery life is 4 days. Four ranges of sensitivity are available:

150 to 300 counts/min.
150 to 500 counts/min.
150 to 2000 counts/min.
1200 to 10,000 counts/min.

This meter is also sensitive to beta radiation (fission products). We believe there are a sufficient number of Esterline-Angus meters on the project so that we can borrow enough to cover our needs.

c. Roentgenometers

We are contemplating using the triple range Victoreen Survey type meters. There should be no trouble obtaining these meters since the Victoreen Company has been making them for over two years. We have ordered 36 of these meters from Chicago.

d. G-M Survey Meters

These are the portable Geiger-Mueller tube outfits made by Hallicrafters. At present there are 30 on the project. They have two ranges, 0.02 R/8 hours and 0.001 R/8 hours. Combined with the Victoreen instruments, a range of radiation intensity from 0.001 R/8 hours to 70 R/8 hours may then be covered. This should be quite adequate for any emergency that may arise.

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e. Air Filters

Satisfactory air filters for measuring small amounts of activity have been developed at Chicago. The apparatus consists of individual holders for large sheets of special filter paper through which air is sucked at the rate of 50 L/minutes (the exact amount of air is measured by means of a flow meter). The active dust collected by the filter paper can be determined by means of a counting circuit. This technique has been shown to be extremely sensitive. There is a delay introduced by the accumulation of activity from the normal radon contact of the air which must be allowed to decay before final measurements are made.

III. Number of Instruments Needed

At the present time the estimated number of instruments is:

a. Alpha proportional counters

Mobile units	12 (including tanks)
Shelters	3
Miscellaneous	5
Total	20

Excluding stuff which can be built in Chi, rest can be built here.

b. Recording Gamma Meters

Shelters	3
Towns	10
Miscellaneous	7
Total	20

c. Roentgenometers 30

d. G-M Survey Meters 30

e. Landsverk Pocket Electroscopes 75
f. Victoreen Pocket Chambers 75
g. Film badges 50
h. Gas Masks 50
i. Respirators 150

IV. Number of Instruments Available:

At the present time these instruments are available:

G-M Meters	30
Roentgenometers	20 — Victoreen
Gas Masks	?

The following has been ordered from Chicago:

Air filters	12
Roentgenometers	36
G-M Survey Meters	24

Hawaii's get them

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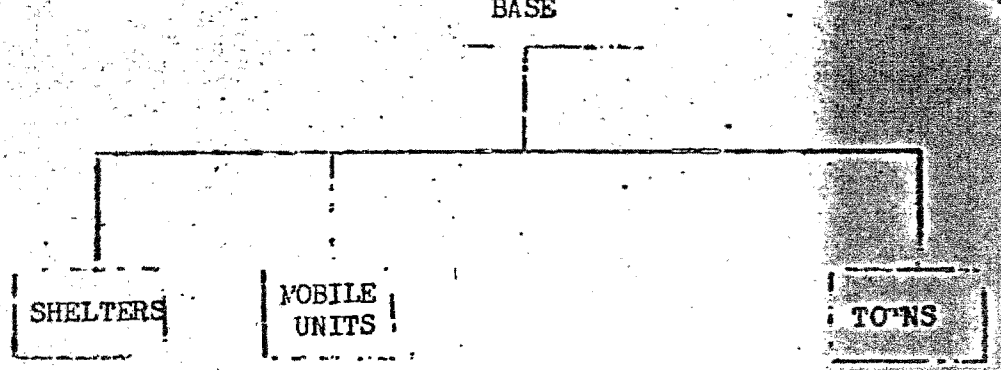
V. Organization:

The following organization is suggested:



This appears to be the most logical proceedure. We would like to have a base (one hutment) far enough away so that it could be used during the blast.

The object of this base is to have a place to set up our instruments to measure the filter paper, to have a place to keep an extra supply of all instruments and to have a place for some of our electronics people to work in case an emergency should arise.

VI. Communication:

The mobile units will be radio equipped. We have asked for 4 handy talkies or walkie talkies. This we hope, will give us sufficient communication flexibility.

VII. Transportation:

We believe it necessary to have two automobiles permanently assigned to the Health Group.

VIII. Personnel needed:

For driving the mobile units and spotting the towns, part of the physics personnel will be available.

We need one person to make previous arrangements in the towns.

We estimate:

10 people for the mobile units
1 person for base
3 people for towns and miscellaneous

We estimate 4 people will be needed to take care of instruments.