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LOS ALAMOS SCIENTIFIC LABORATORY
OF THE UNIVERSITY OF CALIFORNIA ○ LOS ALAMOS NEW MEXICO

June 13, 1947

PREPARATION AND OPERATIONAL PLAN OF MEDICAL GROUP (TR-7) FOR NUCLEAR EXPLOSION 16 JULY 1945

by

L. H. Hempelmann, M.D.

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HISTORY OF THE PREPARATION OF THE MEDICAL GROUP FOR TRINITY TEST II

The initial plans for protection of personnel at Trinity Test II were the result of two meetings in March 1945 of a committee composed of R. Watts, R. R. Wilson, J. Hirschfelder, E. Segre and L. H. Hempelmann. The discussion at these meetings centered about three main topics, 1) danger to personnel at the site and in the neighboring areas during and after the shot, 2) medico-legal aspects of these hazards and 3) instruments and organization needed to cope with the above hazards. The hazards and organization were presented at a meeting with Colonel Warren and Mr. Bainbridge on 12 April 1945. The agenda for the meeting and the notes thereon are included in this section. A definite plan of operation and instrumentation resulted from this meeting which was tested on a small scale in Trinity Test #1 (see also notes of 18 May 1945 in this section).

The data obtained in Trinity Test I gave us a better idea of what to expect in the final test. Previous to this shot, the only information on the fate of the radioactive materials was gleaned from the RaLa experiments. Numerous conferences with Colonel Warren, Weisskopf, Hirschfelder, Magee and Hubbard resulted in a working model of the explosion and of cloud of fission products. On the basis of this concept, a detailed plan of operation was prepared by Captain Nolan who took charge of the medical hazards aspect of Trinity Test II shortly after the 5 May shot. The plan as of 20 June 1945 is included in this section. It is based on the assumption that the meteorologic conditions would approximate those of the first test with a relatively strong wind toward the southeast carrying the cloud south of Carrizozo. The danger to persons in nearby towns from active material falling from the cloud was recognized (see memo Hirschfelder to Bainbridge, 16 June 1945) but the plan of evacuation of personnel from these danger areas was still in a formative stage in Captain Nolan's plan. Even at this time, however, Captain Jones was obtaining permission from General

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Grove's office to use military troops to evacuate persons in danger areas and John Anderson, the G-2 representative at Trinity was surveying the potential "danger area" for the location of ranches and other dwellings. On Saturday, 20, June 1945, Captain Nolan and Paul Aebersold went to Oak Ridge for approval of the plan; they conferred with General Groves and Colonel Warren about the Medical Operation.

During the last week in June, it became evident that we could not count on the meteorologic conditions requested by Captain Nolan because of the pressure being brought to bear to shoot as soon as possible. (see Memo Oppenheimer and Bainbridge to Lt. Daley, 30 June 1945) Hence, there was feverish activity on our part to make the town monitoring program flexible enough to adapt itself to whichever wind condition prevailed when the test was ready. These plans are discussed in detail in the memos of Joe Hoffman on 5 July, 7 July and 10 July, 1945. They are based upon close cooperation of the monitors with the G-2 representatives of Lt. Daley stationed at various towns. The duty of the G-2 men was to observe the event from a certain spot and to observe public reaction. Following this they were free to work with our monitors.

On 1 June 1945, it was learned that Captain Nolan would not be present at the Trinity shot because of a special overseas assignment. He continued in charge of this operation until 9 June 1945 when Hempelmann took over the responsibility. During the week of 7/2/45, Watts and the men of his group moved their instruments and all protective medical equipment to Trinity.

L. H. Hempelmann, M.D.

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 10 August 1945

ABSTRACT OF CONFERENCES ON MEDICAL HAZARDS HELD BEFORE THE TRINITY SHOT:

July 3, 1945 - Colonel Warren arrives from Oak Ridge with doctors to replace our men at hospital.

July 9, 1945-July 10, 1945 - Continuous conferences with Hirschfelder, Weisskopf, Hubbard, Magee, Colonel Warren, Capt. Nolan, Paul Aebersold to discuss what weather conditions to expect on the day of the shot.

July 10, 1945 - Conference with Oppenheimer, Tolman and others to consider Medical plan as affected by the day of shot. (see Aebersold's minutes of this meeting). Following this meeting, Hoffman left with Levine to survey roads and terrain east of Trinity. No further contact with him until Friday 13, July, 1945.

July 11, 1945 - Airplane trip with Colonel Warren, Hubbard, Lt. Col. Holzman, Capt. Lyon and Hempelmann over Trinity and probable easterly course of cloud. Conference with Holzman and Hubbard about probable weather conditions (see Hubbard's weather report). Colonel Warren and Capt. Lyon go to Trinity. Hempelmann returns to Project Y.

July 12, 1945 - Aebersold leaves at 7:00 AM with the convoy carrying the active material. Meeting at Trinity to obtain final clearance of general Medical Program. Present at the meeting were General Farrell, Bainbridge, Oppenheimer, Tolman, Hubbard, Lt. Col. Holzman, Rabi. Plans of site monitoring, town monitoring, evacuation of camp and nearby areas were discussed. Decision to shoot on July 16, 1945 if possible because of other reasons. Safety of personnel at shelters was discussed; J.R.O. calculates one P.S.I. for 100% efficiency at 10,000 yard shelters, .07 P.S.I. the Base Camp for same conditions. Visible light intensity questionable - recommendation of Medical Group consists of supplying persons with dark glasses

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but advising them to face the opposite direction during flash - they will look at the flash only on their own responsibility.

Because of decision to shoot on July 16, 1945 if possible, Hempelmann was advised to come down immediately to help extend Medical Plans for town monitoring either in northeasterly or northwesterly areas. Anderson and Bennett (G-2 representatives) asked to survey northwest and northeast areas for houses. The weather conditions for 16 July 1945 appear to be variable winds toward the northeast at low altitudes and toward northwest at higher altitudes of extremely slow velocity. This means that material may fall out in our own territory.

July 13, 1945 - Hempelmann arrives at Trinity with explosive convoy. Capts. Barnett and Hageman set out on highway 380 to place marking sticks from Bingham to Carrizozo. Conference with Bainbridge, Hoffman, Hubbard, Holzman and Anderson concerning disposition of personnel, monitoring and evacuation plans. Gadget together at 2:00 PM. Hoffman goes out to survey northwest area. Stationary recording meters have been installed by Watts at Carrizozo, San Antonio and Hot Springs. Other instruments not placed at further points because of lack of information about direction of wind. Hoffman leaves in late afternoon to survey N.W. area.

July 14, 1945 - Colonel Friedell arrives at 3:00 AM. Conference at 8:00 AM with General Farrell, Major Palmer, Capt. Allen, and Colonel Warren. Farrell says no evacuation until after shot. Arrangements made for Warren to stay in radio room with Capt. Allen who will record course, height and speed of cloud. This information will be radioed to J. Hoffman who will be stationed with monitors and evacuation troops at Gate #2. Major Palmer will have a radio, Hoffman will have the receiver. 9:50 AM - Conference with Hirschfelder, Magee, Lyons, Friedell, Hubbard, Hoffman, Warren and Hempelmann. It now looks as though winds will be variable and of slow velocity. This means that plans to evacuate nearest houses

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must be very complete for ranches to the West where danger will occur first. These plans are being drawn up by Major Palmer (see final plans for monitoring and evacuation described by Hempelmann). The upper safe limit of radiation raised to 15 r/hr at peak of curve. Since whether or not the cloud will be stopped by the first inversion is purely speculative, plans for northwest and northeast monitoring and evacuation must be continued. Hoffman, Hirschfelder, Magee leave for Santa Fe conference with monitors at 4:00 PM.

July 15, 1945 - Recording instruments installed in Magdelena by Sgt. Lerner. Directions for personnel at Base Camp, Hill Camp and for Evacuation Detachment written up and discussed at mass meeting by Colonel Warren at 11:30 AM. Anderson gets permission for his group to go into contaminated area in tanks. Their equipment (including positive pressure masks, 10R L and W electrometers) will be checked by the medical Group following which they will take the responsibility for their actions. They will not be accompanied by a member of the Medical Group. This is approved by Col. Warren since all persons involved are experienced and have good equipment. Weather prediction at 3:00 PM indicates 5-mile-an-hour wind to the West up to 19,000 feet, above inversion slow winds to the northeast. This indicates, according to Weisskopf, that the following intensities might be expected in the shadow of the cloud - 150 r/hr at the 4th mile (1hr) 24 r/hr at the 8th mile (2nd hr) 6 r/hr at the 12th mile (3rd hr) 2.2 r/hr at the 16th mile (4th hr) 0.6 r/hr, at 20th mile (5th hr). The above will occur if efficiency of explosion is low and the cloud is carried to the northwest. 8:00 PM - raining, - Hubbard still confident that things will be as predicted - use of plane doubtful because of weather conditions in Albuquerque.

July 16, 1945 - 2:00 AM - still raining. Conference with General Groves, General Farrell, J.R.O., Tolman, Warren and Hubbard. Local rain has stopped but sky heavily overcast. Hubbard still holds out for shot. Assures everyone there is no possibility

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of rain following the shot. 5:AM - overcast beginning to break, conference at So 10,000 with J.R.O., Bainbridge, General Farrell, Hubbard and Hempelmann. Zero hour 5:30 - Low winds are slow and almost directly north.

L. H. Hempelmann, M.D.

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FINAL ORGANIZATION FOR TRINITY TEST #2 AS OF

15 July 1945

Hempelmann (contractor's representative) in charge of Medical Program - to be at S-10,000 at time of shot for final consultation on meteorologic conditions.

Colonel Warren (Manhattan District representative) must give final clearance on all plans - to be at Base Camp during shot and to provide radio communications to town monitors (Hoffman et al).

Lt. Colonel Friedell (consultant) - to provide secondary communications center in Albuquerque in case radio contact from Base Camp breaks down.

Joe Hoffman - in charge of town monitoring; only person with authority to give orders for evacuation; assisted by Joe Hirschfelder, John Magee, Wright Langham, Alfred Anderson, T/3 Phil Levine, S/Sgt R.R.Leonard, T/5 Carl Hornberger and T/4 Joel Greene.

Major Palmer - in charge of evacuation troops; assisted by Major R. Miller, Lt. Huene, Lt. H. Miller.

Paul Aebersold - in charge of Site Monitoring; assisted by R. W. Watts, Captain Barnett, Captain Hagemen, Lt. J. H. Allen, Louis Scivally, Larry Brown.

Richard Watts - in charge of development, manufacture, maintainance and calibration of instruments.

L. H. Hempelmann, M.D.

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EVENTS IN CAMP IMMEDIATELY FOLLOWING SHOT--JULY 16, 1945

(Summarized from Col. Warren's and Hempelmann's personal notes)

5:30 a.m. -Nuclear explosion of good efficiency

5:40 a.m. -Aebersold leaves Base camp with guard to monitor Broadway

5:45 a.m. -Barnett given permission by Bainbridge to go to N-9000 to recover equipment.

5:50 a.m. -Aebersold reaches Guard Post 2, and is held by guard at this post.

5:55 a.m. -Barnett reports intensity of 2r per hour 100 years south of N-10,000, asks permission to evacuate this shelter. Permission granted by Col. Warren. No activity reported at West 10,000 and South 10,000.

6:30 a.m. -Aebersold reports Broadway uncontaminated.

7:00 a.m. -Tank with H.L. Anderson and crew leaves S-10,000 for crater region. All other going-in parties postponed because Medical Group became occupied with offsite problems.

8:45 a.m. -Searchlight crew L-5 reports 0.11r per hour to Col Warren.

8:25 a.m. -Intensity of 2.0r per hour at Bingham reported to Col. Warren by Joe Hoffman.

9:05 a.m. -15r per hour reported for region 7 miles northeast of Bingham by Joe Hoffman. Radio contact with monitors becomes increasingly worse-no further radio contact after this report. Hempelmann called in from S-10,000 to Base Camp for conference with Col. Warren. It is decided that Hempelmann should leave at once to help monitors. Col. Friedell ordered in from Albuquerque. All southbound planes from Kirkland field grounded by order of General Groves.

10:00 a.m. -Capt. Barnett and Louis Scivally dispatched to help Hoffman.

10:30 a.m. -Hempelmann leaves base camp in car with good radio car.

11:00 am.. -Col. Warren releases planes on basis of calculation by Weisskopf which indicates that they cannot get more than 0.2r even by flying through

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the cloud at this time.

11:15 a.m. -Hempelmann calls in report from Art Breslow, one of searchlight crew coming back to base camp after traveling over Highway 380. Message states that the path of activity extends from Bingham eastward 10 miles. Reading at Bingham 2.0 r per hour, maximum intensity on this road 2.0 r per hour at a point 4-5 miles east of Bingham.

11:20 a.m. -Hempelmann relays message from Barnett who is with Hoffman and Palmer's troops at Bingham. The area along Highway 380 (Bingham to White Store) and northeast of Bingham have been surveyed. One area is 90 percent of tolerance. All high readings in uninhabited areas, no evacuation deemed necessary.

11:30 a.m. -Col. Friedell arrives at Base camp with Lt. Daley.

11:45-12:00 a.m. -Meeting at Bingham of Hoffman, Hirschfelder, Magee, Hempelmann, and Palmer. The following decisions were made:

1) Hoffman shall check high readings (15.0r per hour) found by Magee northeast of Bingham and shall ascertain whether or not there are ranches nearby. He will be accompanied by a detachment of the military evacuation party. He will then proceed northward along Highway 161 to check ranches in this vicinity. After this he will return to Project Y to await further orders.

2) Langham and Levine will investigate roads emerging Highway 161 for first 15 miles northward.

3) Anderson will check all roads leading south from highway 380.

4) Captain Barnett and Louis Scivally will try to circle the contaminated area by traveling along Highway 380 to Carrizozo, then northward to Corona and Claunch and then back to Bingham along road 161.

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5) Major Palmer and troops except for detachment with Hoffman return to bivuac area to await further orders.

6) Hempelmann returns to Base Camp.

The above message was sent in to headquarters to Col. Friedell by radio communication which had been reestablished by placing relay station at Guard House 1 with Major Miller in charge.

Monday afternoon: 12 July 1945.

Throughout the afternoon and the next two days, Col. Warren and Lt. Col. Friedell directed monitoring parties (Hornberger, Anderson and Hoffman) along roadways to contaminated areas. For details see reports of monitors.

Tuesday: 17 July, 1945:

Lt. Col Friedell and Hempelmann investigate hot canyon and find family in adobe house approximately 1 mile east of hottest region (See report in Hoffman's section). This dwelling was not reported on G-2 map. Decided temporarily against evacuation because of relative low radiation intensity. Parties go into crater throughout this and succeeding days (See Aebersold's report).

Wednesday: 18 July, 1945. 6:00 p.m.

Party consisting of Col. Warren, Lt. Col. Friedell, Captain Lyons, Aebersold and Hempelmann left Trinity for Los Alamos. Lt. Harry Allen and R. W. Watts remain in Base Camp in charge of monitoring.

Thursday: 19 July, 1945:

Meeting of all monitors, with Col. Warren, Hirschfelder, et al. to discuss results. The plotting of the decay curves for different area indicated that the decay was considerably more rapid than anticipated ($> t^{-1}$). The question as to the evacuation of the family in the hot canyon was discussed. It was decided that this was not necessary at this time.

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For the next six months, monitoring parties were sent into the contaminated area for survey purposes and visits were made periodically to the families in the most heavily contaminated regions to determine whether their health had been affected.

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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 material, 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 a chain reaction 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 for a 10,000-ton explosion 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, (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.

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in this case, a fragment with a range of 10,000 yards would have to have an initial weight of from 250 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 temperature produced by the blast wave will probably not exceed 1.0 degrees at 10,000 yards. (Fermi effect not considered.)

(4) Light: (Visible radiation - probably not much heating.) 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 0.1 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.

(5) Radiation Hazards: Weisskopf's maximum estimate of gamma radiation is 2000 R at 600 meters and 10^{-25} 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 only to get the material in the form of a cloud of fine dust.

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, hence in better dispersion in air. Assuming that 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.

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If, however, the cloud should be carried down by a rainstorm and be deposited on the ground, tremendous radiation intensities of the order of thousands of gamma roentgens per hour would result. Although the intensity would decrease as $1/t$, where t is the time after the shot, appreciable dosages would be delivered in short periods of time.

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.

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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.

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

1) one proportional alpha counter (for measuring air-borne contamination)
2) One G-M Survey Meter
3) Sufficient gas masks for all personnel.

B. It is planned to monitor each town by.

1) one alpha air filter.
2) one Recording gamma meter.

C. Each mobile unit (10) will contain.

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

II. <u>Description of Instruments:</u>

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

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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.

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 60 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 content 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

b. Recording Gamma Meters

Shelters	3
Towns	10
Miscellaneous	7
Total	20

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c. Roentgenometer 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:

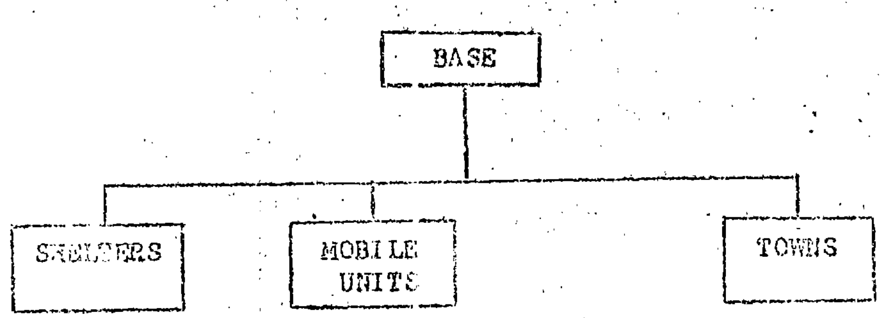
G-M Meters	30
Roentgenometers	20
Gas Masks	?

The following has been ordered from Chicago:

Air filters	12
Roentgenometers	36
G-M Survey Meters	24

V. Organization:

The following organization is suggested



This appears to be the most logical procedure. 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

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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.

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MEDICAL HAZARDS OF TR #2

20 June 1945

I. Introduction:

It is the purpose of the Medical Department to anticipate possible dangers to the health of scientific personnel, residents of nearby towns and of casuals; to provide means of detection of these dangers, and to notify proper authorities when such dangers exist.

It is also necessary to obtain records which may have medico-legal bearing for future reference.

The medical group will act in an advisory capacity and avoid direct orders to personnel except in cases of emergency. It is the responsibility of the Project Director (K. T. B.) to confirm or deny activities to scientific personnel which may be hazardous to them. It has been advised that no person should (of his own will) receive more than five (5) r. at one exposure.

Evacuation of towns or inhabited places will be carried out by G-2 personnel if necessary on advice from the Medical Department. Contaminated areas will be adequately marked and guarded until decontaminating procedures can be carried out.

II. Organization of Medical Group (TR 7):

A. Chief of Medical Group: ⟷ Consultants:

Hempelmann

Consultants:
Warren
Friedell

Deputy at TR: ⟷ Surgeon:

Nolan

Surgeon:
Large
Humphries
Lerner

Instruments:

Watts
Seivally

Site Monitoring:

Aebersold
Barnett
Allen
Hageman

Outside Monitoring:

Hoffman
Levine
Anderson
Leonard
Brown
Green

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B. The Duties of Medical Group Personnel:

1) Hempelmann:

Generally in charge of operations. To have no regularly assigned duties, but to be ready at Base Camp for consultation.

2) Nolan:

To plan for medical personnel and equipment. To acquaint all personnel as to activities of Medical Group. To instruct medical personnel to their duties and responsibilities. To inform Project Director (K. T. B.) as to Medical Hazards.

3) Watts:

To construct and install all monitoring devices. To instruct monitors as to their equipment and duties.

4) Monitors:

To carry out readings and recordings as instructed.

5) Medical Officers:

To be available in case of catastrophe and to act as temporary monitors.

6) Consultants:

To be available at Base Camp for receipt of monitoring reports and to advise as to necessity of evacuation of contaminated areas.

C. Stations of Medical Group Personnel:

1) At Base Camp:

Hempelmann	Warren
Nolan	Large
Watts	Aebersold

2) At 10,000 Yard Shelters:

Barnett	Hageman
Allen	

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3) At Range Camp - Lava Bed:

Levine

4) At Highway 54:

Anderson

5) At Highway 285:

Green

6) At Highway 85:

Leonard

Roving Monitor - Hoffman

7) In Airplane:

Members of Alvarez's Group

8) At Albuquerque:

Friedell

III. Equipment of Medical Group:

A. Transportation:

1) Ambulances:
a. Panel type
b. Field type

2) Four-wheel Drive:
a. Command car
b. Carry-all

3) Sedan

4) On loan - 2 contaminated four-wheel drive vehicles for taking scientific personnel into contaminated area. All available four-wheel drive vehicles for evacuating base camp.

B. Protective Clothing:

1) Coveralls- for people in shelters, Medical Group, Tank Group, and in-going personnel 100

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2) Caps, surgical 100
3) Booties, various 100
4) Gloves, cotton 100

C. Gas Masks:

1) Positive pressure type - Tank Group . . . 12
2) Smoke resistant type - in-going group . . 30
3) Regular gas masks - Shelter group 30
4) Respirators - all personnel at base . . .400

D. Instruments:

1) Portable gamma meters 15
2) Portable alphameters 20
3) Filter Queens 10
4) Recording gamma meters . . . . 12 (Esterline-Angus
5) Hand and Swipe Counter 1
6) Regular pencils 200
7) Chargers 3
8) Resistant pencils 12
9) Film badges - catastrophe 100
10) Film badges - for towns 200

IV. Plans for Monitoring - Before Shot:

A. Transportation of Material:

1) Courier to wear pencil and catastrophe badge
2) Container to be checked with small portable gamma and alpha meters.

B. Assembly:

1) Dry box maneuvers to be checked with portable gamma meter
2) Protective clothing and respirator worn before tamper is in place.
3) Check hand and nose counts of Pit Man

C. Raising of Material and H. E.:

1) Area to be cleared of unessential personnel before, during, and after this procedure.

V. Plans for Monitoring - Time of Shot:

A. At 10,000 yd. Shelters:

[redacted]

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1) All persons to remain inside shelters
2) One member of Medical Group at each shelter
3) Instruments and equipment
   a. portable gamma meter. . . . 1
   b. portable alpha meter. . . . 1
   c. Pencil chambers or film badges for each person
   d. ordinary gas mask for each person
4) All personnel to leave for base camp within 30 minutes using gas masks.
5) a. Evacuate before 30 minutes if gamma reading outside shelter reaches 0.1 r/hr.
   b. Put on gas masks and evacuate if alpha reading reaches 5 c/m.
6) Adequate transportation to be checked by member of Medical Group.

B. At Base Camp:

1) All persons to be outside of buildings.
2) Observers of shot to wear protective goggles and avoid direct vision.
3) To stay at Base until contaminated area is ascertained --- 6 hours.
4) Member of Medical Group to be in communication with town monitors by phone and with plane monitors by radio.
5) Equipment and instruments:
   a. portable gamma meter
   b. portable alpha meter
   c. respirators
   d. adequate transportation for all personnel for evacuation
   e. tolerances - same as in V - A - 5)

C. At Range Camp (Lava Bed):

1) Observe cloud and trail with radar and direct vision
2) Instruments and equipment:
   a. Portable gamma meter
   b. Portable alpha meter
   c. Respirators
   d. Transportation
3) Tolerances - same as in V - A - 5)
4) Communications - radio to Base Camp

D. Member of Medical Group at Highway 54:

1) Check recording meters (alpha and gamma) at:

Carrizozo, Oscura, Three Rivers, Tularosa

[redacted]

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2) Observe cloud visually and record course
3) Observe readings of portable alpha meter beneath cloud
4) Follow cloud towards east and continue with meter readings.
5) Communicate with Albuquerque by phone as to course, intensity of readings, etc.

E. Member of Medical Group at Highway 285:

1) Check recording meters (alpha and gamma) at Carlsbad and Roosevelt
2) Observe cloud visually and record course.
3) Observe readings of portable alpha meter beneath cloud
4) Follow cloud towards east and continue meter readings
5) Communicate with Albuquerque by phone, as to course, intensity of readings, etc.

F. Member of Medical Group at Highway 85:

1) Check recording meters (alpha and gamma) at San Antonio
2) Observe cloud visually and record course
3) Observe readings of portable alpha meter beneath cloud.
4) Follow cloud towards east and continue meter readings
5) Communicate with Albuquerque by phone, as to course, intensity of readings, etc.

G. Roving Town Monitor: (Hoffman)

1) Station himself Carrizozo at time of shot.
2) Follow cloud visually and with portable meters.
3) Direct station and activities of ground monitors.
4) Confer with Albuquerque (W. Friedell) in case of need of evacuation at any point.

VI. Plans for Monitoring - After Shot:

A. At Shelters 10,000 yards:

1) Evacuate area as soon as possible returning all personnel to Base Camp.
2) Check wearing of gas masks and pencil chambers.
3) Report on meter readings.

B. At Base Camp:

1) Receive reports from plane and surface monitors
2) Send consultation group to dangerous areas if need be
3) Check equipment, calculate dosage, instructions to personnel

Nolan

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entering contaminated area to retrieve equipment. This is to be done by a Board consisting of K. J. B., V. W. and J. F. H. with the aid of information obtained by Tank Team and from gamma sentinels of Moon. Men to wear coveralls, caps, boots, smoke masks, film badges and direct reading electroscopes.

4) Record gamma and alpha readings at Base Camp and evacuate if necessary. This must continue until all of Base Camp can be evacuated after 4- 7 days.

5) Check equipment of Tank Team - before and after their activities.

6) Map out area of gamma contamination to tolerance limit (0.1 r/8hrs.)

7) Map out area of alpha contamination to tolerance limit (five c/m on ground)

8) Set up wind-socks at various locations for ground wind direction.

C. At Highways and Lava Bed:

1) To report at Base after recording devices are secured and after cloud and trail have passed. Be prepared to proceed in direction of cloud if necessary. Return to Base when advised to watch for and retrieve film badges dropped through cloud by plane.

D. Plane:

1) This to be performed by members of Alvarez's group and to be instrumented to carry out the following measurements:

a. size of cloud
b. shape of cloud
c. course of cloud
d. gamma intensity by direct reading at distance
e. gamma intensity by dropping film through cloud at intervals.

E. Additional Measures:

1) Film to be sent to post offices of surrounding towns and be picked up by G-2 man and recorded.

VII. Immediate Hazards:

A. Blast:

Hirschfelder's calculations 10 June, 1945 for an effeciency of 100,000T. would yield at 10,000 M. - 0.69 p.s.i. and at 20,000 M. = 0.34 p.s.i. With such pressures, less than 1 p.s.i., bodily injuries will not occur. Ear injury may occur from 1 to 5 p.s.i.

B. Fragments:

It has been calculated by Zimmerman (ref. memo. to Bainbridge, 2 Oct. 44)

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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 a 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 yds.

C. Heat:

According to Hirschfelder the rise in temperature produced by the Blast Wave will probably be 40° instantaneously and within one second be only 1° at 10,000 yds.

D. Light:

With 10,000 T at 10,000 M -	1 sun for 1 millisec. 1/10 sun in 1 sec.
With 100,000 T at 10,000 M -	10 sun at 1 millisec. 1 sun at 1 sec.
With 100,000 T at 10 miles -	5 sun at 1 millisec. 0.5 sun at 1 sec.

Observers within 10 miles will not be injured and will be especially protected by smoked glasses.

E. Gamma Rays:

According to Weisskopf's maximum estimate of immediate gamma radiation, the amount delivered immediately would be 10^{-4} at 10,000 M.

F. Neutrons:

At 10,000 M the peak neutron flux would be less than one neutron per square cm, which is far below tolerance.

We find that all personnel housed in the shelters at the time of the shot will be adequately protected. However, premature detonation will be quite dangerous. For these reasons, persons working around the tower after the charge and pit are in place will wear "catastrophe badges" and precautions will be taken for the evacuation of injured persons and the treatment of blast injuries.

VIII. Delayed Hazards:

A. Ground Contamination:

Because of the necessity of retrieving scientific apparatus for

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records after the shot, the ground contamination becomes important. The alpha contaminated area will be appreciable, but will not be dangerous if the correct protective clothing is worn. The gamma contaminated area will be appreciable, but will shrink due to decay of the fission products. Although these areas must be measured at the time in question, estimates of their size have been made in order to facilitate the placement and removal of apparatus. Calculations by Weisskopf and data reported by Anderson from the 100 T shot are used. They are enclosed in the appendix.

Due to the fact that the area of the crater will be contaminated with alpha particles and that these will be closely associated with fine particles of dust on the surface of the ground, it will be necessary to bind the dirt in this area rather closely and bury it later. Local winds are variable and danger from breathing contaminated air will be ever present unless this is done. The area of alpha contamination will represent an "attractive hazard" to the curious even though it be fenced off and adequately marked.

The area of alpha contamination will be monitored by Anderson's dirt samples from the tank; also, the area of contamination will be marked by the Medical Group in the following manner: A portable alpha meter designed by Watts which can read accurately 5 c/m will be wheeled into the area. Dirt scooped up in a measured plate which gives this reading will indicate that if all the dirt in this area were dispersed in the air, one would inhale the tolerance dose of 49 in 15 min. People entering this area will wear protective clothing and smoke masks.

Calculations:
1 ugm 49 = tolerance dose = 140,000 dis/min.
= 70,000 counts/min.
Respiration = 15,000 cc/min (100 o/o retention assumed)
Meter has window = 2 cm x 9 cm with 8 mm thin wall window.
Alpha range in air = 4 cm. in air or 3 cms in front of window.
Vol. measured by meter = 2 x 9 x 3 = 53 cc = 1/20 liter.
Effective geometry = 30 o/o
Best practical reading = 5 c/m
In air = 5 c/m in 50 cc.
= 1500 c/m in 15,000 cc
$= \frac{1500 \times 3}{70,000}$ = 1/16 tol. dose per minute.
or tolerance dose 1 ugm in 16 min.

Gamma contaminated area will be measured by Anderson and Moon's sentinels. These figures will be used by Weisskopf to calculate time and duration of entrance of personnel. Also, the Medical Group will outline the region of the tolerance level 0.1 r/8 hr. with portable gamma meters.

D. Cloud Contamination:

The activity of the cloud will vary with the efficiency of the

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[redacted]

explosion and measures to monitor it until it is dispersed must be taken since it represents a possible dangerous hazard to the population of the surrounding territory. Also definitive measurements must be obtained for medico-legal reasons. However, the size, shape, and activity of the cloud have been calculated in anticipation and are enclosed in the appendix. Also, its course of probable action are discussed in section IX under Meterology. A description of the monitoring by airplane will be furnished by Alvarez and Weldman, who are undertaking the procedure.

C. Trail Contamination:

There is a probability that loose dust from the crater and surrounding area which will be drawn upward by the hot air currents, may form nuclei upon which radio-active materials will condense. It has been calculated by Hirschfelder from actual measurement of the TR dust and the surface area afforded by the particles that if this dust should rise to 10,000 ft. and then fall at a normal rate there may be danger to towns 30 miles away. His calculations are based on pessimistic assumptions, but the possibility of this happening cannot be excluded. The calculated amount of radiation resulting is 7 r/hr for fission products and 1 ugm of 49 in 22 hrs at normal respiratory rates.

It is most probable that there will be a selectivity of particles by the updraft, so that only dust of small diameters will reach this height, that is, 100 micron or less. Also, it is probable that the cloud will ascend higher than 10,000 ft. resulting in greater dispersion and dilution if these particles should fall. It is also probable that these particles will not fall at a normal rate, but will be held together by electric forces. Also, the probability that the cloud will pass over populated places is not certain.

In any case, this possibility will be watched for by the town monitors and steps taken to evacuate the town if danger is eminent. As the decay rate proceeds as 1/t, there should be adequate time to cause evacuation after contamination is noted. The ultimate decision will be made by the Medical Consultants with the complete information at hand after the shot.

IX. Meteorology:

The TR#2 shot will occur during a time when meteorological conditions are similar to the 7 May shot. As far as the medical considerations go, the main planning for monitoring the surrounding territory has been with this in mind. Mr. J. Hubbard has reasonably assured all concerned that these conditions are predictable at least 6 days in advance.

A summary of the conditions to be expected and their bearing on the cloud is as follows:

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1) The humidity will be low enough to exclude the causation of a thunder shower by the blast and heat effects of the explosion. Such a thunderstorm would be dangerous in that it might cause the precipitation of the active material over a small area which could not be controlled.

2) There will be a small temperature inversion over the site and surrounding territory from 1000 to 1700 ft. high. This will retard heavy particles in traveling any great distance and impede lighter particles which have penetrated the inversion from falling back through it. The latter effect will tend to protect the nearby towns until the morning thermals have mixed the active material more thoroughly.

3) Above the inversion there will be at least a 30 m.p.h. wind towards the S.E. This will carry the cloud beyond the nearby towns giving the active material time to diffuse somewhat and become more dilute.

4) Five miles from the site there is a range of mountains 4000 ft. above terrain. With the winds in the S.E. direction this range will cause an increase in the velocity of the winds above it to 10,000 ft. This will give a "shearing effect" to the trail at the bottom of the cloud. What material from the trail that is not deposited on the west face of these mountains will be diffused by the high turbulance of the winds. Some 50 miles from the site there is another range of equal height which by the same effect will spread and diffuse material which may have started to fall from the cloud.

5) There will be a slightly stable atmospheric lapse rate. The effect of this will be to allow the ball of fire to ascend until stopped by a higher inversion. This higher inversion is expected to be from 20,000 to 25,000 ft. In the 100 T shot, the height reached was from 12,000 to 14,000 ft. because of a slight inversion at that height. The energy of the TR #2 shot will probably be enough to exceed such a slight inversion as this one was, but all calculations as to the action of the cloud have been on the basis of 12000 ft. The higher the cloud ascends, the less danger from heavy active particles falling on a small area. We are assured that the lapse rate will exclude any possiblity of the cloud descending.

6) The usual heating of the earth at about 9:00 A.M. will start the general movement of air in an ascending manner as the inversion is broken. Besides this there will be rather large updrafts or thermals. The effect of this will be to disperse the cloud in the matter of a few hours. The cloud's station at this time will be about 250 miles from the site and again we have been reassured that no local thunderstorms will form which could "suck in" the entire cloud and deposit it over a small area.

7) Mr. Hubbard finds it conceivable that contaminating material thrown in the air will remain at high altitudes until thorough mixed and may be suspended for a matter of weeks (for example the volcanic dust and surface dusts from the interior of China.)

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To: Lt. D. Daley 5 July 1945

From: Joseph G. Hoffman

Subject: Town Monitoring

The monitoring of towns must of necessity be on a flexible program. Accordingly, there are three major possibilities: (1) the North blow in which the cloud moves in the cone 20° north of Carrizozo, (2) the South blow in which the cloud moves in the cone south of Carrizozo, and (3) the indeterminate case in which the cloud moves in any other direction from those given in (1) and (2). The monitoring setups for these cases are described below. In any case there will be set up at Hot Springs, San Antonio, Carrizozo, and Tularosa, continuously recording radiation meters and Filter Queens requiring 60 cycle, 110 volts a.c. power. These will be installed by Mr. Dick Watts and his crew.

1. North blow: this case is most likely at present writing.

a. On road 380 about 20 miles N.W. of Carrizozo will be stationed T/4 Phil Levine.

b. On road 54 about 30 miles N of Carrizozo will be Mr. Alfred Anderson.

c. On road 285 about 10 miles S. of Ramon will be T/3 Joel Green.

d. On road 60/84 between Tolar and Melrose will be T/3 Bob Leonard. He will be stationed at Ft. Sumner. He should have a Filter Queen to make tests of Ft. Sumner, Clovis and Portales.

2. South blow:

a. Phil Levine will be stationed on the lava beds N.W. of Oscuro.

b. Bob Leonard at Tularosa with a means for moving North along 54 to see where the cloud crosses the road.

c. Alfred Anderson at Hollywood on road 70.

d. Joel Green at Roswell with a Filter Queen and facilities for moving South along road 285 to see where the cloud crosses 285.

3. Indeterminate Case:

The movement of monitors from their fixed positions in the indeterminate case will depend on transportation facilities available. In general, the direction of the cloud can be gotten from the Albuquerque headquarters by telephone. The monitor should drive to the nearest town near which the cloud is expected to pass and make survey measurements on gamma and alphameters.

Joseph G. Hoffman

cc/ Dick Watts
L. H. Hempelmann

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II-B-2 7 July 1945

SUBJECT: Changes and Supplement to Town Monitoring

The monitoring of towns must of necessity be on a flexible program. There is assumed to be a "safe" region into which the cloud will not be blown and it is defined by the sector made by drawing two radii 6° north and 6° south of Carrizozo, and passing through zero point. Accordingly, there are three major possibilities: (1) the "North blow" in which the cloud moves Northeast in the 20° sector north of the Carrizozo safe zone; (2) the "South blow" in which the cloud moves Southeast in the 20° sector south of the Carrizozo safezone; and (3) the indeterminate case in which the cloud moves in any other direction from those given in (1) and (2). The monitoring setups for these cases are described below. In any case there will be set up at Hot Springs, San Antonio, Carrizozo, and Tularosa continuously recording fission products meters and Filter Queens, which instruments require 60 cycle, 110 volt a.c. electric power. The instruments at these four monitoring sites will be set up 4 to 6 days before the shot by Mr. Dick Watts and his crew and will be operated by the seismographic groups at these places.

1. North blow: This case is most likely at present writing.

a. On road 380 about 20 miles NW of Carrizozo, T/4 Philip Levine (stationed at Carrizozo)

b. On road 54 about 30 miles N of Carrizozo, Mr. Alfred Anderson (stationed at Carrizozo)

c. On road 285 about 10 miles S of Ramon, T/4 Joel Green (stationed at Roswell)

d. On road 60/34 between Tolar and Melrose, T/3 Robert Leonard (stationed at Ft. Sumner)

e. Roving monitor stationed at Carrizozo, Mr. Joseph G. Hoffman. The roving monitor is to move cross-country following the cloud, checking on the observed data of the above monitors and keeping contact with headquarters in Albuquerque.

The monitors will survey first with gamma ray meters, and then take a sample of the ground one foot square and one inch deep. Their measurements should be telephoned to Albuquerque as soon as possible.

Two to three days before the shot Mr. Dick Watts will install at Clovis, Portales, and Ft. Sumner recording fission products meters and Filter Queens. These will be run

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through the day of the shot and the following night and then be turned off by T/3 Leonard.

Each of the monitors will be accompanied by one of Lt. Daley's crew. This permits an affidavit to be made as to the time, place, and nature of the radiation measurement made.

2. South blow

The monitors have been established in a manner such as to facilitate their shifting easily from the North to the South blow. The exception is the monitor at Ft. Sumner who must swing South to Artesia.

a. On road 54 about 15 miles SW of Carrizozo (near Oscuro), T/4 Phil Levine.

b. On road 70 between Hollywood and Hondo, Mr. Alfred Anderson.

c. On road 285 near Hagerman, T/4 Joel Green.

d. On road 83 near Maljamar, W of Artesia, T/3 Bob Leonard.

e. Roving monitor stationed at Carrizozo, Joseph G. Hoffman.

3. The Indeterminate Case

If the direction the cloud will move in is known sufficiently in advance the monitors will deploy along the possible roads in that direction. In the event the cloud moves in an unpredicted manner its general direction should be gotten from Albuquerque headquarters. The monitor should then drive to the nearest large town near which the cloud is expected to pass.

The monitors will meet previous to the shot at Santa Fe and receive their instruments and car assignments from Lt. Daley. The monitors will act merely as observers and only Mr. Hoffman will be able to call Albuquerque to advise on evacuation. The records of the stationary meters will be the responsibility of Mr. Dick Watts who will pick them up and measure the alpha recordings at Base Camp.

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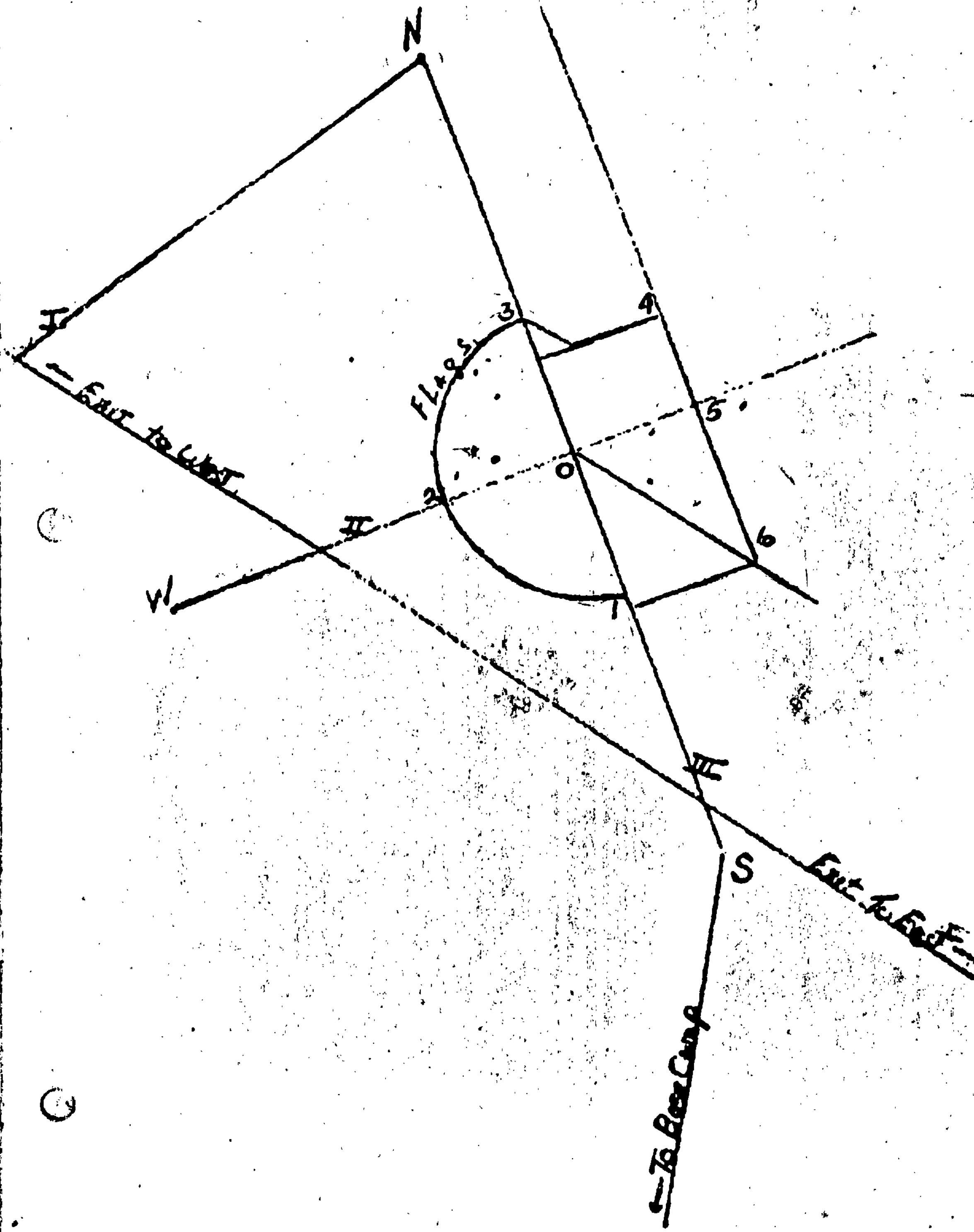
Changes and Supplement to "Site Monitoring"

Captain Nolan and Paul Aebersold



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INTER-OFFICE MEMORANDUM

To: J. G. Hoffman Date: 10 July 1945
From: L. H. Hempelman
Subject: Procedure to be used by Town Monitors

On Saturday afternoon, 7 July 1945, Captain Nolan and I discussed with Lt. Davies, the claims officer for the Trinity project, what procedures should be used to legalize your monitoring records for the outlying country. He asked that you and your monitors keep as complete notes as possible in your own handwriting to be signed and filed away by you for future reference. These notes can be written up more fully at a later date but in any court proceeding it is necessary to present your original data.

We discussed the following measurements which you plan to use and agreed that they should be handled in the following way:

(1) Film sent out by registered mail to neighboring towns:
These will be sent out from Albuquerque by one of Lt. Daley's men who will keep a careful record of the number of each film, the place to which it is sent etc. He will make sure that the films have not been tampered with by carefully examining their containers and will mail one out of each dozen to you in the Technical Area to be developed and kept as a control. You will keep a record of the receipt and the development of these control films.

The films will be collected in the various post offices by Lt. Daley's men within five days after the shot. They will keep careful records as to the registry number of the envelope, the time of collection, etc and will place them in lead boxes provided them by us. They will give the films to you in Santa Fe. You will keep a record of receipts of these envelopes in your own handwriting, will bring them to the Technical Area and will either develop and read them yourself or be with Hornberger when this is done so that you can testify that you have witnessed this operation. It is important that you keep notes of the development and readings in your own handwriting.

(2) Stationary instruments which give permanent records:
Careful notes will be taken by you as to when the instruments are turned on and off, as to when they were calibrated and as to the serial number of the instruments. You will also sign the records and mention the time, place and date.

(3) Earth samples:
These will be collected by the chief monitor (Hoffman) at various points in the shadow of the cloud five ore more hours after the cloud has passed. They will be placed in marked, sealed bottles by the chief monitor who will sign his name to a label on the bottle and will be brought to the Technical Area to be turned over to the chemist for analysis. The chemists will keep careful record of the receipts of the samples and will save the final plates as evidence. If the samples are to be analyzed by Langham in his uncontaminated laboratory, arrangements can be made for Langham to help Hoffman with the collection of samples. It is also important that control samples be taken from the same areas before the arrival of the cloud because of the possibility of natural radio-activity in the earth.

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INTER-OFFICE MEMORANDUM

Date: 10 July 1945

Page two - continued

(4) Observation of monitors other than Hoffman on portable instruments which give no permanent record:

Careful notes will be kept by each monitor as to when he leaves his station, exactly where on the road he stops, the time when he first sees the cloud, its appearance, the readings of his meters exactly at the time that the cloud is overhead, etc. These readings can be verified and vouched for by the G-2 man who will be asked to witness the readings. The serial number of the meters will be kept, and if possible, samples of radio-active material will be used to test the instrument immediately before the reading is made. These records will be signed by the monitor and then turned over to Hoffman who will keep them with his final report. The monitor also will write up a more detailed report on these records. The instruments should be calibrated before and after in the presence of Hoffman who will keep a record for each instrument.

(5) Notes to be kept by Hoffman:

You will keep as complete notes as possible in your own handwriting as to the calibration of all instruments and your movements as you chase the cloud. These notes shall be signed by you and kept together with your final report of the entire incident. All of your records will be kept so that they can be used as evidence in future legal proceedings. You will be the chief witness for off-site contamination.

Since you were not available for this discussion, I would suggest that you go over these details with both Lt. Daley and Lt. Davies.

L.H. Hempelmann, M.D.

cc/ Lt. Davies
Colonel Warren
File

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7/10/45 45

Conference with Hoffman, Col. Warren, Major Palmer, and Hempelman to Decide on Evacuation of Fifty Miles of Clouds Path (on the Basis of a N.E. Blow)

The following tentitive plans were decided upon:

1. Two monitors each on Highways 54 and 380. They will delimit the contaminated path of the cloud by means of numbered markers placed every ¼ mile on Highway 380 and ½ mile on Highway 54. They will check houses but <u>cannot</u> order evacuation unless okayed by Hoffman.

2. Hoffman will be on Highway 380 at the time of the shot. He will remain here until activity has reached peak, will issue evacuation orders if necessary to Major Palmer and then proceed to Highway 54 to evaluate the dangers there.

3. Palmer will provide his own plan as to how to evacuate with troops at hand. Must remain in close contact with Hoffman who is only monitor with authority to order evacuation.

Palmer, Hoffman and Monitors, Camp Hdq. (Col. Warren) and Albuquerque Hdq. (Lt. Col. Friedell) will all have identical maps showing local ranches and houses and markers (for identification) on the main highways. The markers will be placed by members of medical staff at Trinity, the maps with inhabited locations are now being prepared by Lt. Daley's men.

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II-B-5 [redacted]

10 July, 1945

TOWN MONITORING CREW, FINAL INSPECTIONS

The radiation monitoring crew will assemble on Sunday, 15 July 1945, in the Technical Area at room T-13 preparatory to leaving at 10:00 AM for Santa Fe. There they will contact Lt. D. Daley's men at room 128, La Fonda Hotel, after which they will be assigned to cars in pairs, one G-2 man with one monitor in each car. The names are as follows with the towns at which they are stationed. Instruments will be picked up at 109 East Palace Avenue; these instruments will have been deposited there by T/4 Phil Levine and T/3 Bob Leonard on the previous Friday.

MONITOR	G-2 MAN	STATIONED AT
T/4 Phil Levine	Julian Bernacci	Carrizozo, Nogal
Mr. Alfred Anderson	Lee Porter	Carrizozo, Capitan
T/5 Joel Green	Charles Nally	Roswell
T/3 Bob Leonard	Richard Foley	Ft. Sumner
T/5 Carl Hornberger	William Devlin	Artesia
Joseph G. Hoffman		Carrizozo

Successful monitoring depends to some extent on inter-communication. As soon as a monitor has seen the cloud and made measurements of what he judges to have been its trail of activity he should telephone to Albuquerque as soon as possible. This will enable the headquarters at Albuquerque to advise any other monitor who has not yet seen the cloud as to where it may be expected.

In the above table where there are two names of towns the G-2 man is stationed at Carrizozo. When he has been alerted by radio that the shot will go off he will procede to the second named town and wait. His instructions are to wait until 45 minutes after the scheduled time of shot. If he has not seen or heard any signal to indicate that it went off he will phone back to headquarters for more information. If the shot goes off as scheduled he will procede to Carrizozo to report to Lt. Daley. Then he will drive in the direction indicated by the radiation monitor.

The directions taken by the monitors will depend on whether it is a North blow or a South blow. This information is gotten when the G-2 man calls up headquarters or is alerted. Specific instructions as to the movement of the monitors in each case are given below:

<u>T/4 Phil Levine</u> in the North blow will arrive at Carrizozo from Nogal and proceed NW along 380 about 10 miles. By that time the cloud should be discernable and he should guess as to where it will cross the road 380. There he will take control samples of earth, drive stakes in the ground for future reference. After the cloud has passed he will take samples of contaminated earth near the stakes. The stakes should be left in the ground. After he has taken readings with the gamma and alpha meters he will hurry back to Carrizozo to report to Albuquerque and to Hoffman.

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In the South blow he will move from Carrizozo South along road 54 about 15 miles and look for the cloud there. He will make the same measurements as outlined above and go back to Carrizozo to report to Hoffman, and telephone Albuquerque.

Mr. Alfred Anderson will arrive at Carrizozo from Capitan. In the North blow he will procede North along road 54 about 18 miles and after locating the cloud carry out the measurements as indicated above for Levine and return to Carrizozo to phone Albuquerque and report to Hoffman.

In the South blow he will drive SE along 380 to Hondo. (Hoffman will follow him) He will then go along 70 toward Hollywood to see where the cloud crosses 70 and make measurements there. Then the data will be phoned to Albuquerque from the nearest phone. Hoffman will contact him for his results and procede to Roswell.

T/5 Joel Green

In the case of the North blow he will move N along 285 to a point 10 miles beyond the junction of roads 20 and 285 toward Ramon. He will try to locate the cloud and find where it crosses the roads and make measurements. These should be phoned to Albuquerque from the nearest phone station. Hoffman will be at Vaughn to hear from headquarters of Green's report.

In the South blow Green will move along 285 to a point 2 miles South of Hagerman and try to locate the point where the cloud crosses the road. Roughly, it should take 4 hours for the cloud to get there. After he is certain that the cloud has passed, or should have passed (allow 8 hours time) he should make measurements at Lake Arthur, Hagerman and Dexter.

T/3 Robert Leonard

In the North blow will wait until information from Albuquerque reveals approximately where the cloud may come. He will move East along 60 and make measurements near Tolar, Melrose, Clovis and Portales. He should allow 8 hours for cloud to pass. At Clovis and Portales he will see that the recording fission products meters and Filter Queens are in operation throughout the remainder of the day. Hoffman will have come over from Vaughn to check his readings.

In the case of the South blow Leonard will procede along the same course and make the same measurements as above.

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T/5 Carl Hornberger

In the case of South blow, will move East along 83 toward Lovington. Before doing so he should wait at least 8 hours or until he can see the cloud. If he can see the cloud he should find where it crosses 83, which may be at a point East or West of Artesia. Measurements should be made at this crossing. If the cloud does not appear discernable after 8 hours he should plan to make measurements at Artesia in any case and procede East along 83 and make measurements at Maljamar and Lovington and Hobbs.

In the North blow he should make measurements at Artesia, Maljamar, Lovington and Hobbs.

Monitoring Equipment

a) Alpha and gamma survey meter (to be supplied at Santa Fe)
b) Rags or rubber cushion for carrying meters in the auto, the roads are bumpy.
c) Searchlights with which to read meters in the dark.
d) A compass in order to interpret directions that may come from Albuquerque. A foot rule (12")
e) A notebook and pencils for recording data.
f) Ten large mouthed liter bottles for samples of earth. Red or black wax chemistry pencils for writing on glass for labeling the bottles.
g) New Mexico Official Road Map.
h) Two respirators and 2 pairs cotton gloves.

Cloud Detection

The cloud will be preceded by a series of lighted balloons to be released by Mr. Hubbard. These may be invisible at high altitudes. It seems certain that two airplanes will follow the cloud. One airplane crew has instructions to follow the cloud for as much as 8 hours (Waldman's crew). The meteorlogists expect to fly near the cloud but not for a time long enough to be useful to monitors.

[redacted]

[redacted] IL-B-6

10 July 1945

INSTRUCTIONS FOR MONITORS

THIS DOCUMENT CONSISTS OF 1 PAGE(S)
NO. 7 OF 15 COPIES, SERIES A

I. Keep ample notes on your itinerary. The following items are pertinent to an adequate record:

a) Where you are stationed.
b) How you left station to go on a monitoring trip.
c) Time you saw flash or heard blast.
d) When did you see any lights or signals or airplanes?
e) When was cloud first visible? When did it pass over you? (Or near you)?

II. Radiation Record:

a) When were instruments first turned on. Test the meter with a source. Have someone witness the test or see the operation of the meter before radiation appears.
b) Have a witness to any radiation readings. Note the time and place of reading. If cloud is visible take readings in the interval up to five hours after it has passed.
c) Note in detail any weather conditions such as wind(direction) or rain or fog; or just sunshine.

III. Earth Samples:

Earth samples one foot square and one inch deep should be taken. The time at which they are taken and the position of the area relative to the path of the cloud should be given in detail.
Control sample of earth should be taken at a given place before the cloud has passed. For example, if the cloud is visible in the distance the monitor should make a guess as to where it will cross the road he is on. At that approximate place before the cloud passes a control ground sample should be taken. After the cloud has passed, a test ample is taken nearby. Obviously the sampling should be done on earth which is free from covering such as weeds and grass.

IV. Keep detailed notes on all occurrences. Time(hour)and place; if your car breaksdown, if you see someone you know, if anyone asks questions (after the sho if you see any airplanes, any gatherings of people.

cc: Joel Green
Alfred Anderson
Bob Leonard
Phil Levine
L.H. Hempelmann

[redacted] [redacted]

ARMY SERVICE FORCES
UNITED STATES ENGINEER OFFICE
P. O. BOX 1539
SANTA FE, NEW MEXICO

IN REPLY REFER TO

EVACUATION DETACHMENT AT TRINITY

I. Detachment, Equipment, Personnel, Organization, Base Operations

A. Equipment and Personnel

This detachment consisted of 140 enlisted men, 4 officers, 140 vehicles, including one 500 gallon improvised water tank for drinking purposes, 2 lister bags, latrine flies, 30 pyramidal tents, 1000 type "C" and "K" rations, coffee, sugar, milk, and 3 field ranges.

B. Organization

The detachment was formed into four platoons of nine vehicles each. The first and second platoons made-up the first section under the Command of Capt. Huene. The third and fourth platoons made-up the second section under the Command of First Lt. H. Miller. Each vehicle had a driver and two men; three jeeps, under the direct supervision of the detachment Commander to act as messengers; one two-way radio vehicle.

C. Operating Base

The detachment moved into its bivouac area 14 July. For security reasons this area was 40 miles from Trinity; the detachment remained there until the morning of 15 July, then moved to s semi-permanent Base Camp, with an alternate base site selected. The Base Camp was set-up as a company; latrine dry flies put up; lister bags hung, and field ranges set-up. The rest of the day and night was spent in briefing the men and having the section leaders and drivers familiarize themselves with the roads and dwellings in their assigned sections, and visiting Trinity headquarters for instructions. The Base Camp was approximately nine miles from Zero. The detachment Commander returned to Base Camp from Trinity around mid-night 15 July with last minute instructions. Major Miller was assigned the radio vehicle and put in Command of the Base Camp. The detachment was alerted in case the wind shifted in that direction, so it could quickly move to the alternate site.

D. Operations

The orders received by the detachment Commander from

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General Farrell were generally as follows:

1. The two prepared press releases were made known to the detachment Commander. One in case of no evacuation, which stated briefly that an ammunition dump had blown up; and one in case of evacuation, which stated that an ammunition dump had blown up which contained gas shells and the people would be evacuated for 24 hours to protect them from the gas.

2. The detachment Commander would work with Mr. Hoffman and Mr. Herschfelter, with their crew of monitors, and was to evacuate upon Mr. Hoffman's request.

The detachment Commander planned, in case of evacuation, to set-up the base camp as a shelter for the people; tents and shelters would be provided to cover and feed 450 people for two days. This was ample shelter for the small population centers that were close enough to be in immediate danger. The larger centers were some distance away and there was ample time to transport them to Alamogordo Air Field and house them in barracks. In cases of one or two families, it was planned to send them to a hotel in a near-by town.

The area in the vicinity of the shot was divided into sections and each section leader was responsible for his section, with additional help if needed.

A jeep was assigned to Trinity headquarters, Major Miller at Base Camp, and to the detachment Commander during the operation, to supplement radio communications.

Immediately after the shot, the wind drift was ascertained to be sure the Base Camp was not in danger. Monitors were immediately sent out in the direction of the cloud drift to check the approximate width and degree of contamination of the area under the cloud. A small headquarters was set up at Bingham, near the center of the area in the most immediate danger. The monitors worked in a wide area from this base reporting in to Mr. Hoffman or Mr. Herschfelter. One re-enforced platoon, under Captain Huene, was held at Bingham; the rest of the detachment was held in reserve at Base Camp. Fortunately, no evacuations had to be made.

Mr. Hoffman released the detachment about 1300 hours 16 July; by that time, any danger of serious contamination had passed.

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The detachment Commander would like to take this time to say that the Officers and men of the detachment were alert, obedient, and conducted themselves in a superior manner throughout the experiment.

T. O. Palmer

T. O. PALMER, JR.
Major, C. E.
Detachment Commander

[redacted]

FINAL PLANS FOR MONITERING AND EVACUATION N.E. AND N.W. REGIONS AS OF

14 July 1945

All personnel will meet with Hoffman and Friedell at noon 15 July 1945. They will receive these instructions and will be sent out with Daley's men to the following regions:

Alfred Anderson	at Carrizozo, Captain (with Porter)
Joel Greene	at Roswell (Nally)
Carl Hornberger	at Ft. Sumner (with Foley)
Bob Leonard	at Soccoro (with G-2 man)

These men will not leave their stations until they get in contact with Col. Friedell in Albuquerque. They will call him 30 munutes to one hour after the scheduled time of the shot to obtain information about wind direction, velocity, height of cloud and approximately where it will cross the road on which they are stationed. They will call back every hour except for those persons in Carizozo and Socorro who will call every half hour. When they obtain this information, Anderson will proceed north along Highway 54 and wait for the cloud, Greene will go north on Highway 285, Hornberger will travel east on Highway 60, Leonard will go west on Highway 60 to Magdelina or beyond. They shall keep records of measurements, shall take control earth samples in the path of the cloud, etc. exactly as in Hoffman's Instructions of 10 July 1945. They will stake out where the cloud passed the highway so that Hoffman and Langham may take earth samples at these places within 24 hours. They shall also record the direction and approximate strength of ground winds as the cloud passes overhead.

The remainder of the moniters shall gather with Major Palmer's men at Post II. This party will consist of Hoffman, Hirschfelder, Magee, Levine and Langham and will have four vehicles, and three radios in addition to the one at the Guard house. They will remain at their station until they obtain information by radio from the base camp about the height of the cloud and the direction. In the case that the cloud moves to the northwest,

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Magee will proceed with a small detachment of Palmer's men including an officer along the south road to evacuate two families. They will either continue south if the case contamination is heavy or will retreat back along their path to Highway 380.

Langham will proceed with another detachment along the Highway 380 to evacuate the "Telephone" Ranch.

Hoffman and Hirschfelder will leave for Highway 85 together with Major Palmer. They will meet another detachment of Palmer's men who will be able to evacuate this region.

In case the cloud moves to the northeast, all of the moniters will proceed east along Highway 380 to the place where the cloud crosses the road. After the cloud passes the nearest Highway, Hoffman and Hirschfelder will follow the cloud as far as possible, and confer with the moniters, calling in their information to Col. Friedell in Albuquerque.

Addendum: The moniters who are in the opposite direction to that taken by the cloud shall remain for 8 hours and then only after calling Col. Friedell. They will take an earth sample at eight hours and bring it to Langham/Hoffman in the Technical Area where a receipt must be signed.

Recording instruments have been placed in Carrizozo, Tularosa, Hot Springs, San Antonio, Socorro and Madgelena. They will be collected by Hoffman within 24 hours.

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PLANS FOR TRINITY SITE MONITORING 1 July 1945

1. Stationary red flags have been set up around circular road and fire-breaks between 2000 and 3000 yards from zero. This area will be well beyond the extent of danger from either alpha or gamma radiation. The flags are six feet high and about 50 feet apart. They can be seen easily by people on foot, in cars or on horseback. The flags will act as windsocks for the initiated who need to approach the crater area. Besides the red flags there will be available just before or just after the shot, twelve signs in English and Spanish warning inquisitive casuals that this is a dangerous area. These signs will be placed at the six access points to the crater marked in the diagram as 1, 2, 3, 4, 5, and 6.

2. Since it will be impossible to get all the necessary personnel into the shelters at the time of the shot and since the calculated blast pressure and frequent trajectory of the full scale shot will be innocuous it will not be necessary for the monitors to insist that everyone is in the shelters. However, the monitors will insist that personnel stand behind the shelter and do not look directly at the flash.

3. At the shelters the doctors acting as monitors will be supplemented by technicians from Mr. Watts' group. This will have to be done because the M.P. guards who will be in the shelters at the time of the shot will have to move toward the crater to set up road blocks at the access points from the main road. These are marked on the diagram as I, II, III. The technicians will take the portable meters from the shelters to these road blocks and monitor the guard station for the length of time it is necessary as ascertained by the tank and sentinel measurements. If it is necessary to maintain these road-blocks for an indefinite length of time, the men will monitor these spots by traveling back and forth along the road in shifts.

4. The doctors at the shelters can after the shot check the personnel as to equipment and transportation and escort men back to the Base Camp.

5. The tank personnel will be checked immediately before going in by Aebersold.

6. Hempelmann will replace Nolan on the "Going-in Board". This will be set up after the shot as described before. However, the equipment, meters and badges will be checked by Aebersold. Aebersold and any other necessary monitor will follow each recovery team to a safe distance and be available in case of accidents. On return of each recovery expedition the personnel will report in to the "Going-in Board" and surrender meters and monitoring apparatus. Nose counts and personal decontamination will be carried out at S 10,000 before return to Base Camp.

7. As long as the Camp is maintained there will be a number of the monitoring group present. The Base will be evacuated of all unnecessary personnel as soon as possible. The recovery of apparatus will take place as soon as feasible and after one to two weeks the crater

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area will be treated in order to find the contaminated dust. Until this is done Lt. Bush will guard the area from casuals and monitoring activities will continue to protect the guards and essential staff.

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TO: L. H. Hempelmann

FROM: P. C. Aebersold

SUBJECT: TR SITE MONITORING PLANS AS OF JULY 11, 1945
(Supplement to Medical Hazards of TR #2 by Capt. Nolan)

I. <u>General Functions & Responsibilities</u>

The anticipated functions of the TR Site Monitoring Group, headed by the author, are as follows:

1. To monitor, or see that proper monitoring is provided for, all site personnel who may be exposed to above-tolerance-limit amounts of penetrating radiation and/or radioactive materials. (Both before and after the shot.)

2. To monitor and mark the safe limits of approach of the contaminated area.

3. To monitor the base camp and roads skirting the contaminated area for possible contamination.

4. To provide and advise the use of, as deemed necessary, protective and monitoring equipment, such as coveralls, gloves, booties, masks, film badges, and radiation meters.

5. To keep a record of exposures received by site personnel. It is understood that it is the responsibility of the Project Director and his designated representatives to engage the cooperation of all site personnel in these functions of the Site Monitoring Group. Cooperation is particularly requested in the proper use of protective equipment and the constant wearing of monitoring films. It is further understood that the responsibility for policing (denying entrance to) and for granting permission to enter regions designated as unsafe will be taken only by the Project Director or his authorized representatives. Permission to enter the unsafe region of contamination after the shot will be granted only by the "Going-in Board", composed of Bainbridge, Hempelmann, and Weisskopf.

The Site Monitoring Group will have four functions in connection with the "Going-in Board" as follows: (1) To report to the Board the location and marking of safe limits of approach to the contaminated area; (2) To be advised of all personnel granted permission to enter the unsafe area and consequently to see that the personnel enter with proper protective and monitoring equipment; (3) To obtain from personnel upon leaving the unsafe area records of exposures received (meter readings, film badges, and nose swipe counts); (4) To examine the personnel and equipment coming from contaminated areas for advisable decontamination measures and to aid if necessary in such measures.

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II. Details of Monitoring Plans

A. Before the Shot:

1. Handling of Active Material & Final Assembly:

The Head Monitor (the author) should be advised of all persons who will handle active material or who will be near the final assembling procedure. These persons will be requested to wear at such times "Catastrophe" film badges capable of recording large exposures. Protective clothing and respirators may by advised during certain operations with active material. In addition, persons handling active material will have hand and nose counts taken.

2. Flagged Area

Stationary red flags have been set up in advance around circular road and fire-breaks between 2000 and 3000 yards from zero. This area is expected to be well beyond the danger from either alpha or gamma ground contamination after the shot. The flags are six feet high and about 50 feet apart. They can easily be seen by people on foot, in cars, or on horseback. The flags will also act as windsocks for the initiated who may need to approach the crater area. Besides the red flags there will be available twelve signs in English and Spanish warning inquisitive casuals that this is a dangerous area. These signs can be put up just before or just after the shot and will be placed at the six access points to the crater area marked in the appended diagram as 1, 2, 3, 4, 5, and 6. The flagged area and the access points may also serve as a preliminary clearance region during final assembly operations.

3. Clearance of Shot Area

It is understood that the Head Monitor will be available to work with the Guard Captain, Lt. Bush, in clearing the area to the 10,000 yard shelters prior to the shot and in making the last check of preparedness at the shelters.

B. Time of Shot - Immediately Preceding and Following

1. Equipment available at 10,000 yard shelters

(1) A respirator or gas mask for each person.

(2) Resistant film badge and regular pencil chamber for each person.

(3) Coveralls for each person.

(4) Welders filter for persons who may be where light flash is visible.

(5) Vehicles satisfactory for evacuation of all personnel.

(6) A vehicle for use of the monitoring technician and M.P. to use in road survey and control.

(7) A vehicle for the use of Moon's special monitors after other personnel have left the shelter.

(8) Portable gamma meters - one for the monitoring tech-

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[redacted] 11 July 1945

nician on road surveys and one for the doctor when evacuating personnel. Should have sensitive as well as less sensitive (up to 1 r/hr) instruments.

(9) One portable alpha meter.

(10) One Filter Queen

(11) At South Shelter - nose swipe and hand counting equipment.

2. Duties of Monitoring Technician

(1) Be responsible for placement, operation, and reading of the monitoring equipment - checking the instruments with standard sources at frequent intervals.

(2) Take readings with the gamma and alpha instruments outside but immediately behind his shelter - readings say every 1/2 hour before the shot and almost continuously a few minutes preceding and following the shot. Readings should be recorded in legally satisfactory manner - giving times, location, instrument number, latest calibration time, initials of monitor, and witness of the doctor monitor.

(3) Take a Filter Queen air sample outside the shelter in advance of the shot for a background and start a sample collection immediately after the shot. Care should be taken not to contaminate the samples during handling and transport to Base Camp (put in closed jars, for example.)

(4) Survey the area around the shelter soon after the shot before personnel proceed away from behind the shelter.

(5) Succeeding duties of road monitoring, etc., given in next section.

3. Duties of Doctor

(1) Be responsible for placement at shelter of protection equipment and evacuation vehicles.

(2) Check that all personnel at the shelter are wearing film badges and are provided with respirators and coveralls.

(3) Advise personnel at the shelter concerning proper protection from blast, light, and radiation, as follows:

(a) There is little expectation of danger from blast or fragments or from direct pulses of gamma rays and neutrons at 10,000 yeards; even the eardrums should not be affected. However, for perfect safety, all those who can perform their function at the shelter either inside or directly behind the shelter should be urged to do so.

(b) There is insufficient knowledge on the amount of light coming from the reaction and on the damage of brilliant flashes to the eye to permit the Medical Group to recommend the

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safety of looking at the original flash even through a one to 5,000 reduction welder's filter. Although the latter procedure may be safe, the Medical Group will not take the responsibility for any ensuing eye damage. The recommended procedure for viewing the flash is to look in the opposite direction until one sees the sky light up, turn around with the welder's filter in front of the eyes, remove the filter only when the light looks pale.

(c) If the alpha count in the air around the shelter by Watts' portable proportional counter reaches 5 counts/min, the personnel should be advised to put on respirators.

(d) If the gamma intensity around the shelter approaches 1 r/hr, the doctors should advise immediate evacuation from the shelter proceding away from zero. During any evacuation, normal or otherwise, respirators or masks should be worn by all personnel.

(4) Witness and aid in recording the readings of the monitoring equipment.

(5) Responsibility for policing personnel to stay within prescribed limits or follow suggested procedures is not the function of the doctor. The Project Director should assign that responsibility to the M.P. or other representative at the shelter.

C. <u>After the Shot</u> - <u>Shelter Evacuation & Road Monitoring</u>

1. <u>Duties of Monitoring Technician</u>

(1) After surveying the area around the shelter and as soon as feasible, start the gamma intensity survey of the proposed normal evacuation road to Base Camp. This is to be done in the company of the M.P. who will allow no one to advance ahead of the monitor. The doctor will stay with the shelter group and later escort them as a party (except for Moon's special monitor) to Base Camp. Masks will be worn by all personnel coming along the roads, since the preliminary monitoring will be for gamma and not alpha contamination. If the gamma intensity approaches 1 r/hr along the course, return to the shelter and use the alternate evacuation road leading farther away from zero.

(2) Assist in setting up temporary road block stations by the M.P.'s as follows (using masks and staying below 1 r/hr):

(a) The N shelter monitor will procede with the M.P. on the road leading west until the main road is reached, point I on the appended diagram. The gamma and alpha intensity will be carefully monitored at this station and, if they are below tolerance, the M.P. will be stationed there. The M.P. will prevent anyone except monitors or the Guard Captain from proceding to N shelter or along the main road from I to II. Orders to permit persons along these blocked routes will come from the Guard Captain or designated representative of the Project Director. The monitor will stay with the M.P. at I until the Head Monitor and/or Guard Captain arrive. Passage along the main road from I to III will then be permitted if the Head Monitor has signified its safety.

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(b) The W. Shelter monitor will procede observing the same precautions with his M.P. going east to point II. The M.P. will be stationed here if the radiation levels are below tolerance and the monitor will stay with the M.P. till the Head Monitor and/or Guard Captain arrive. This M.P. will deny entrance to anyone toward zero on the W-E radial road until ordered to do otherwise. Passage along the main road from II to III or II to I will also be denied until the Head Monitor arrives to signify the safety of such passage.

(c) The S Shelter monitor will procede in a similar manner with his M.P. to point III, station the M.P. there if the radiation intensities are below tolerance, and stay with the M.P. until the Head Monitor arrives. The M.P. will deny passage toward zero along the S-N radial road and also along the main road from III to II to all but the Head Monitor and Guard Captain.

(d) The Head Monitor and Guard Captain will immediately after the shot leave Base Camp and monitor the road to S Shelter. They will then monitor the main road from III to I, giving instructions depending on the results to the M.P.'s and monitors at III, II, and I.

(e) The monitors will then signal or return and notify the doctor at his shelter whether normal evacuation to Base Camp is possible. Masks will be used until the monitors have time to certify the alpha safety of the air along all routes.

(3) Check on the safety of the M.P. and any personnel who may have remained at the shelter until the Head Monitor signifies that such is no longer necessary or provides relief.

2. Duties of Doctor

(1) Look for signs of any possible personnel injury.

(2) Aid in reading the monitoring instruments.

(3) Advise wearing of masks or rapid evacuation, if necessary, as already indicated.

(4) Monitor the shelter after the monitoring technician has left to monitor the road.

(5) Escort the shelter personnel as a group back to Base Camp.

(a) After notification that the entire normal route is safe.

(b) Keep the group together waiting until all (except the special monitor of Hoon's group) are ready to leave, which should be within 30 minutes.

(c) Advise all personnel to wear masks, check and record the gamma intensity observed along the road to camp.

(d) See that any personnel who may have to remain have adequate transportation and that the monitoring technician or other person will be back to check on their safety and escort them finally to Base Camp.

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[redacted] 11 July 1945

3. Alternate Evacuation Procedures

In case the gamma intensity is greater than 3 r/hr along the normal proposed evacuation routes at N and W shelters (S Shelter having a direct road away from zero to Base Camp), the doctor or monitoring technician will be advised of the evacuation procedure by the Head Monitor or Dr. Hempelmann. The alternatives are:

(1) Wait and procede along the normal route when it is calculated that the integral dose is not excessive.
(2) Use alternate exit routes which will be available away from zero.

In other respects the procedure should be as discussed above. Road blocks will however then be determined by the Head Monitor and Guard Captain.

D. After the Shot - Contaminated Area Monitoring & Marking

1. After most of the personnel have been escorted back to Base Camp and temporary road blocks have been established, the Site Monitoring Group will meet with the "Going-in Board" to discuss setting further safe limits and road blocks around the contaminated area. In a few hours results from Moon's monitors will be available to aid in the plans.

2. The Monitoring and/or Medical Group will accompany the tank groups to their tanks and give the monitoring and safety equipment a last minute check.

3. After the tank groups and Moon's monitor results are in, the Site Monitoring Group will have a basis for monitoring farther toward zero. After 4 to 8 hours safe limits of approach along most roads will have been established.

4. The Site Monitoring Group will cooperate with the "Going-in Board" as discussed under General Functions. All "Going-in" personnel will be escorted to the safe limits and checked for safety and monitoring equipment. On coming out the personnel will be measured for contamination and records made of their exposure. Checking-in and-out station will be at 10,000 yard S Shelter.

cc/ R. Oppenheimer
K. Bainbridge
F. Oppenheimer
S. L. Warren
Monitoring Group (10)

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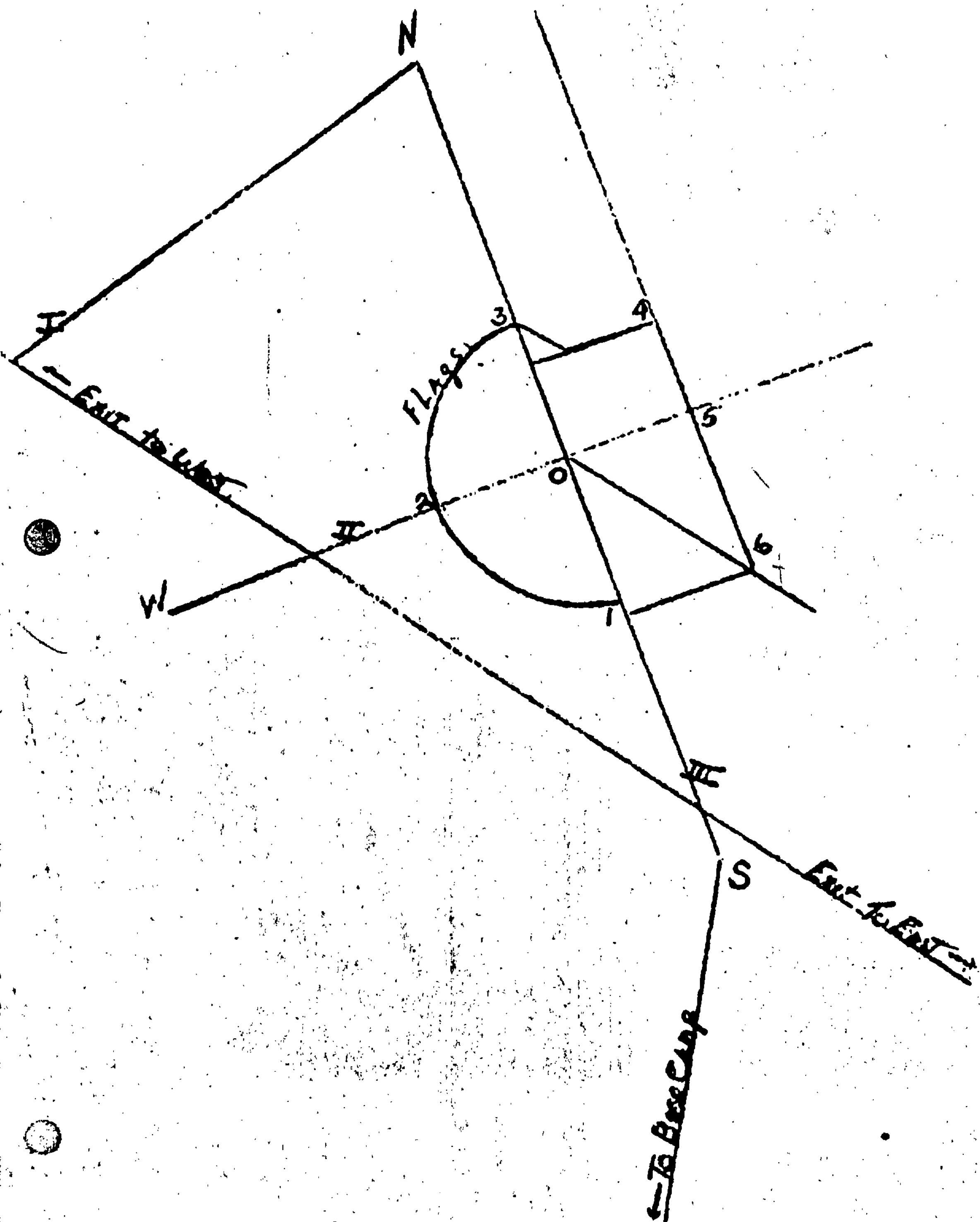
Changes and Supplement to "Site Monitoring"

Captain Nolan and Paul Aebersold



APPROVED FOR PUBLIC RELEASE

K. T. Bainbridge June 7, 1945

H. L. Anderson

Operational Plans for Trinity

In the following we give a tentative schedule of the sampling group for the Trinity shot insofar as it can be imagined at the present time.

-2 hours All sampling personnel at the base camp. Tanks, Weasel and fuel truck parked at south 10,000.

1/2 hour Sampling personnel leave base camp with carryalls and sedans.

Survey Operation

1 1/2 hours The tanks will approach crater as follows:

a. White tank along south road toward zero.
   Driver: Sgt. Smith
   Observer: H. L. Anderson

b. Silver tank around 3000 yard circle along west road to zero.
   Driver: Sgt. Brothers
   Observers: G. Wel, E. Fermi

c. Weasel will follow 1000 yards behind silver tank.
   Driver: Sgt. Banas
   Observers: D. Nagle, L.D.P. King

d. Carryalls will remain at south 10,000 to receive radio reports.
   Operators: J. Twombly, H. Heskett, A. Novick, J. Tabin, A. Turkevich, V. Cannon

Both tanks will proceed toward zero along the tank right of way until each enters an easily measurable radiation field of about 1 R/hr. From the distance and the time after the shot the time scale of subsequent operations will be determined from previously prepared charts. The observers in the tanks will determine not only the general radiation level above the gound but also what fraction of this comes from active material present on the ground

Sampling Operation

In what follows it is assumed that the yield is 5000 tons and that the distribution of active material scales from the 100 ton shot. The radiation intensity

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as a function of the time in hours and the distance in meters is shown on the accompanying graph. The tables below give the time schedule and radiations which will be encountered by the tanks in their sampling operations. A shielding factor of 17 for the white tank and 3.6 for the silver tank is estimated from the absorption data of Borst (C 217). Positive pressure masks are always put on inside 800 meters.

a. White tank along south road toward zero.
Driver: Sgt. Smith
Observer: H. L. Anderson

Time Hours	Distance Meters	R/hr Outside	R/hr Inside	Accumulated R
2	800	0.9	.05	.01
2.25	600	4.5	.27	.08
2.50	500	11.7	.69	.25
2.75	400	36.0	2.16	.80
3.00	350	52.5	3.15	1.58

b. Silver tank at south 1000 at 2.50 hours
Driver: Sgt. Brothers
Observer: D. Nagle

c. Weasel at south 1000
Driver: Sgt. Banas
Observer: L. D. P. King

d. Carryall #1 at south 3000
Operators: H. Heskett, A. Turkevich

Carryall #2 at west 3000
Operators: J. Twombly, E. Hoagland

The white tank checks its position by the flagpole when it reaches 500 meters. The white tank now returns to south 3000. The samples are delivered, the air is changed, and the tank goes along the west road.

a. White tank along west road
Driver. Sgt. Brothers
Observer: D. Nagle

4.50	800	.36	.02	.006
4.75	600	2.1	.13	.036
5.0	500	5.	.31	.114
5.25	400	14.	.84	.324
5.5	350	22.	1.32	.654

b. Silver tank at west 1000
Driver: Sgt. Smith
Observer: H. L. Anderson

[redacted]

c. Weasel at west 1000
Driver: Sgt. Banas
Observer: L. D. P. King

d. Carryall #1 at south 3000
Operators: H. Heskett, A. Turkevich

Carryall #2 at west 3000
Operators: J. Twombly, E. Hoagland

The first rocket launching operation by the silver tank takes place at plus 12 hours from south 300. The white tank is at west 300 to observe the rocket positions. The white tank returns to south 3000, changes air, delivers samples.

a. The white tank at west 300
Driver: Sgt. Smith
Observer: H. L. Anderson

	Time Hours	Distance Meters	R/hr Outside	R/hr Inside	Accumulated R.
White Tank	12		13.3	.76	.76

b. The silver tank at south 300
Driver: Sgt. Smith
Observers: G. Weil and M. Gentry

Silver Tank	12		13.3	3.7	3.7

c. Weasel at south 1000
Driver: Sgt. Banas
Observer: L. D.P. King

d. Carryall #1 at south 3000
Operators: H. Heskett, A. Turkevich

Carryall #2 at west 3000
Operators: J. Twombly, E. Hoagland

It is assumed that the launching and spotting of 10 rockets will take one hour. The silver tank drags the rockets back out to 1000 meters where they are loaded on a carryall and brought back to base camp.

a. At 24 hours the white tank returns along the south road to zero to collect further samples.
Driver: Sgt. Smith
Observer: J. Tabin

[redacted]

K. T. Bainbridge June 14, 1945

Time Hours	Distance Meters	R/hr Outside	R/hr Inside	Accumulated R
27.00	300	4.5	.25	.065
27.25	250	6.6	.38	.16
27.50	200	10.9	.62	.31
27.75	150	18.0	1.02	.57
28.00	100	28.5	1.62	.97
28.25	50	49.5	2.81	1.67

b. The silver tank at south 1000
Driver: Sgt. Brothers
Observers: G. Weil, and, M. Gentry

c. The Weasel at south 1000
Driver: Sgt. Banas
Observer: L. D. P. King

d. Carryall #1 at south 3000
Operators: H. Heskett, A. Turkevich

Carryall #2 at west 3000
Operators: J. Twombly, E. Hoagland

The second rocket launching operation takes place from west 300 the next day with

a. The white tank
Driver: Sgt. Brothers
Observer: D. Nagle

White Tank	29.5		4.07	.23	.23

b. The silver tank
Driver: Sgt. Smith
Observer: G. Weil, M. Gentry

Silver Tank	29.5		4.07	1.13	1.13

c. Weasel at west 1000
Driver: Sgt. Banas
Observer: L. D. P. King

d. Carryall #1 at south 3000
Operators: H. Heskett, A. Turkevich

Carryall #2 at west 3000
Operators: J. Twombly, E. Hoagland

[redacted]

The final sampling operation of the white tank is made along the west road.

a. The white tank
   Driver: Sgt. Brothers
   Observer: D. Nagle

Time Hours	Distance Meters	R/hr Outside	R/hr Inside	Accumulated R
31.5	300	3.8	.22	.05
31.75	250	5.7	.33	.14
32.0	200	9.4	.54	.27
32.25	150	15.5	.88	.49
32.5	100	24.6	1.40	.84
32.75	50	41.5	2.37	1.53

b. The silver tank
   Driver: Sgt. Smith
   Observer: H. L. Anderson

c. Weasel at west 1000
   Driver: Sgt. Banas
   Observer: L.D.P. King

e. Carryall #1 at south 3000
   Operators: H. Haskett, A. Turkevich

   Carryall #2 at west 3000
   Operators: J. Twombly, E. Hoagland

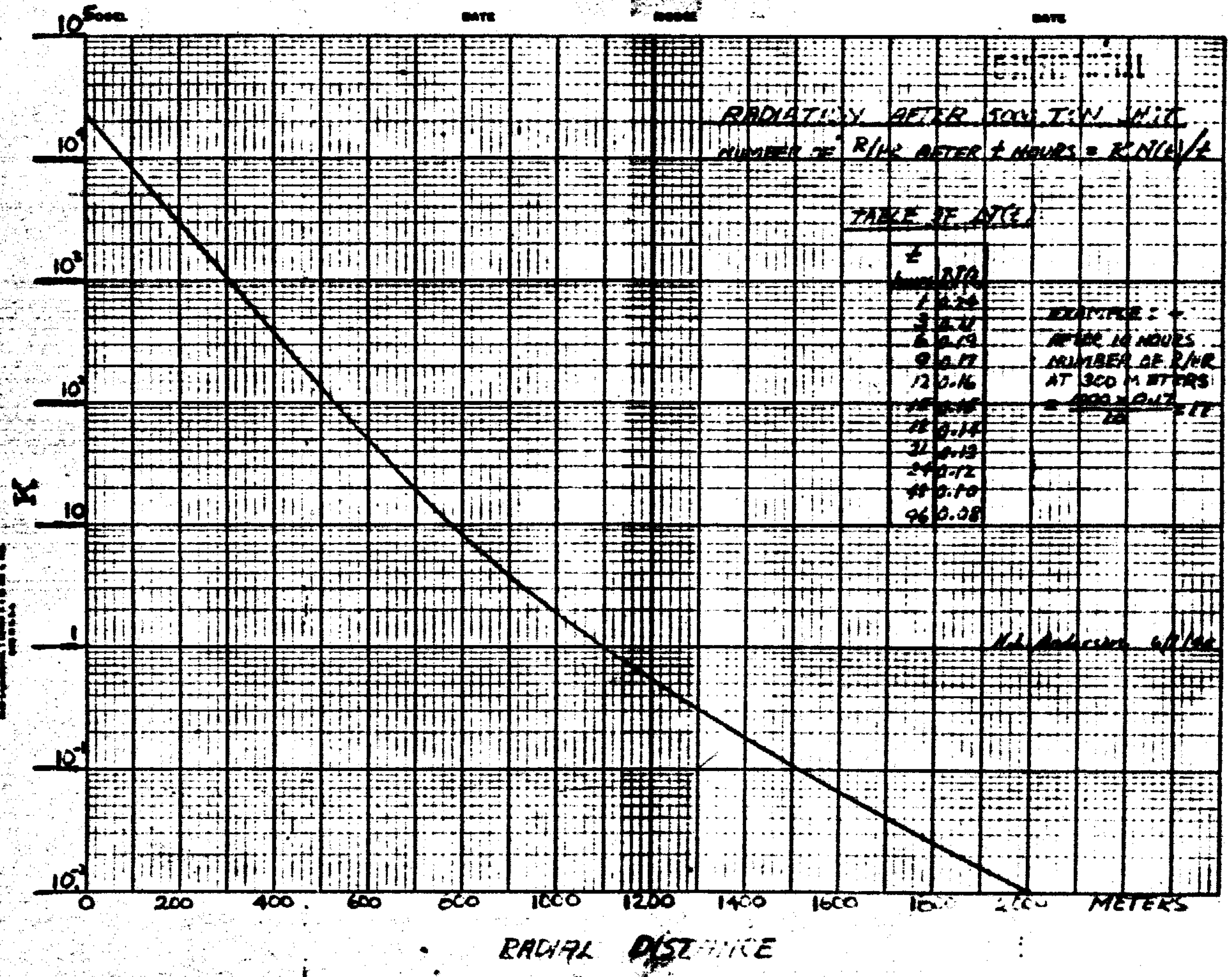
Accumulated dosages are:

	Total
Sgt. Brothers	6.11
Sgt. Smith	5.00
H. L. Anderson	2.34
D. Nagle	2.41
G. Weil	4.83
M. Gentry	4.83
J. Tabin	1.67
Sgt. Banas	.3
L.D.P. King	.3

H. L. Anderson

HLA:ah
att.

cc: L. Hempleman, Capt. Nolan, Cdr. Keeler, John Williams, D. Nagle, G. Weil, File



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[redacted]

HEADQUARTERS

SPECIAL SERVICE DETACHMENT

14 July 1945

MEMORANDUM TO CAMP PERSONNEL:

1. The First Sergeant will see that all windows in all buildings are removed and all doors are braced or hooked open.

2. The First Sergeant will be responsible that all personnel are awakened and are out of all buildings not later than minus one hour.

3. The First Sergeant will be responsible to see that all military personnel pack their belongings, equipment, and effects in barracks bags and footlockers by minus two hours.

4. The Post Engineer and aids will be responsible that all available vehicles are serviced and ready for use, complete with drivers, at the central point in camp selected by him, not later than minus two hours.

5. In the event of evacuation of the Base Camp (as determined by the Senior Medical Officer) the Post Engineer will supervise and take charge of loading and unless time and vehicles permit otherwise, baggage to be carried will be limited to toilet articles, as determined by the Post Engineer. The Senior Medical Officer, and Post Engineer will supervise evacuating of all personnel. The route of evacuation will be determined by the Post Engineer on the advice of the Medical Officer.

6. The refrigerator truck will be serviced and parked at the rear of the mess hall. The mess Sergeant and selected aids will see that all available foods are loaded, and will be ready not later than minus 2 hours. When ready the Mess Sergeant will report to the Post Engineer and await instructions.

7. All movements and decisions should be predicted on the advice of the Medical Corps Officer.

8. All personnel of the camp are warned that serious difficulty to sight will probably result if they look at the "shot" with the naked eye. Glasses of the type worn by welders are required for protection.

Howard C. Bush
First Lieutenant, CMP
Camp Commander

[redacted]

15 July 1945

Directions for Personnel at Base Camp at Time of Shot

1. Do not leave the main group at the camp where there will be monitoring and evacuation facilities. There will also be contact by radio with the planes, the shelters, and area monitors.

2. No one should remain in camp who can view the show from the mountains to the north and then leave immediately for Site Y. A minimum number of vehicles should be taken away from camp.

3. Persons will not be permitted to leave along Broadway until all danger of contamination has passed and the monitors have declared it safe. This may take several hours.

4. We do not expect danger to the Base Camp, but all personnel will conform with the following Safety Regulations:

   (a) At a short signal of the siren at minus (-) 5 minutes all personnel whose duties do not specifically require otherwise, will prepare to face the south, looking in the direction parallel to the long axis of the barracks buildings.

   (b) At a long signal of the siren at minus (-) 2 minutes all personnel whose duties do not specifically require otherwise, will lie prone on the ground or in an earthern depression, the face and eyes directed toward the south.

   (c) After the south hills light up, one may look toward zero with the eyes covered by a welder's filter, which will be issued to camp personnel by Fubar's supply room.

   (d) Do not arise before the blast wave arrives, which takes about 50 seconds.

   (e) At two (2) short blasts of the siren, indicating the passing of all hazard from light and blast, all personnel will "carry-on" thereafter conforming with such directions as may be announced over the loud speaker.

5. In event that evacuation becomes necessary, directions for this action will be broadcast on the loud speaker and carried out in orderly fashion according to prepared plans.

6. Any possible hazard from ultra-violet light injuries to the skin is best overcome by wearing long trousers and shirts with long sleeves.

Howard C. Bush
First Lieutenant, CMP
Camp Commander

[redacted]

Directions for Personnel at Campana Hills Camp at Time of Shot

(Coordinating Council Camp) July 15, 1945

1. Do not leave main group at Camp where there will be monitoring and evacuation facilities. There will also be contact with planes, shelters, and area monitors over the radioreceivers.

2. All personnel at Hill Camp will conform with the following Safety Regulations:

a) At a short signal of the siren at minus 5 minutes all personnel whose duties do not specifically require otherwise will prepare a suitable place to lie on.

b) At a long signal of the siren at minus 2 minutes all personnel whose duties do not specifically require otherwise, will immediately lie prone on the ground, the face and eyes directed toward the ground and with the head away from "zero." Do not watch for the flash directly, but turn over after it has occurred and watch the cloud. Stay on the ground until the blast wave has passed (2 minutes).

c) At two short blasts of the siren, indicating the passing of all hazard from light and blast, all personnel will prepare to leave as soon as possible.

3. The hazard from blast is reduced by lying on the ground in such a manner that flying rocks, glass, and other objects do not intervene between the source of the blast and the individual. Open all car windows.

4. The hazard from light injury to the eyes is reduced by shielding the closed eyes with the bended arms and lying face down on the ground. If the first flash is viewed a "blind spot" may prevent your seeing the rest of the show. A Welder's filter glass should be used upon first looking at the ball of fire after the initial flash has passed.

5. The hazard from ultraviolet light injuries to the skin is best overcome by wearing long trousers and shirts with long sleeves.

Note: Above directions read to persons viewing the explosion from the Campana Hills, about 20 miles from zero; read aloud by David Dow, Capt. T.O. Jones, and others.

[redacted]

Sample of statement to be signed by everyone entering crater area.

TO PEOPLE ENTERING THE AREA AFTER THE SHOT:

Permission to enter the region of contamination after the shot will be granted only by the "Going-In-Board" composed of K. Bainbridge, Dr. L. Hempleman, and V. Weisskopf.

No one can enter the area unless he has read the statements below and signs below saying that he has read them.

1. It is recommended that the maximum dosage should not exceed 5 R units. This is the individual's responsibility. Provision should be made for second teams to go in so that the first group should not feel that with a little more time beyond that corresponding to the recommended dosage they can complete a job.

2. Protective and monitoring equipment and instructions in its use will be given by the Medical Officer.

3. The Medical Officer will advise the use of protective and monitoring equipment such as coveralls, gloves, booties, masks, film badges, and radiation meters as required by the existent conditions.

4. A chart will be provided at each shelter giving the distribution of radiation intensity as determined from Moon's monitoring equipment, Anderson's tank measurements and Aebersold's monitoring measurements.

5. You should cooperate with the Medical Officer on duty after returning to S-10 in providing him with meter readings or any records of exposures received, return film badges and permit nose swipes, return contaminated clothing and special equipment, and take a shower at the facilities provided at S-10.

I HAVE READ THE ABOVE STATEMENT:

[redacted]

[redacted]

[redacted]

III-A

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[redacted]

INTER-OFFICE MEMORANDUM

Date: March 24, 1945

To: Mr. J. H. Williams

From: K. T. Bainbridge

Subject: Your memorandum dated March 20

Mr. Kershaw is general safety advisor. Dr. Hempelmann and Comdr. Bradbury are members of his committee. Dr. Hempelmann, as you know, has various specific responsibilities with respect to the health side of Trinity. Comdr. Bradbury will be at Trinity for stacking of the 100 T shot and will provide us with aid on pre-test calibration shots through his Group X-6.

The responsibility for preparation of the slug soup is H. Anderson's. I agree that his organization should fill the tubes so that they are sure there is no seregation or undesirable deposition of the active deposit, and the R-meter monitoring of the men who do the tube filling properly falls within Dr. Hempelmann's province.

K. T. BAINBRIDGE

KTB/bsa

cc - Dr. Hempelmann
S. Kershaw
J. E. Mack
J. H. Manley
B. Waldman
R. R. Wilson
file

[redacted]

[redacted]

SAFETY PRECAUTIONS

DRIVING.

SLOW DOWN AND PULL FAR TO THE RIGHT WHEN A CAR TRIES TO PASS.

SLOW DOWN TO AT LEAST 1/2 YOUR DRIVING SPEED WHEN PASSING ON COMING CARS, AND GIVE PASSING SPACE.

USE HAND SIGNALS ALWAYS.

LOOK BOTH WAYS WHEN ENTERING "HIGHWAYS".

SPEED LIMIT ON RESERVATION IS 35 MPH.

TOWER.

DONNOT CARRY ANYTHING UP LADDER (INCLUDING SMALL TOOLS, ROPES, HATS).

WEAR HARD HATS UNDER TOWER AND NEAR IT.

ALWAYS APPOINT ONE PERSON TO ANSWER PHONE AND CLEAR AREA (GUARD HATCH ALOFT) AT BOTH TOP AND BASE OF TOWER.

ONLY APPOINTED PERSON TO OPERATE CRANE (an operator may have to be appointed each day but it should soon be possible to use only experienced crane operators).

THROW NOTHING, ABSOLUTELY NOTHING OFF TOWER.

WARN ALL PERSONNEL AT TOWER IF ANY CHARGES ARE FIRED WITHIN EARSHOT OF THE TOWER.

CLOSE HATCH ALOFT WHEN NOT USING CRANE TO HOIST THINGS TO THE TOP.

GENERAL.

DO NOT LEAVE BOARDS LYING WITH POINTED NAILS UPWARD.

DO NOT SWIM IN POOL WHEN ALONE.

THERE IS A DOCTOR AND ABULANCE, CALL THEM IF SOMEONE IS HURT.

USE SALT TABLETS DURING HEAT OF DAY, THEY ARE AVAILABLE IN THE INFIRMARY.

WEAR A HEAD COVERING WHEN WORKING IN THE SUN.

MAXIMUM SPEED LIMIT IN CAMP AREA 12 MILES PER HOUR.

FRANK OPPENHEIMER
CHAIRMAN
SAFETY COMMITTEE

[redacted]

14 July 1945

To: K. T. Bainbridge

From: L. H. Hempelmann

Subject: The Influence of Meteorologic Conditions on the Monitoring and Evacuation Plans of the Medical Group.

The ability of the Medical Group to monitor successfully the surrounding countryside will depend to a large extent on the meteorologic conditions which prevail at the time of Trinity Test 2. There are two conditions which must now be considered; these are covered by Operation N.E. and Operation N.W.

1) Op. N.E.: This plan will cover the case where steady winds blow toward the N.E. such as is predicted for the 18th and 19th of July. This plan is much more complete than Op. N.W. since until the last few days all of the efforts of both the Medical and G-2 Groups have been directed at covering such a condition. There will be three monitors on the nearest highway 20-30 miles from zero point, others on the crossroads 50, 100 and 175 miles away. These monitors will measure the radiation intensity from the cloud as it passes overhead and will determine the amount of active material which has been deposited on the ground. If their measurements indicate that there is danger to persons in these regions, Major Palmer's troops will be called to evacuate the danger areas. Recording instruments are being placed in all large towns in the shadow of the cloud in a radius of 200 miles. Thus, if these conditions prevail, we will be able to monitor the cloud and the area of possible contamination, to evacuate the hazardous areas, and can be reasonably assured of obtaining adequate records for the countryside in the shadow of the cloud for a distance of 200 miles.

[redacted]

[redacted]

2) Operation N.W.: This plan covers the circumstances where there are varying winds toward the northwest below 15,000-20,000 feet and toward the northeast above 25,000 feet. These conditions have been predicted for the 16th and 17th of July 1945. If the shot is made under these conditions, the direction of the cloud will not be known until a few minutes after the shot. It will be impossible for us at this time to deploy our personnel and instruments in such a way as to monitor both directions for more than short distances. Consequently, as a compromise, we plan to place our monitors as in Op. N.E. to cover a blow to the northeast which is most likely to result from a highly successful experiment. In the case of the less efficient reactions where the cloud does not rise above 15,000 feet and drifts slowly toward the northwest, our closest monitors will be able to cover the first thirty miles and to evacuate in case of danger. It is probable that the danger area will not extend beyond thirty miles and that the plans just described will adequately cover the worst possible condition. Nevertheless, our records of what happens beyond thirty miles will be unsatisfactory.

cc: Mr. Oppenheimer
Col. Warren
Files

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

IV-A

Dr. Hempelmann
Capt. Nolan

THIS DOCUMENT CONSISTS OF 9 PAGE(S)
NO. 9 OF 15 COPIES, SERIES B

To: All Concerned

From: K. Bainbridge

[redacted]

PROJECT TR ORGANIZATION

June 1, 1945

TR Circular No. 10

K. T. Bainbridge	Head
F. Oppenheimer	Aide
Capt. S.P.Davalos	TR U.S.Engr.Det.
Lt. R. A. Taylor	Security
Lt. H. C. Bush	C.O. M.P. Det. in residence at TR

Consultants

R. W. Carlson	Structures
P. E. Church	Meteorology
E. Fermi	Physics
J. O. Hirschfelder	Damage
S. Kershaw	Safety
L. D. Leet	Earth Shock
W. G. Penney	Blast and Shock
V. Weisskopf	Physics

TR - Assembly

Comdr. N. E. Bradbury (X-1,X-6)	
G. B. Kistiakowsky, alternate	
M. G. Holloway, P. Morrison (G-1)	Pit Assembly
L. Fussell, D. F. Hornig (X-5)	Detonators
K. Greisen (X-7)	Asimultaneity
Comdr. N. E. Bradbury (X-1, X-6)	Unit Assembly

TR-1 J. H. Williams (R-2) — Services

TR-1A Lt.Comdr.T.M.Keiller, Head — Construction
T/4 A.H.Jopp, Supv. — Electrical constr. & telephone services

Pvt. A.L.Brehm, Supv. — Motor generators
3 SED's — PBX operators
1 SED to assist Jopp — Battery charge
1 SED to assist Brehm

[redacted]

[redacted]

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TR-1B	J. L. McKibben, Head	Timing
	E. W. Marlowe	Relay time signals
	T/3 W. Treibel	
	Pfc. R. Moore	
	R. Perry	
	Pfc. A. Hirtle	
	E. W. Titterton	Electronic time signals
	Sgt. V. Fitch	
	Sgt. R. Lowry	
	G. Mathis	
	C. R. Linton	
TR-1C	R. J. Van Gemert, Head	Procurement
	T/5 T. Montgomery	Stock
	T/5 E. Percy	"
	T/5 C. Pettis	Y Shipping to S-45
	Additional unloaders and clerks	"
TR-1D	D. Greene, Head	Transportation at TR
	1 SED to assist Greene	"
	Sgt. M. Swank, Head	Transportation at Y
TR-1E	F. Stokes, Head	Radio Communications
	Sgt. G. Curl, or substitute	
	T/5 A. Martinez	
	2 SED's	
TR-1F	Capt. B. Geary	Balloon Flying
TR-2	J. H. Manley (R-3)	<u>Air Blast & Earth Shock</u>
	W. G. Penney, Consultant	
	H. H. Barschall, 1st alternate	
	T. Jorgenson, 2nd alternate	

<u>Air Blast</u>

TR-2A	R. L. Walker	Piezo Gauges
	H. Sheard, Consultant	
	D. Littler "	
	W. D. Kennedy "	
	W. Myer	
	T/3 M. Battat	
	Pvt. F. Michaels	
	T/5 C. Wahlig (from R-4)	
	M. Sands (from G-4)	
	Pfc. C. Simons (from CM-13)	
	R. Babick (from A-1)	

[redacted]

[redacted]

TR-2B	W. C. Bright T/4 K. Kupferberg W. Hane (from G-4) T/4 R. Dye (from G-4) T/4 D. Leed (from G-4) 1 SED	Condenser Gauges
TR-2C	H. H. Barschall G. Martin R. W. Davis W. Elmore (from G-4)	Excess Velocity Measurement
TR-2D	T. Jorgenson One other	Impulse Gauge
TR-2E	H. Sheard, D. Littler	Maximum Pressure Gauge
TR-2F	J. C. Hoogterp 1 SED	Box Gauge

<u>Earth Shock</u>

L. D. Leet, Consultant

TR-2G	H. M. Houghton J. Coon, alternate R. Nobles SED 1 (Seborer?) SED 2	Velocity geophone
TR-2H	L. D. Leet H. Gewertz, alternate 8 others	Displacement Seismographs
TR-2I	W. G. Penney F. Reines Surveyors	Permanent Earth Displacement

TR-3	R. R. Wilson (Div. R) E. Fermi, Consultant V. Weisskopf, "	<u>Physics</u>
TR-3A	R. R. Wilson (R-1) J. DeWire, alternate H. Bridge R. Sutton W. Schaefer W. Caldes T/5 W. S. Hall P. Daloh W. Woodward T. Snyder L. Lavatelli T/5 R. Fortenbaugh	Prompt Measurements; α and implosion time

[redacted]

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TR-3A (cont.) — Prompt Measurements; α and implosion time

B. Rossi, Consultant
J. Allen
D. Nicodemus
B. Diven
C. Moni
J. Fredricks
Man from M.I.T. — Cooperating with R-1 on M.I.T. fast oscillograph

TR-3B H. T. Richards — Delayed Neutron Measurements
J. M. Blair
D. Frisch
J. Hush
E. Klema
R. Krohn
C. Turner
R. Perry

<u>Trinity</u>

1. R.Krohn - Installing moorings for barrage balloon; charge of putting up balloon; or liaison with Army balloon crew.
2. R.Krohn - Construction of one ground station.
3. J.M.Blair, D.Frisch - Recovery of camera and records after shot.
4. E.Klema, J.Hush, R.Krohn - Distribution and collection of static gold foils and threshold detector.
5. H.T.Richards - Counting activity on cellophane at TR or in charge of.

<u>Work at Y</u>

1. D.Frisch - Differential σ_N and σ_0
2. D.Frisch, H.T.Richards, C.Turner - Integral liquid air mock-up.
3. D.Frisch, H.T.Richards - Calibration of catcher technique.
4. E.Klema - Calibration of gold foil and sulphur.
5. R.Perry - Intensity of delayed neutrons from 49 for fast excitation and for times < 1 sec.
6. J.M.Blair, J.Hush - Design of cellophane catcher camera.
7. H.T.Richards - Spectrum of short period delayed neutrons.
8. R.Krohn - Procurement and testing of barrage balloons for airborne recording.
9. R.Krohn, J.M.Blair, J.Hush - 400 meter drop test to make sure that vital records survive the destruction of balloon by blast wave.

TR-3C E. Segre (R-4) — Delayed Gamma Rays
C. Wiegand — Electrical part
M. Deutsch — Ionization chambers & calibrations
O. Chamberlain — Shelter design

G. W. Farwell
G. A. Linenberger
T/4 A. H. Spano
W. Nobles

[redacted]

[redacted]

TR-3D	P. B. Moon	Gamma Ray Sentinels and Delayed Gamma Rays
	Pbs. I. Halpern	
	S/Sgt. W. J. Breiter	
	T/4 J. A. Hofmann	
	T/5 M. J. Pincus	
TR-3E	H. L. Anderson (F-4)	Conversion
	G. L. Weil	Rocket Sampling
	D. E. Nagle	Tank Sampling
	H. Heskett	
	T/5 Twombley	Radio Maintenance
	T/5 Smith	Tank Driver
	T/5 Brothers	" "
	T/5 Tucci	Tank Maintenance
	T/5 Banas	" "
	V. Cannon	Gross Counting
	N. Wilkening	Alpha Counting
	J. Tabin	Beta Counting
	A. Novick	Gamma Counting
	N. Sugarman	Chemistry
	D. Engelkemeir	49 Chemistry
	M. Kahn	
	J. Miskell	
	S. Katcoff	Fission Product Chemistry
	J. Seiler	
	L. Wineberg	
	C. Schwob	
	T/3 E. Hoagland	
	A. Goldstein	Counting Room
	WAC Technicians	
	M. Young	
	M. Wirz	
	S. Lozier	
	S. Corl	
TR-4	J. M. Hubbard	Meteorology
TR-4A	Lt. C. D. Curtis	Radar
	Pvt. R. L. Heller	
	Pvt. G. F. Mason	
	Pvt. G. Meyers	
	Pvt. F. K. France	
	1 SED	
TR-4B	Sgt. J. C. Alderson	Pilot Balloons
	Sgt. J. G. Taylor	
TR-4C	Sgt. P. A. Tudor	Radiosonde
	Sgt. L. Caskey	
TR-4D	Sgt. W. Blades	Base Weather and Records

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TR-5 J. E. Mack (G-11) — Spectrographic and Photographic Meas.

B. Brixner, alternate
N. Bifano, alternate at Y
T/3 N. York (permanently at TR & in charge in absence of Mack and Brixner)

T/5 E. D. Wallis — Photographer (and stockkeeper until Shue's arrival)

~~T/5 H. C. Barr~~
T/4 B. C. Benjamin
~~T/4 G. E. Economou~~
F. E. Geiger
T/5 K. J. Shue — Stockkeeper
T/3 G. W. Thompson — Probable photographer
T/4 J. Wahlen — Wiring Liaison
Possibly new staff member
T. S. Neadels

Exp. 2, 3	B.Brixner	- Fastaxes
5,6,7	F.E.Geiger	- Spectrographs and photometer
6A	B.Brixner	- Turrets
8	B.Brixner, T/5 Wallis, T/3 Thompson	- Mitchells
9,10	T/3 York	- Fairchilds, incl. flash bombs
11	J.E.Mack	- Pinhole
12	T/4 Benjamin	- Shock switches, charges, and GR recorder
14	~~T/4 Economou~~	- Air mass motion, primacord (except cameras)
	B.Brixner	- Fastax for primacord
~~15~~	~~T/4 Wahlen, T/5 Barr~~	~~- Marley camera~~
16	J.E.Mack	- Photocells
17	J.E.Mack	- Black body receiver & 16 mm camera
18	J.E.Mack	- Schlieren sources
19	J.E.Mack	- Slit gamma ray camera
20	F.E.Geiger	- Recombination spectrographs
21	T/3 Thompson	- Cine Kodaks

TR-6 B. Waldman (O-2) — Air Blast

I. Alvarez
H. Agnew
R. Dike
W. Stroud
T/3 E. Karas
T/3 J. Wieboldt
T/5 W. Goodman
T/5 R. Alhbrand
L. Johnston

[redacted]

[redacted]

TR-7	Dr. L. H. Hempelmann Capt. J. F. Nolan, Head at TR Col. S. L. Warren, Consultant J. Hoffman, Consultant	Medical Group
TR-7A	R. Watts W. Scivally L. Brown	Instruments
TR-7B	Capt. Barnett Lt. Allen Lt. Large Sgt. P. Levine Sgt. J. Green Sgt. H. Leonard A. Anderson	Monitors

KTB/bea
TR Distribution

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Page

B. 100 Ton Shot

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18 May 1946

To: File

From: L.H. Hempelmann

Subject: Hazards of 100 Ton Shot at Trinity

The hazards relative to the 100 ton shot containing fission products at Trinity on 7 May 1945 were slight. However, advantage was taken of the similarity of this test to the final shot to develop a system of monitoring the next test. Our problems in this first shot were three-fold: (1) Medical emergencies caused by pre-detonation and routine construction hazard, (2) Monitoring the chemical procedure of dissolving the "Hanford Slug" and pumping the solution into the explosive, (3) monitoring the area following the explosion, and (4) the cloud containing active material. Mr. Bainbridge and Lt. Bush took the responsibility of clearing the area immediately before the shot.

1. Concerning medical emergencies there was only one - an accident in which Milton Kahn was run over by a truck trailer. Although the truck wheels ran over his entire body and head, it was fortunate that because of the extremely soft dirt no bones were broken and only fairly superficial lacerations of the chin were suffered. Lt. J.H. Allen, who had been at Trinity since 25 April 1945, took care of the patient and sent him up to this site for recovery on 4 May 1945.

2. The radiation hazards relative to the chemical procedures turned out to be extremely slight even though the "slug" contained 400 gamma curies and about 1000 beta curies. The "slug" was transferred by Sugarman's group from a lead container to an underground chamber (by means of a remote control operation) behind a concrete wall. The "slug" was then dissolved in a nitric acid solution and the nitric acid fumes together with the radioactive xenon and iodine were discharged through a seran tube, the outlet of which was about 1000 feet from the chamber. The underground chamber was so well shielded that the radiation intensity in the working area was less than one-tenth r per eight hour day. Similarly, the amount of radioactive gases issuing from the chamber was not hazardous. It was found by means of air chambers built by Mr. Watts that if no nitric oxide could be smelt in the air there was no detectable activity in the air. The exposures of all personnel were considerably less than tolerance dose except for the final day on 6 May 1945 when samples amounting to about 1/2 curie were taken from the buffered nitric acid solution. Only one person, Sugarman, exceeded the daily dose while taking these samples and he only received approximately 1½ times tolerance. After the material was pumped up into the stack, the radiation intensity around the towers was fairly high. Mr. Buchanan, who was installing the detonator, probably received about three or four daily doses due to difficulties encountered during the installation which required him to stay in the vicinity for about four hours. This dosage was not measured but was not considered serious because he has had no other exposure to radiation.

3. Radiation hazard after the shot. This too proved negligible but arrangements were made so that no one except the people in the tanks could enter the contaminated area until it was surveyed by the medical group. Both medical personnel and Anderson's group in the tank were clothed with coveralls,

[redacted]

[redacted]

booties, gloves and masks. Anderson's men used gas masks while the medical group used respirators. It turned out that there was measurable activity only within a radius of about 30 feet around the center of the tower. Even here the activity did not exceed 1/10 r per 8 hour day. In the center of the crater the activity was about 0.7 r per 24 hours. Measurement of the fine powdery dust around the crater showed extremely small amounts of activity estimated to be only a few microcuries per handful of earth. Nevertheless, it was recommended by the medical group that no one enter the powdery zone without booties and everyone was advised to wear respirators for all dusty operations. The system which was used proved quite successful and will undoubtedly be used again for the final shot. The only infraction of rules occurred when Mr. Oppenheimer entered the potentially contaminated zone immediately after the medical officers. However, he took full responsibility for his actions.

4. The cloud arising from the explosion contained approximately 98% of the active material. It was observed to rise to a height of between 13 and 15,000 feet where there was a westerly wind which carried it at a rate (according to Hubbard's observation) of 35 miles an hour in the direction between Carrizozo and Tularosa. It was still visible four hours later at which time it was somewhat south of Roswell. Although dilution had occurred, the cloud still hung together at this time. It is thought by Hubbard that the thermal air currents starting at about 9 o'clock in the morning resulted in a rapid dispersion of the cloud.

It is felt that there was very little likelihood of any contamination ever reaching the earth since there has been shown to be a dilution of 10,000 times for every 2,000 feet vertical descent of such clouds. It was impossible to detect the cloud by radar for more than six miles. The cloud was not followed or trailed except visually from the base camp.

[redacted]

[redacted]

Mr. K. Bainbridge May 26, 1945

J. M. Hubbard

The question of dissipation of the trailing column and ball of smoke is not primarily a problem of forecasting; however, we are concerned with forecasting the weather condition which will give maximum dissipation and least hazard. For this reason the following comments are presented:

1) During the May 7 shot at TR, pilot balloon and Rawin observations at TR showed a marked increase in wind velocity over the escarpment reaching 80 mph at 8100 ft. and 70 mph at 8700 ft. as the balloon passed from the observation point at O across the mountains. In comparison the radar wind aloft at point P showed velocities of 28 mph at 8000 and 9000 ft. The difference between these velocities is attributed to a crowding of the stream lines over the escarpment with a corresponding decrease in pressure and increase in velocity at the crest of the mountains. The wind aloft at the O point shows that this effect began at approximately 4500 ft. and extended to 9300 ft. As the top of the Oscuras are approximately 3800 ft. above the O point, it may be assumed that any residue material from the shot was dropped along the escarpment below the 3800 ft. level or was well mixed in the high velocity winds over the crest up to 9300 ft. At 10,000 ft., residue material probably remained undisturbed by the mountain effect. In our opinion this material did not descend but was carried eastward in the laminar flow which existed between 10,000 and 20,000 ft. If any residue material had descended at the rate of 100 ft. per minute (which in our opinion is an extremely rapid descent rate, being 1/3 that of commercial aircraft descent) then it would have taken 100 minutes for this material to reach the ground. In this 100 minutes, the wind velocity averaging 30 mph, the material would have finally reached the ground at a point 50 miles to the east of the O point.

Assuming that the second shot may possibly reach an altitude of 20,000 ft. before the gas is concentrated, we see that a descent rate of 100 ft. per minute would require 200 minutes for any residue to reach the ground, and a 30 mph wind would carry this material 100 miles. In view of the above it seems unlikely that an operation carried out under similar weather conditions could produce unfavorable effects in the Tularosa valley.

2. A discussion of the possibility of the gaseous material remaining aloft should be included. During the night-time, temperature inversions normally occur in the atmosphere over this area. The exceptions to this are found in frontal zones and regions of thunderstorm activity, both of which are undesirable to this operation. These temperature inversions aloft retard vertical movement of gases which are in equilibrium with the atmosphere. During the daytime, solar heating produces an increase in temperature and therefore an increase in energy in the lower levels. This energy increase manifests itself in kinetic energy and it may be shown that motion upward per unit area is greater than motion downward while this heating occurs.

[redacted]

Mass is conserved by the corresponding decrease in density or an increase in volume.

Terrain effects are important in this mechanism. The terrain is heated unevenly and this results in small columns having large vertical velocities upward and large columns having small vertical velocities downward. The extent of the upward piping can be ascertained by considering an aircraft travelling at 180 mph being lifted for a normal period of 6 seconds in these thermal drafts. It is easily seen that such a lift is produced by a column approximately 1/4 mile broad. The effect of this thermal activity is a general upward movement, and this movement is sufficient to maintain aircraft in the air without power and should effect gaseous particles in such a way as to keep the contaminating material aloft and move it even higher. It is conceivable that contaminating material thrown in the air will maintain at high altitudes until thoroughly mixed. Examples of volcanic dust and surface dusts from the interior of China may be cited where solid particles have been suspended at high altitude for a matter of weeks.

JMH/bsa J. M. HUBBARD

cc - Dr. L. H. Hempelmann
Capt. T. O. Jones
P. E. Church
file (2)

[redacted]

IV-B-c [redacted] 92

Mr. John Williams 14 May 1945

Captain James F. Nolan

In reference to the request for surveying the crater at TR site it is advised that the men entering this area wear bootees, coveralls, gloves and gas masks; also that they limit their time in this area to four hours. If victoreen and pencil chambers are available it is also recommended that these be worn during the work.

JFN:kpd

James F. Nolan
Captain, M.C.

[redacted]

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[redacted]

12 May 1945

Lt. Comdr. Keiller:

Lt. Allen:

Health and Safety at TR:

The crater and surrounding area at TR is not considered seriously contaminated. Working in the area would give a person only about a daily dose in eight hours. It is advisable, however, to have the workers wear canvas boots to avoid beta-contamination of their shoes, and also to wear respirators in case there is any danger of inhaling dust of that area.

Jerry H. Allen, Jr. 1st. Lt., M.C.

[redacted]

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Hempelman 95

IV-C-1 [redacted]

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INTER-OFFICE MEMORANDUM

June 16, 1945

TO: K. T. Bainbridge

FROM: J. O. Hirschfelder and John Magee

SUBJECT: DANGER FROM ACTIVE MATERIAL FALLING FROM CLOUD - DESIREABILITY OF BONDING SOIL NEAR ZERO WITH CONCRETE AND OIL.

There is a definite danger of dust containing active material and fission products falling on towns near Trinity and necessitating their evacuation. This is shown by the following calculations based on the assumptions that:

1. The active material condenses on the surface of the normal Trinity dust to give a distribution of activity with particle size similar to that observed by H. L. Anderson in the 100 ton shot.

2. The dust on which the active material is deposited is quickly (3 minutes) raised to a height of approximately 12,000 feet. This is approximately the height to which the smoke puff rose in the 100 ton shot and this same height may be expected in the next shot. Between 1000 and 12000 feet the change in temperature with altitude should very nearly follow a dry adiabat and therefore there should be no tendency for material which has risen above 1000 feet to stop before it gets to 12,000. After 12,000 feet Hubbard expects a temperature inversion so that it will be difficult for any material to rise much above the 12,000 foot level.

3. The dust settles in accordance with a modified Stokes law like normal industrial dust settling in still air.

4. The material as a whole is carried along at a wind velocity of 30 miles per hour. This dangerous situation could be eliminated by reducing the number of dust particles of around 100 microns which get into the cloud. This can be done by bonding the ground in the vicinity of zero - preferably using a light slurry of concrete in the vicinity of the future crater and a coating of oil thinly distributed to a distance of 2000 feet from zero.

I. Distribution of Active Material

Lacking any indications to the contrary, it is natural to assume that the distribution of active material with particle size will be the same as Anderson found in the last Trinity shot. This distribution indicated that the active material was uniformly distributed on the surface of the sand particles - the activity of the particles being roughly proportional to their surface area. The following table summarizes Anderson's observations together with some recent measurements of the particle size distribution of Trinity dirt made by Kamm and Magee (which will be discussed in detail in another memorandum).

[redacted]

[redacted]

Particle Diameter (microns)	DIRT FROM CRATER			NORMAL TRINITY DIRT Percentage Weight	
	Percentage Weight by Screening	Percentage Activity	Percentage Surface Area	Sample #1	Sample #2
> 840	32	3.8	4.2	52	30
840-250	21	12.6	4.8	35	45
250-149	15	14.5	9.2	7.6	10
149-74	16	18.1	8.5	2.1	9
< 74	16	51.0	73.3	2.4	6

It will be noticed from the last two columns that the weight distribution of various samples of Trinity dirt vary considerably. Similarly Anderson found considerable variations between different samples of dirt in the crater. Therefore we cannot argue about the amount of activity to be expected for a given range of particle size to within a factor of two.

II. The Rate of Settling of Dust

According to Stoke's Law, particles of specific gravity ρ and diameter D microns should fall at the rate:

$$0.00592\ D^2\rho \text{ feet/minute}$$

According to John L. Alden "Design of Industrial Exhaust Systems" (Industrial Press New York, 1939), dust particles found in industry follow this law quite well for particles between 5 and 300 microns. For larger particles the velocity of falling is somewhat slower:

D microns	Velocity ft/minute
5000	1750ρ
1000	790ρ
500	555ρ

Using the above data it is easy to calculate the length of time required for particles of various sizes to fall 12,000 feet. Here we assume that the specific gravity of the dust is 2.6. The results are summarised below:

[redacted]

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Diameter (microns)	Time to Fall 12,000 ft (hours)
840	0.110
500	0.139
250	0.208
200	0.325
149	0.585
110	1.08
74	2.37
60	3.61
33	12.0
22.6	25.5
16.0	50.8
11.3	102
8.0	204
5.65	408

From the above table and Anderson's data it follows that 3.8% of the activity drops in the first 6.6 minutes; 12.6% of the activity drops between 6.6 and 12.5 minutes; 14.5% of the activity drops between 12.5 minutes and 35 minutes; 18.1% of the activity drops between 35 minutes and 2 hours and 22 minutes; and the remaining 51% drops at a much later time.

The dust particles which have diameters ranging between 149 and 74 microns are therefore the most dangerous from the standpoint of nearby towns since they fall in the time interval between 35 minutes and 2 hours and 22 minutes. Since they contain 18.1% of the activity it follows that during this time interval the active material will be dropped at the average rate of 10% per hour. If this dust is swept along at an average velocity of 30 miles per hour, each mile along the path will contain 1/3% of the active material. It is reasonable to suppose that at this time the path of the active material on the ground will be 3 miles wide. (This figure is completely speculative but seems neither pessimistic nor optimistic). Then each square mile along the path at a distance between 17.5 and 71 miles contains 1/9% of the activity.

III. The Radiation Intensity Suffered by Person in Nearby Town

The following calculation was made with the help of A. Turkevitch and agrees with a similar calculation made by L. Hempelman. Assume that the gadget is 5% efficient so that 2 moles of fission products are formed. Then according to a formula of Fermi's .15 f/t gamma rays are emitted per second after t seconds after the explosion. Here f is the total number of fissions. If the total active material is spread uniformly over one square mile there will be emitted one hour after the explosion

$$10^9 \text{ gammas/sec/cm}^2 \text{ of surface area}$$

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Or spreading the 1/9 of 1% of the activity over one square mile, there will be emitted one hour after the explosion

$$10^6 \text{ gammas/sec/cm}^2$$

In unit solid angle this will amount to

$$I_o = 10^6/4\pi \text{ gammas/sec/cm}^2\text{/unit solid angle}$$

But since the mean free path of the gammas in air is of the order of $\lambda = 140$ meters, at a height h equal to one meter above the ground the flux of gammas is approximately

$$I = \pi I_o \log_e(\lambda^2/h^2 + 1) = 28 I_o = 2\times10^6 \text{gammas/sec/cm}^2$$

And since one R unit corresponds to 10^9 gammas/cm^2 we could therefore expect a person in the path of the cloud at a distance of between 17.5 and 71 miles to receive radiation at the rate of

$$7/T \quad \text{R/hour}$$

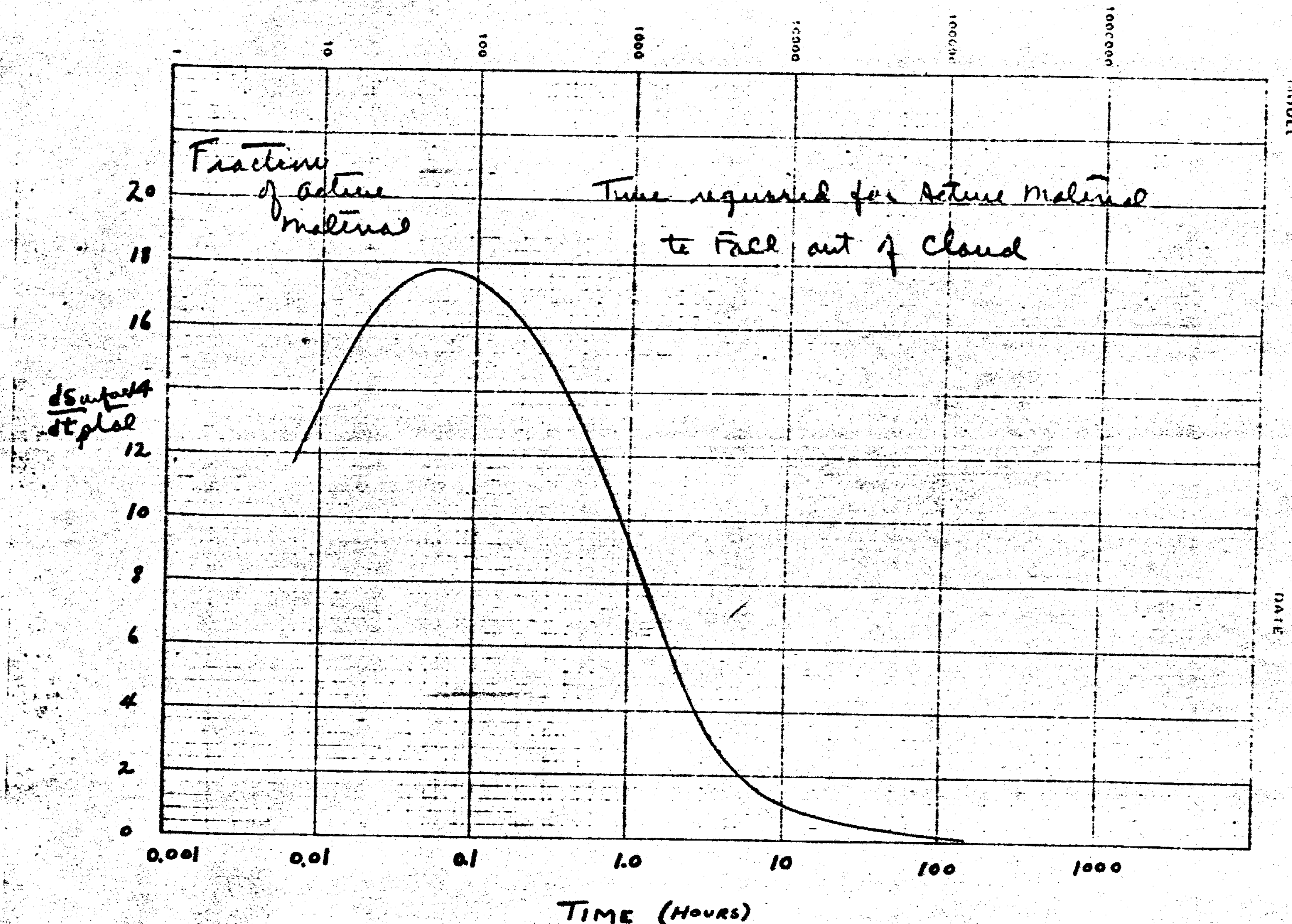
Here T is the time after the explosion in hours. In the first day he receives approximately 22 R. Here we have only considered the danger of gamma radiation. Weisskopf has made a similar consideration for 49 and finds that over a long period of time, it too might be dangerous.

IV. Suggested Remedy

Since the danger from the radiation is due to the presence in the cloud of a large percentage of dust ranging in size between 149 and 74 microns, the obvious solution is to take steps to prevent such dust from getting there. This should be feasible by filling the region which will become the crater with crushed rock (from a nearby quarry) and adding a small amount of concrete slurry. At larger distances (up to 2000 feet) it would suffice to cover the ground with a thin film of oil. Carlson estimates that this would require approximately 750,000 gallons - a large amount but not prohibitive.

cc: Col. Warren, Capt. Jones, Capt. Nolan, Bethe, Carlson, Eberstat, Hempelman, Parsons, Penney, Oppenheimer, Segre, Weisskopf

[redacted]



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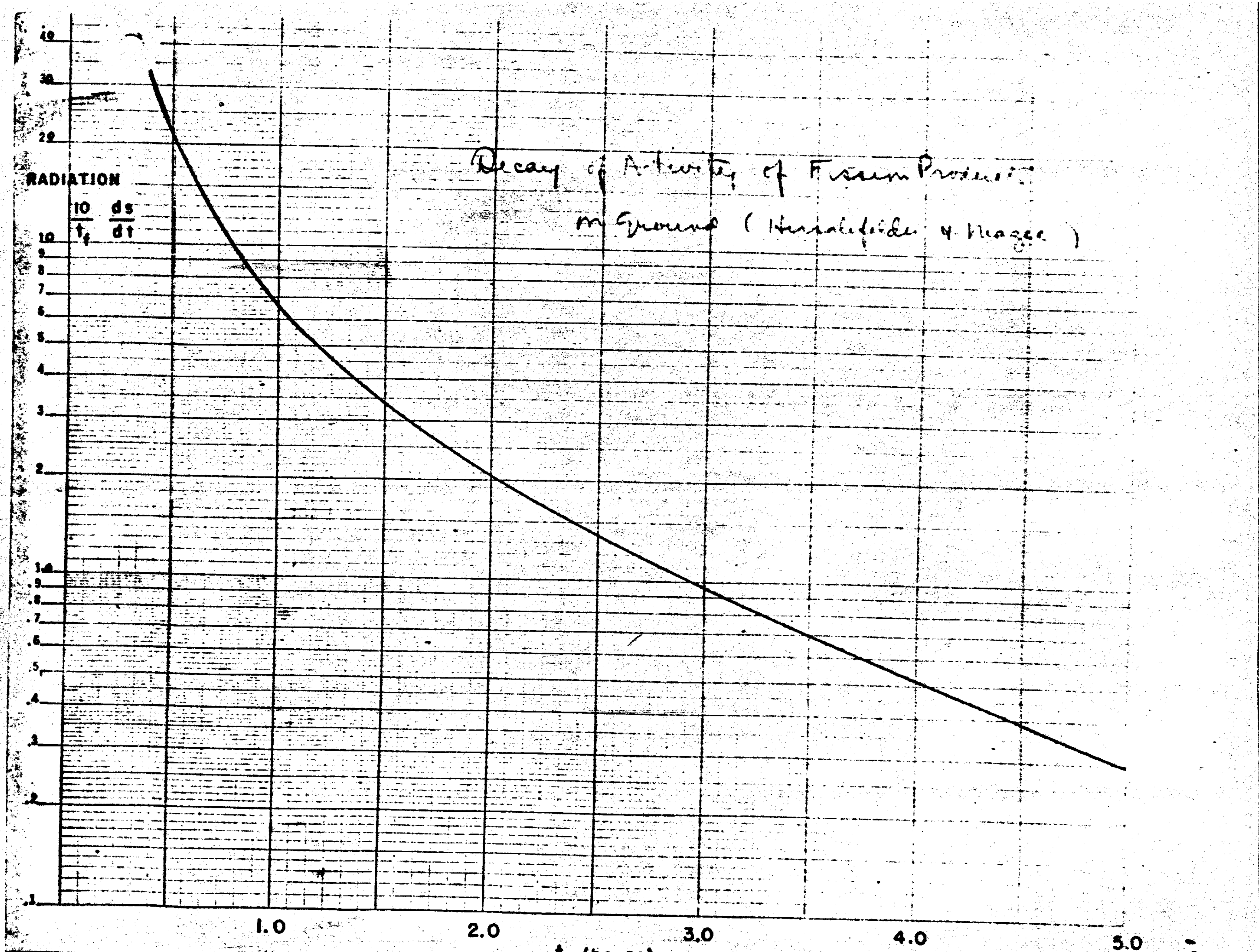
Decay of Activity of Fission Products
on Ground (Hirschfelder & Magee)
RADIATION
$\frac{10}{t_f} \frac{ds}{dt}$
40
30
20
10
9
8
7
6
5
4
3
2
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
1.0
2.0
3.0
4.0
5.0
t_f (hours)

INTER-OFFICE MEMORANDUM [redacted]

To: K. T. Bainbridge Date: June 22, 1945

From: L. H. Hempelmann and James F. Nolan

Subject: Danger to Personnel in Nearby Towns Exposed to Active Material Falling from Cloud

In a memo. to you (16 June 1945), Hirschfelder and Magee discuss the possibility of active material and fission products falling from the cloud. Assuming that these calculations are correct, the following is a consideration of the actual danger to personnel in the contaminated area.

I. Danger from 49: This would seem to be nil in any reaction which has enough energy to carry the cloud over the escarpment because

A. Particles of 100 microns and over (which would fall in the first few hours) are filtered out completely by the nose and upper respiratory tract and are not retained by the lung. This means that there is no danger from inhalation of 49 until the particles of small size (5-10 microns and under) reach the earth; this is a matter of days according to Hirschfelder's calculations.

B. The absorption of 49 from the intestinal tract is so poor (0.1 percent or less) that it would be necessary for an individual to ingest at least one milligram of material to absorb a* tolerance amount. This would correspond to the amount of material distributed over 9000 sq. feet of surface.

II. The danger from fission products: This presents a more real hazard than 49; nevertheless, in the situation described by Hirschfelder and Magee, it would seem extremely improbable that injury would result in the case of people not previously exposed to radiation.

A. External radiation: The integrated amount of radiation in the first 14 days is 68 r. This would certainly not result in permanent injury to a person with no previous exposure to radiation. It would probably not even cause radiation sickness. A normal person could probably stand two or three times this amount without sustaining permanent bodily damage. Fatalities probably would not result unless ten or more times this dose were delivered.

B. Ingestion: The danger from ingestion can be stated with less certainly than the above. Experiments have been done (Chicago Handbook, Chapter XII) to determine the tolerance dose for ingestion of mixed fission products (after thirty days cooling.) This corresponds to 16.4 millicuries which in the case described by Hirschfelder and Magee would be distributed over a surface area of approximately 500 square

*(1 - 5 microgram)

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INTER-OFFICE MEMORANDUM [redacted]

To: K. T. Bainbridge Date: June 22, 1945

From: L. H. Hempelmann and James F. Nolan

Subject: Danger to Personnel in Nearby Towns Exposed to Active Material Falling from Cloud

centimeters. Since a great portion of the activity in the contaminated area comes from short-lived products which can be tolerated in much larger amounts, it is probable that ten to thirty times the above amount (16.4 mc.) could be safely ingested.

C. Inhalation: Since the large particles which would reach the earth during the first few hours probably would be completely filtered out by the upper respiratory tract, this hazard is not great.

It is felt that the above discussion indicates that even if dust falls from the cloud in the manner described by Hirschfelder and Magee, there is little likelihood of serious damage to individuals in neighboring towns unless the contamination is 2 - 3 times that which is described. This should not be taken to mean that the hazards described by Hirschfelder and Magee are not serious and to be avoided if possible. All precautions should be taken for evacuation of the countryside should the contamination be worse than that described.

L. H. Hempelmann, M.D.

J. F. Nolan, Capt., M.C.

cc: Hirschfelder
Penny
Capt. T. O. Jones
File

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IV-C-3 Hempelman

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INTER-OFFICE MEMORANDUM

July 6, 1945

TO K. T. Bainbridge

FROM J.O.Hirschfelder and John Magee

SUBJECT: IMPROBABILITY OF DANGER FROM ACTIVE MATERIAL FALLING FROM CLOUD

In a previous memorandum to you dated June 16, 1945, we showed that there was the possibility of a dangerous amount of active material sedimenting down onto nearby towns, IF all of the active material were to condense onto cold sand particles with the same distribution of activity versus particle size that H. L. Anderson found in the 100 ton Trinity shot.

We have tried to examine this hypothesis in some detail. It appears likely that a considerable fraction of the active material will be co-precipitated with vaporized silica in the form of very small particles which remain suspended in the form of smoke. This smoke should gradually diffuse and cause no health hazard (unless it were washed down in a thunderstorm). Unfortunately we cannot make a quantitative estimate of what fraction of the active material will be co-precipitated in the smoke and what fraction will plate onto the cold sand. In this memo we will try to present a picture of the mechanism involved. Our present arguments would seem to indicate that the amount of active material sedimenting onto a nearby town may be less by a factor of from 2 to 10 than the amount estimated in our previous memorandum. As near as we can tell, the sand which causes the danger comes up from the crater rather than from very large distances.

I. MIXING OF ACTIVE MATERIAL WITH VAPORISED SAND AND STEEL

Originally the active material is located in the outer fringes of the ball of fire. The ball of fire when fully expanded at the end of one tenth of a second has a radius of around 500 feet. Because of the interaction with the ground and the reflected shock the ball of fire will be quite flat on the bottom and still almost round on top (i.e., almost a hemisphere). It will be sitting immediately on top of the crater. The crater according to present estimates will be only 190 feet in radius (see LA-292) or 60 feet according to Penney's estimates, so that all of the sand rising from the crater will pass through the ball of fire. The total amount of dirt contained in the

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crater as expected by MacMillan and Wilcox is 50,000 tons, or 5000 tons according to Penney. It is reasonable to expect more than 250 tons of dirt will rise into the ball of fire. The energy required to heat one gram of sand up to its boiling point (2500° C.) and vaporized it is approximately 2700 cals (This figure would apply for pure silica.) Thus the energy of 2.7 tons of T.N.T. would be required to vaporize one ton of sand. If the ball of fire contained 10% of the energy, or 500 tons T.N.T. equivalent, it could vaporize something less than 250 tons of dirt. The length of time to vaporize the sand is very short once it comes into the high temperature region. Assuming that the surface of the dirt is black and the radiation is black body, it follows that:

$$dr/dt = -2\ (T/10{,}000)^4 \ \text{cm/sec}$$

Here r is the radius of a sand particle and T is the temperature of the black body. The steel tower will be dissolved at approximately one fourth this rate because of its greater density. In any case the vaporization processes are extremely rapid and should serve very effectively to cool the ball of fire down to around 5000° C.

II. CONDENSATION OF ACTIVE MATERIAL

The maximum rate at which the ball of fire could cool by emission of radiation would require 0.6 of a second to reach 2000° C. (This is calculated for a black body radiating into a vacuum.) Actually the emissivity of the ball of fire is probably somewhat greater than 0.1 which is a reasonable valve for a non-luminous gas such as CO_2. Therefore a reasonable upper limit on the cooling time would be 6 seconds. At the 2000° temperature all of the solid material will presumably be condensed.

The dirt which rises when the blast wave first hits the ground is given a large horizontal velocity most of it making an angle of around 15°. This dirt has been pulverized by the blast and the upper portions are rapidly vaporized. There is no rapid method of transferring the silica vapor to the central and upper portions of the ball of fire. This process will continue until approximately 100 tons of sand is vaporized and the ball of fire is chilled below the condensation point. This silica is then rapidly precipitated in the form of a fine smoke. The upper and central portions of the ball of fire contain so little solid material that the rate of condensation is very slow. Convection currents are set up at the bottom of the ball which mix the smoke and the sand and these turbulent eddies eat into the ball of fire.

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The active material will adhere impartially to whatever solid it happens to hit. In this way the smoke and sand scours the 49 and fission products. The relative amount of these substances which adhere to the smoke and to the sand depends only on the relative surfaces of the two components. It is impossible for us to estimate this ratio quantitatively. If there were the same weight of silica in the form of smoke (with mean diameter of 0.5 micron) and of sand (with mean diamter of 20 microns) the smoke would have 40 times the surface and therefor pick up 40 times the active material. Actually there will be much more weight of cold sand than smoke in this mixture, possibly 4 to 40 times as much. Thus there should be 10% to 50% of the activity plated out onto the cold sand. The active material sedimenting onto a nearby town should therefore be less by a factor of from 2 to 10 than we anticipated in our previous memorandum.

The high rates of chilling make the chemical nature of the various components completely unimportant so that there will be co-precipitation of the active material with the sand in the smoke. Furthermore, 49 is known to adhere to sand and scrubbing with sand is used to remove 49 from surfaces.

At first a fraction of the fission products (~20%) are in the form of noble gases which transmute to Alkali metals within a minute and these, of course, are easily absorbed on the smoke particles.

The large amounts of ionization in the smoke cloud will tend to prevent agglomeration and thus help to dispose the active material over a larger area. This ionization is due both to the radio activity and to the rapid chilling from the high temperatures where ions are stable.

We wish to thank Robert Kamm for his experimental assistance. He showed that Trinity sand vaporized in either a carbon arc or a tantalum crucible condenses into the form of a very fine bluish-white smoke. He also determined the distribution of particle size in normal Trinity sand which we used in our previous memorandum.

Because of the difficult nature of this problem we felt it advisable to discuss a number of the technical points with experts. Drs. F. G. Cottrell and Bernard Welch (Western Precipitation Co.) gave their opinion that the 100 micron particles about which we are concerned should sediment according to the normal Stokes' Law as we had assumed in our previous

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memorandum. Cement dust of the same size falls in noticeable quantities at distances up to 50 miles. Drs. Sage and Lacy of C.I.T. studied the problem of condensation of the silica and felt that practically all of it will come out in the form of smoke.

We should also acknowledge many helpful discussions with Drs. G. I. Taylor, C. S. Smith, W. G. Penney, and V. Weisskopf.

J. O. Hirschfelder

John Magee

jsh

cc - Oppenheimer
Aebersold
Bethe
Carlson
Hempelman
Capt. Jones
Robert Kamm
Capt. Nolan
Parsons
Penney
Reines
Segre
C. S. Smith
Sugarman
G. I. Taylor
Turkevich
Col. Warren
Weisskopf

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INTER OFFICE MEMORANDUM

July 7, 1945

TO K. T. Bainbridge

FROM John Magee and Robert Kamm

SUBJECT: SURFACE AREA DISTRIBUTION OF TRINITY SAND

A dirt sample taken from the crater of the 100 ton Trinity test shot was screened and analyzed for surface distribution with results shown in Table I.

TABLE I

Particle Diameter Microns	Wt. Percentage	Average Diameter of Group	Surface Area Per Gram cm^2
> 840	32	1200	6
840 - 250	21	500	9
250 - 149	15	200	17
149 - 74	16	110	33
74 - 44	8	60	30
< 44	8	6.94	261

Total = 356

The screening operation was carried out by Sugarman's Group except for the last operation (diameters below $74\ \mu$).

We carried out an analysis of the surface distribution of the finest fraction, using the Photelometer. This method makes use of sedimentation of the particles in water and results are calculated as though the particles were spherical and had diameters much larger than the wave length of light. This analysis should be approximately correct. Two runs were made. Since the small particles do not obey Stokes' law and a relatively large fraction of the surface area is contributed by very small particles, the total surface is somewhat uncertain.

A microscopic examination was also made. A number of particles was measured on a sample projected at a magnification of 2500 diameters. Four hundred ninety (490) particles were measured in all. The distribution found is given in Table II.

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TABLE II

Particle Diameter Microns	Number Particles per hundred
0 - 3.32	98.286
3.32 - 4.68	0.941
4.68 - 6.62	0.545
6.62 - 9.35	0.0993
9.35 - 13.2	0.0743
13.2 - 18.7	0.0413
18.7 - 26.5	0.00827
26.5 - 44	none seen

The Photelometer results leaves the number of particles in the smallest group (0 - 3.32 μ) uncertain and thus the weight fraction is not known. The microscopic count did not measure the average diameter of the small particles very well. To get a rough value of the absolute surface, we combined the results: we assumed that the Photelometer value of 44% of the total area of the sample in this group was correct, and that the relative numbers of particles was given by Table II. These assumptions lead immediately to a surface average diameter of 0.26 μ for the 3.32 micron group and 6.94 μ for the 0 - 44 μ group. The total surface of the sand per gram is 356 cm^2 with the distribution shown in Table I. The density of the sand was measured to be 2.65 by Potratz. The value of the diameter of the largest group (> 840 μ) was assumed to be 1200 μ. Since there is such a small fraction of the surface in this group, this diameter does not matter very much.

The surface average diameter of the sample as a whole is calculated to be about 64 μ.

John Magee and Robert Kamm

jah

cc - Oppenheimer, Aebersold, Bethe, Carlson, Hempleman, Capt. Jones, Capt. Nolan, Parsons, Penney, Reines, Segre, Seybolt, C.S. Smith, Sugarman, G. I. Taylor, Turkevich, Col. Warren, Weisskopf

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 [redacted]

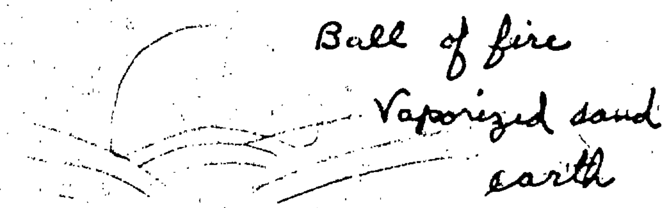
CONFERENCE ABOUT CONTAMINATION OF COUNTRYSIDE NEAR TRINITY WITH RADIOACTIVE MATERIALS

Present: R. Oppenheimer, R. Tolman, L. H. Hempelmann, Col. Warren, Capt. Nolan, J. Hoffman, J. Hirschfelder, V. Weisskopf, Magee, Capt. T. Jones, and P.C. Aebersold.

Hirschfelder discussed the mechanism by which radioactive materials fall out of cloud.

After explosion most of active material is on fringe of ball of fire. When shock wave hits ground (expanded 100 ft.) the ball of fire will be 10 ft. from ground. Reflected shock wave will bring up some dirt, largely vaporized. Ten percent of energy of gadget will to into the ball of fire--500 tons TNT, at most, will vaporize 100-200 tons of sand. Under ball of fire will be air under compression--after shock wave passed the dirt will pop up.

Fig. I



Most of dirt will go out at angles, but there will be conditions of turbulence bringing earth into ball of fire. Vaporized sand will form smoke. Active material will be deposited on smoke and on sand. Oppenheimer questioned deposition on sand as compared with formation of nuclei of active material. Weisskopf pointed out that there would be a competition for the active material by atoms, smoke, and sand. Time for active atoms to find each other is longer than for active atoms to find smoke and sand particles. Guess that 10% to 50% of activity deposits on sand.

This ball of fire cools in a few tenths to several seconds during which time all activity condenses on smoke or sand. Assumed rise to 12,000 feet.

[redacted]

 [redacted]

Particle size and time of fall:

Diam u	t fall hrs.	% Act
340	.110	3.8
250	.208	12.6
149	.585	14.5
74	2.37	13.1
less than 74		51%

Figure II.

Weisskopf explained influence of wind velocity and height of cloud on activity on ground. If the wind velocity is doubled, the activity on the ground will be doubled if the height is the same. Doubling the height will double the activity if the wind velocity is not changed. There is lateral spread and spread due to falling from greater height. If all activity on cold sand following table results

Figure III.

Distance from zero	h	Wind velocity	R/hr on ground
30	12,000	30	4
30	24,000	30-60	6.3-15 (reduced by lateral spread)
30	12,000	60	11
12	12,000	30	100
12	24,000	30	110 } reduced by lateral spread
12	24,000	60	200 } reduced by lateral spread
30	12,000	10	(0.6)

Danger ends after about 2½ hrs.

[redacted]

[redacted]

Low ground winds improve situation by not carrying activity as far. Ground winds should help spread activity. Afternoon thermals very strong will break cloud up. Cloud gets bigger as h increases--lateral spread greater as h increases.

Summary of discussion to this point

1. Prefer wind velocity not too high, propose 15-30 mi/hr.
2. Inversion at any altitude above 8-10,000 ft. will be O.K.
3. Wind not blowing over Carrizozo.
4. Exclude rain within morning hours.
5. Unlikely in a low wind to get into trouble unless direction indeterminate

Tolman brought up question of tolerance dose. Col. Warren took 60r in two weeks as safe. Even 100r would not be harmful provided there would be no further exposure to radiation.

Col. Warren thought a wind velocity of 30 mi/hr along either the N or S "blow" and an inversion around 12,000 ft. would be best.

Directions of wind were considered. South blow over Oscuro has the advantage of no near-by towns and has two mountain ranges to provide turbulence spreading. At end of falling range for 70 micron particles ($2\frac{1}{2}$ hrs.) dose will be small. North blow over Largo or Coyote has lots of farms but not much population close.

Question of integral dose considered. After 6 hrs. can get 4 times dose already accumulated. Effect of rain and wind may reduce the dose. Col. Warren would worry if peak reached 10r. Would make measurements for several hours and consider evacuation if total dose reached final total of 60-100r.

Tolman thought height of inversion not important (since, if too low, cloud will go through it); low wind velocity would be desirable, plans for evacuation should be very good. Plans for evacuation must be effective. Means a definite direction should be picked.

Weather policy will be made definite at Trinity meeting Thursday. By Saturday rehearsal plans of Medical Group can be definite.

10 July 1945

[redacted]

[redacted]

D. Aebersold's Calculation on Activity and Radiation Intensities of Cloud and Crater Region and Nolan's Map

(Pages 113 through 119 will be found in LA 631A.)

[redacted]

[redacted]

[redacted]

APPROVED FOR PUBLIC RELEASE

[redacted]

To: K. T. Bainbridge October 2, 1944

From: V. Zimmermann

Subject: FRAGMENT SIZES, VELOCITIES AND RANGES

A detailed study was made of fragments which would be likely to occur in Jumbo #2 for internal explosions of 50 to 500 tons TNT equivalent. The calculations indicate that no fragments will reach 10,000 yards, and that structures at this distance and beyond would be safe from damage from fragments. The worst cases gave a range of about 6,500 yards with a striking velocity of less than 600 feet per second, a weight of about 30 pounds and an impact angle of 75° from the vertical.

The difference between the calculated values and those which may be obtained experimentally will be due largely to two factors, (a) the impossibility of assigning correct ballistic coefficients to the fragments, and (b) the generous approximations made in the calculation of the paths. Both (a) and (b) were purposely made large and the results obtained, therefore, contain a large safety factor.

For internal explosions of 50 to 500 tons TNT equivalent, it can be assumed that Jumbo #2 will fragment. For higher energy yields, between 500 and 1000 tons, the steel will become "dust" or the temperature will become so high that it vaporizes.

As in bomb fragmentaion, we can assume that the Jumbo will expand somewhat before fragmentation occurs. Hence, the vessel becomes more nearly spherical in shape before breaking up.

Calculations were made for various energy yeilds, using the following basic assumptions (recommended by Dr. Bethe in connection with Jumbo #1):

Maximum fragment thickness = 3 inches

Diameter of fragment = 3(210/E) inches

$$V = 3(E/M)^{1/2} \text{ kilometers per second}$$

where E is the energy yield in tons of TNT and M the weight of Jumbo in tons. Taking this initial velocity assumes that all the energy is converted into kinetic energy.

Because of their low ballistic coefficients, fragments suffer tremendous retardation at the beginning of the paths. This retardation was computed from the residual velocity law for fragments*:

*Morse: Directions for numerical reduction of bomb fragmentation data and the calculation of the damage function. Report no. T. D. B. S. 9, May 11, 1943.

 [redacted] 122

$$r = 22{,}460\ (C/H)\ (\log_{10} V_0 - \log_{10} V)$$

r = distance along path in feet

C = ballistic coefficient = $0.0204\ w^{1/3}$

w = weight of fragment in grams

$H = 10^{-.000045\ y}$

y = altitude in meters

These results were obtained from elaborate experimentation by Charters et al, at the Ballistics Research Laboratory at Aberdeen Proving Grounds. They agree substantially with the experimental results of Lt. Comdr. Norris Bradbury at Dahlgren Naval Proving Grounds. Bradbury found $C = .014\ w^{1/3}$ and a retardation function agreeing closely with the above. The difference of 30% in C is due to the difference in the nature of the fragments fired and shows the sort of accuracy to be expected in calculations of fragment trajectories.

The altitude of the test was assumed to be between 4,000 and 5,000 feet above sea level.

When the residual velocity reached about 3,000 feet per second (which occurred in less than 0.25 seconds in all cases) a point to point integration was made for the rest of the path. The approximations used in this integration were very large and the trajectories are probably about 10% in excess of the true paths.

The following results were obtained for the most dangerous fragments at the various pressures:

E (tons)	Max. wt. (lbs)	Initial Velocity (ft/sec)	Max. range (yds)	Striking velocity (ft/sec)	Angle of fall	Max. alt. (ft)
50	30	4,802	6,500	572	75°	9,004
250	1.21	10,739	3,550	337	82°	5,526
500	0.302	15,187	2,300	293	86°	4,511

The maximum altitude recorded in the last column of the table is that altitude obtained by the most dangerous fragments at the given energy yield. However, directly above the explosion and within a radius of 2,000 yards of it, fragments which are projected at high angles will obtain an

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[redacted]

altitude of between 15,000 and 25,000 feet at 500 tons TNT equivalent. Comparable altitudes will be obtained at other pressures. These calculations were made ignoring the damping effects of the concrete casing. This will probably reduce the figure appreciably.

The ballistic coefficient of any projectile can normally be determined only by experiment. This is true because the ballistic coefficient varies inversely as the form factor of the projectile. The form factor assumed for the fragments was 1, which is obviously low and, therefore, the ballistic coefficients, which ranged from 0.10 to 0.50 are probably high for a majority of the fragments since the variations in shape and size are indeterminate. We can assume, therefore, that a large safety factor is included in the results.

For a fragment to have a range of 10,000 yards, it would have to weigh between 230 and 500 pounds as the energy of the explosion ranged from 500 to 50 tons. This would give a ballistic coefficient greater than 1, which is highly improbable. Since the fragment size used in the calculations was high in comparison to that encountered in analogous experiments, it seems impossible for any such large fragments to be projected at an initial velocity high enough to complete 10,000 yards. These large fragments could occur only if the explosion was non-symmetrical or if rupture occurred in the steel before the high pressure had been obtained. In which case, the energy yield would be much lower, and the corresponding velocity would be so low that the maximum range would be less than 10,000 yards.

V. Zimmermann

cc: Oppenheimer
Parsons
Carlson
Bradbury
File - 2

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Page

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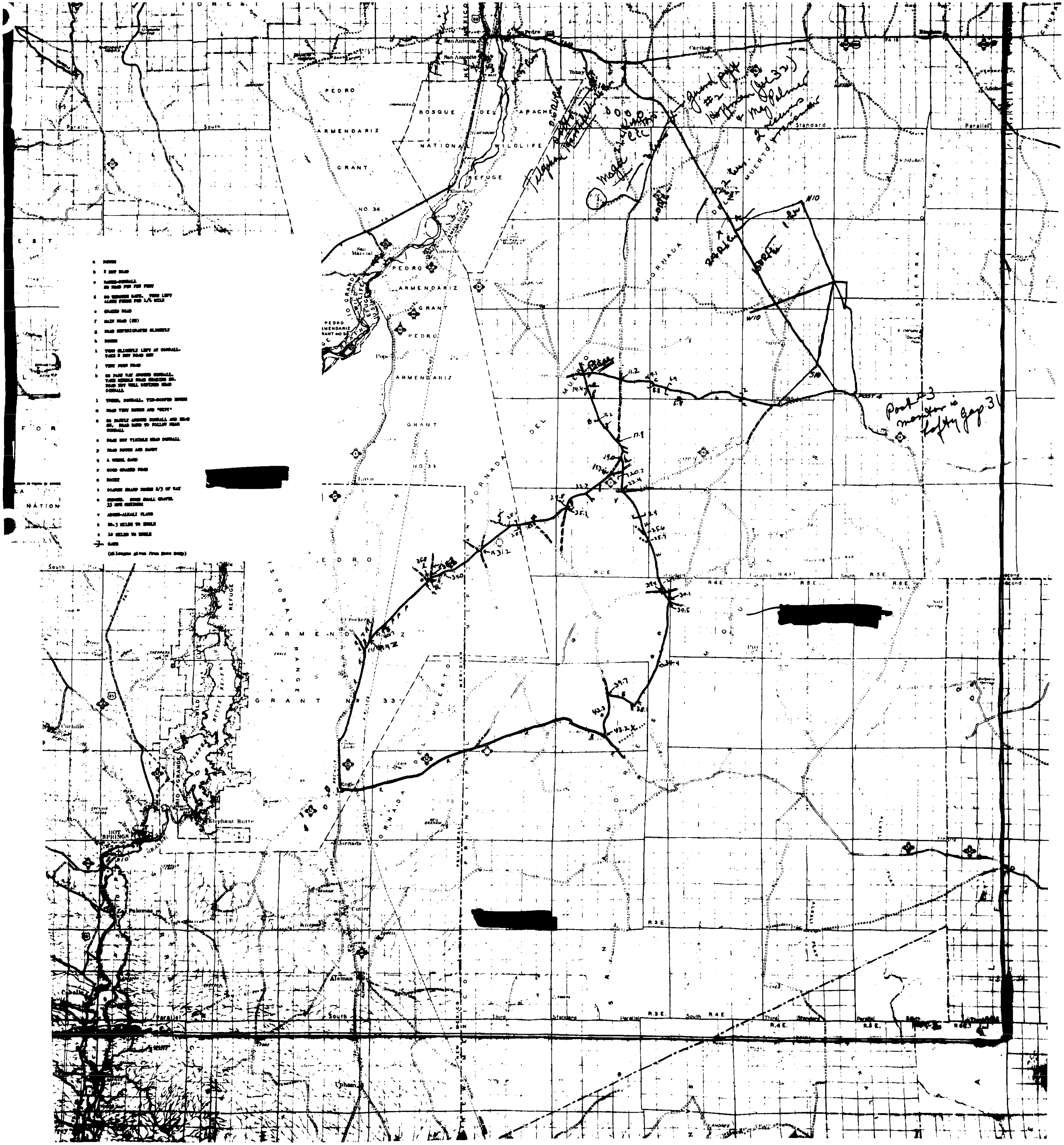
PEDRO
ARMENDARIZ
GRANT
BOSQUE DEL APACHE
NATIONAL WILDLIFE
REFUGE
NO. 34
NO. 33
JORNADA
DEL
MUERTO
San Antonio
Carthage
Bingham
Tokay
Elmendorf
San Marcial
Engle
Elephant Butte
HOT SPRINGS
Las Palomas
Cutter
Aleman
Jornada
Upham
RIO GRANDE
RANGE
South
Standard
Parallel
Third
R 3 E.
R 4 E.
R 5 E.
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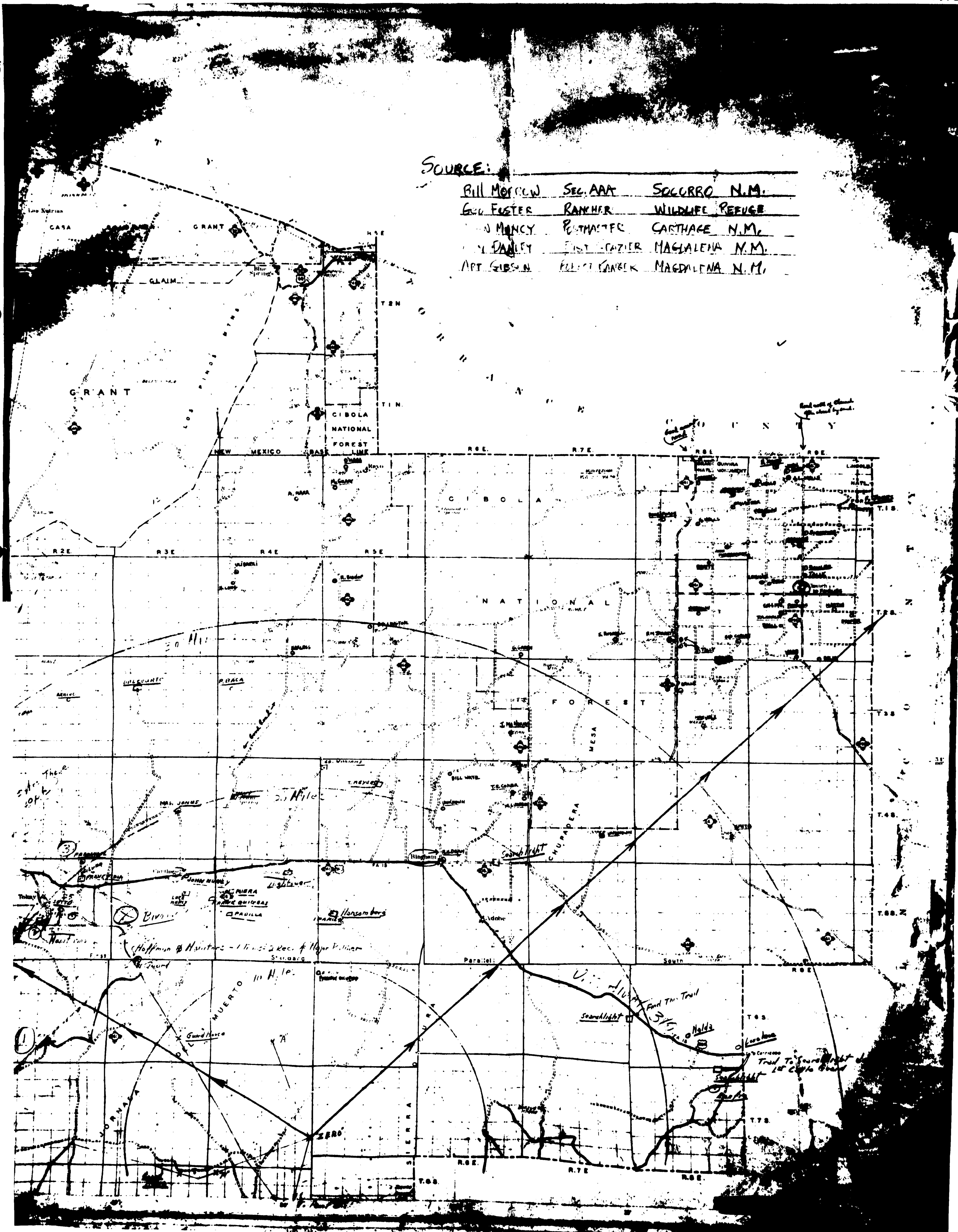
SOURCE:
Bill Morrow Sec. AAA Socorro N.M.
Rancher Wildlife Refuge
Postmaster Carthage N.M.
Magdalena N.M.
Art Gibson Magdalena N.M.
GRANT
CIBOLA NATIONAL FOREST
NEW MEXICO BASE LINE
CIBOLA
NATIONAL
FOREST
CHUPADERA
MESA
R2E
R3E
R4E
R5E
R6E
R7E
R8E
T.1N.
T.2N.
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T.3S.
T.4S.
T.5S.
T.6S.
T.7S.
T.8S.
SIERRA
ZERO
Searchlight
Bingham
Adobe
Hansonburg
Padilla
Find This Trail
Lavalorosa

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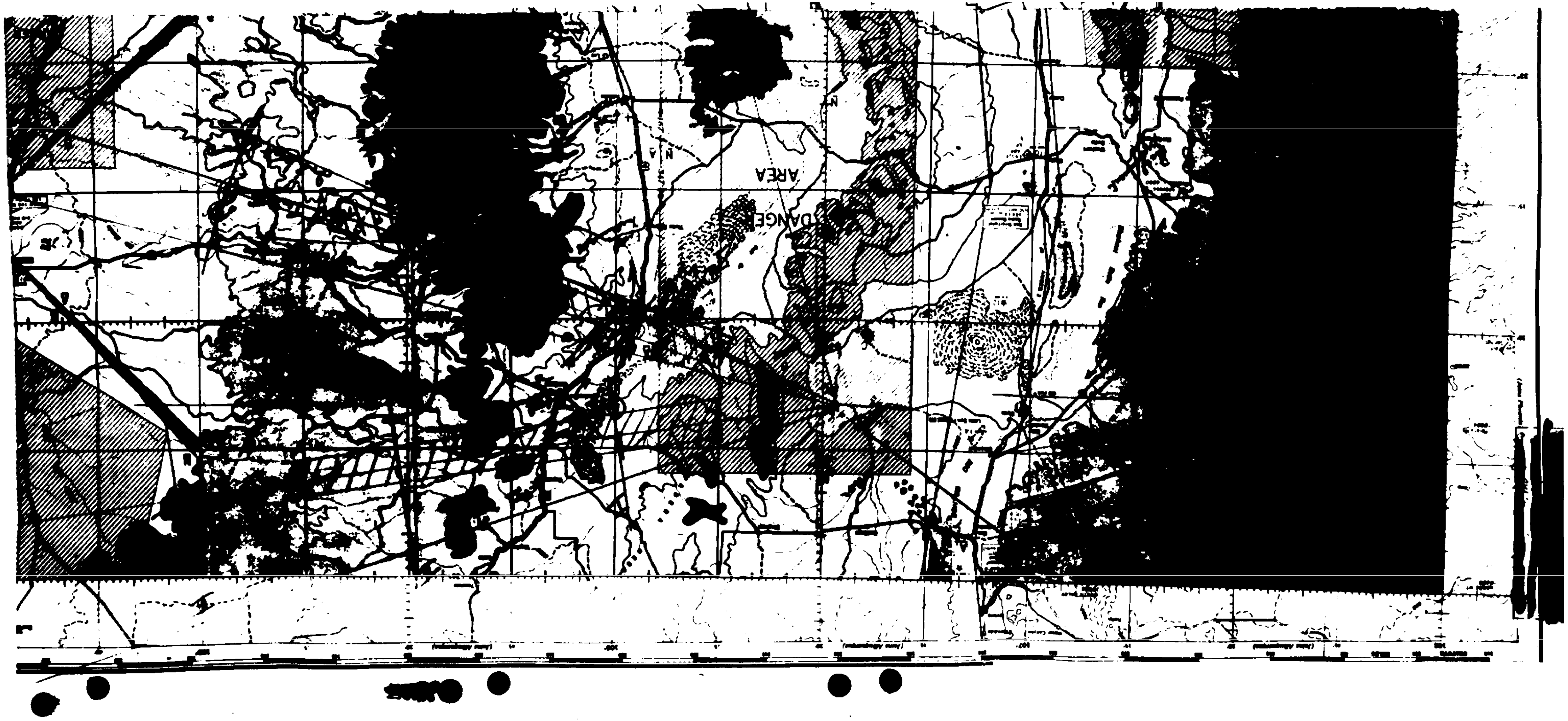

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IV-G-a [redacted]

All Concerned June 16, 1945

K. Bainbridge

Preparations for Covering Up at O After the Shot:

I have appointed the following committee on which I hope you will serve:

J. H. Williams, Chairman
Capt. J. Nolan
F. Oppenheimer
R. W. Carlson
V. Weisskopf
K. Bainbridge

The first meeting of the committee will be in Bainbridge's office, Room A-201, on Monday June 18, 1:15 p.m.

The purpose of the committee is to consider in detail methods for rendering harmless any plutonium which is left behind following the shot, and ultimately, through J. H. Williams, to arrange for carrying out the method or methods recommended by the committee.

J. H. Williams and F. Oppenheimer are obtaining cost estimates on several of the following proposals:

1. The soil surrounding O is picked up and conveyed pneumatically to the crater, and after the greater portion is deposited there it is sprayed with oil or capped with a layer of concrete.

2. The soil is oil sprayed in place and later disposed of by piling or trucking to the Rio Grande for disposal.

3. The soil is cemented in place by mixing with cement dust and then watering and later is piled or trucked away.

4. The soil is picked up and loaded into trucks by a pneumatic conveyer system and the trucks deposit it in the Rio Grande.

5. A ditch is dug with a ditch digger on the west side, towards which the ground slopes, and the soil from the ditch is piled on the west side of the ditch. The top soil is then hydraulically sluiced into the ditch and covered up with the ditch soil.

6. The soil around O is given the Hercules resin treatment and then fenced in.

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[redacted]

7. The contaminated soil is covered with clean soil sprayed on pneumatically and then the region is oiled or capped with concrete and fenced in.

8. This may be the most promising -- the contaminated soil is piled in the crater and in a cone above the crater by drag line, or the contaminated soil is covered with clean earth brought in by drag line.

In almost every case a fence will be essential around the contaminated region.

The solubility of the oxide or other probable compunds of plutonium enters into these considerations, and information on probable compounds and their solubility shall be obtained by F. Oppenheimer prior to the meeting.

KTB/bsa

K. BAINBRIDGE

J. R. Oppenheimer
Capt. J. Nolan
R. W. Carlson
F. Oppenheimer
V. Weisskopf
J. H. Williams
file

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[redacted]

INTER-OFFICE MEMORANDUM

TO: Covering Up Committee

DATE 25 June 1945

FROM John H. Williams

SUBJECT: Agreements Reached in Meeting of 25 June 1945

Proposed program is as follows:

1. Carlson will make tests with the samples of emulsified oil at present en route to him for oil penetration in TR dirt. He will also procure of the order of 20 gallons each of certain weights of emulsified oil for rapid delivery.

2. After the choice of oil is made, plans will be made to spray or drool this oil over 800,000 sq. yds. around 0. Williams has agreed to consult with Major Stevens as to availability of pressurized oil spray vehicles or if these are not available the usual oil drooling trucks. This operation should be planned to commence within 10 days to 2 weeks after the first TR shot.

3. Consideration should be given to the practicability of using Sauerman dragline equipment to move this oil penetrated dirt into the crater region. Stevens will be consulted on this point.

4. If the above operations can be accomplished the center pile will be capped with concrete or similar material.

5. Security fence will be constructed about the operations.

Subsequent discussion lead to the conclusion that Dr. Nolan would consult with Lt. Bush as to security guarding and health problems associated with the contamination period during the period from 4 days to 2 weeks after the operations, and later during the covering up program suggested above.

John H. Williams

cc-Capt. J. Nolan
F. Oppenheimer
[illegible] Carlson
V. Weisskopf
K. Bainbridge
File

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[redacted]

[redacted]

Form 25

[redacted]

[redacted]

[redacted] [redacted]

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INTER-OFFICE MEMORANDUM

DATE 18 May 1945

TO: Mr. John Williams

FROM J. F. Nolan, Captain, M.C.

SUBJECT: Reference your TR memorandum 17 May 1945

1. VEHICLES:

Aside from the two ambulances now stationed at Trinity, the Medical Group will need two (2) four wheel drive vehicles; one of these will be needed about 1 June 1945, and the other about 15 June 1945.

2. SHELTER SPACE REQUIREMENTS:

The health instruments for monitoring the shelter will be placed outside of the shelters, but one member of the Medical Group is to be stationed inside each shelter.

3. ELECTRONIC EQUIPMENT - BUILT, BUILDING OR CONTEMPLATED FOR GADGET SHOT:

This information will be furnished in a separate memorandum by Richard Watts.

4. PERSONNEL:

On a semi permanent basis from 1 June 1945, the following men will be at Trinity:

Captain Nolan, R. Watts and Scivally.

Just prior to the shot, the following men will act as monitors:

Lts. Allen and Large, Captain Barnett, Sgts. P. Levine, Joel Green, Robert Leonard, and Mr. A. Anderson. Colonel S. L. Warren, Dr. L. H. Hempelmann, and J. Hoffman will act as medical observers and consultants. (if a plane is to be available, Mr. Larry Brown will be necessary to aid Mr. Watts in the installation of communication equipment between the plane and base)

5. ORGANIZATION:

Captain Nolan will act as Dr. Hempelmann's deputy at this experiment; Mr. Watts will be in charge of the health instruments; the Medical Officers will be present in case of disaster, but will act as monitors; however, monitoring will be the primary duty of the technicians.

cc/ Mr. K. Bainbridge
File

[redacted]

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[redacted]

Mr. J. R. Oppenheimer

May 19, 1945

K. Bainbridge

Request for an Airplane and Crew for Use by Capt. Nolan
G-2
J. M. Hubbard

1. An airplane, preferably a C-47 with crew to be based at Alamogordo or Albuquerque is needed on and after June 10, 1945.

2. Capt. J. Nolan has discussed his problems with Lt. R. A. Taylor and a C-47 is desired for "Health and G-2".

(a) Air and gound coordination of crews.

(b) Chasing the mushroom top.

(c) Measurements of the amount of fission products in the cloud and their dilution up to the time the cloud is innocuous.

3. J. M. Hubbard had independently requested an airplane for checking the local meteorological conditions near point zero, and in the adejacent valley and over the mountain ranges and towns to the east.

4. I shall be glad to discuss the question with you and would appreciate your advice on how best to proceed to obtain the airplane within the rather tight time schedule which should be met for maximum effectiveness.

The C-47 or Douglas DC-3 is one of the more easily obtainable planes and meets the ceiling and reliability (2 engine) requirements.

KTB/usa

K. BAINBRIDGE

cc - Capt. J. Nolan
Lt. R. A Taylor
J. M. Hubbard
file

[redacted]

[redacted]

135

May 19, 1945

Messrs. J. H. Williams and K. Bainbridge

K. Bainbridge

III Vehicles

Capt. Nolan will require two 4x4 3/4 T carryall vehicles for local survey work for the period extending from one week before the test to two weeks after the test. These should be equipped with radios. This request is based on a conversation with Capt. Nolan on May 18.

K. BAINBRIDGE

KTB/bea
cc - Lt. Comdr. Keiller
Capt. Nolan
Dr. Hempelmann
file

[redacted]

[redacted]

Capt. T. O. Jones May 19, 1945

K. Bainbridge

Addition to Your List of May 1 of Persons Authorized to Place Calls from TR to Project Y or from Project Y to TR

Please add Capt. J. Nolan's name to this list and acknowledge to me. Capt. Nolan is working with Dr. Hempelmann and is responsible for the TR phase of Dr. Hempelmann's work.

Dr. Hempelmann's extension (214) should be added to the list of authorized extensions and the local operators and Denver operator should be notified. The load on extension 21 is increased to such an extent, and Dr. Hempelmann's and Capt. Nolan's work will increase, so that I do not believe the use of extension 21 by them is feasible any longer.

K. BAINBRIDGE

KTB/bsa
cc - Dr. Hempelmann
Capt. Nolan
J. H. Williams
file

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[redacted]

[redacted]

XV-L.a [redacted] 138

L. Alvarez and B. Waldman 9 June 1945

N. F. Ramsey

This memo is to confirm my oral agreements with you that you will assume the responsibility for cloud chasing in the Trinity tests. This work will have to be coordinated with Bainbridge, Nolan and Hempelmann, etc.

NFR:de N. F. Ramsey

[redacted]

APPROVED FOR PUBLIC RELEASE

IV-L-3 [redacted] 139

June 18, 1945

Bernard Waldman

V. F. Weisskopf

Here are the data concerning the danger of flying through the radioactive cloud with an airplane. In the following table you find under column A the time in minutes in which you breath one microgram of 49 in the cloud. Under column B you find the amount of radiation received per second in R units. From this you can see that it is perfectly safe to fly through the cloud one hour after the shot. The safety limit is one microgram of 49 in your lungs and 5 Rs of gamma radiation. The effect of the beta-rays are much smaller than the gamma-ray effects.

Time in minutes after shot	A in minutes	B (R units/sec)
20	9	2.1
60	24	.3
120	60	.05
240	175	8×10^{-3}

V. F. Weisskopf

cc: Alvarez
Bainbridge
Hempelmann

[redacted]

IV-I-(

140

[redacted]

2 January 1945

To: Trinity

From: L. H. Hempelmann

Subject: Report of airborne operations on 16 July 1945

No written report ever obtained from persons in air at Trinity 16 July 1945. Entire operation including pressure gauge measurements snafued because of poor visibility. First plane circled cloud for 25 minutes at 27,000 feet and apparently did not see upper cloud. According to Captain Parsons, the cloud had begun to be torn apart at this time. Relief plane followed cloud for 2 hours but did not know location or size. Films were not dropped through cloud because of great height.

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Page

J. Miscellaneous Memos

[redacted]

IV-J-1

INTER-OFFICE MEMORANDUM

[redacted]

April 18, 1945

To: Dr. L. H. Hempelmann

From: E. Segre

At the beginning of May we plan to make an experiment involving the use of about 200 curies of RaLa at TR. I would like to discuss the safety precautions for this experiment with you, but we will need anyway 3 Landsverk radiation meters and coveralls for the persons involved. Deutsch, Linenberger, and myself will participate in this experiment.

E Segrè

[redacted]

K. T. Bainbridge April 16, 1945

J. Hirschfelder

FREAK GLASS BREAKAGE AND NOISE

The following table is a summary of the distances at which glass damage was done in various large explosions recorded in Assheton's History of Explosions. There is no regularity in these figures and no indication as to whether only a few windows were broken or whether the window breakage was general. Also there is no information as to whether the glass breakage at the largest distances occurred downwind.

However, from this table it appears that:

I. It would seem unlikely that windows would be broken at a distance of 20 miles in the 100 ton test.

II. It seems very likely that large store windows may be broken at a distance of 20 miles in the actual test.

Because of unpredictable zones of silence, we cannot be sure that no damage will be done at a particular location. For example, in the Bombay explosion, no glass damage was reported at a distance greater than 2-1/2 miles.

I have been studying the existing data on the noise from large explosions. Apparently sound travels up into the stratosphere to a height of 30 to 40 kilometres and is then refracted downwards so that the sound of the explosion is often heard at distances of 100 to 200 miles away. There is a rule that in the summer time this noise is to be expected to the west of the explosion and in the winter time to the east, but this rule does not seem to hold in a large percentage of known cases.

I believe that the air conditions in the stratosphere above Southern California have been extensively studied and as a result we might be able to make some sort of estimates on the region in which the Trinity blast might be heard.

Would this be of any particular interest from the standpoint of security and the like?

J. Hirschfelder

JH:jsh

cc - Captain Jones
Hempelmann
W. G. Penney

[redacted]

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[redacted]

[redacted]

GLASS BREAKAGE - Asphetons HISTORY OF EXPLOSIONS

D miles	W tons	D/W 1/3	Page
[illegible]	[illegible].09	4.875	97
15.	[illegible].75	9.6774	127
[illegible]	4.83	[illegible].5503	1[illegible]8
1.	5.0	[illegible].848	[illegible]12
[illegible]	[illegible].44	4.[illegible]011	150
0.5	10.	.2[illegible]26	[illegible]96
0.[illegible]4	10.[illegible]	.1096	[illegible]13
[illegible]	1[illegible].0	[illegible].4934	169
[illegible]	1[illegible].78	[illegible].187[illegible]	255
[illegible]	1[illegible].79	12.8906	[illegible]08
[illegible]	17	.9728	300
.19	[illegible]0	.0701	297
[illegible].68	[illegible].75	.[illegible]47[illegible]	2[illegible]3
[illegible]	[illegible].95	[illegible].727	193
18.	[illegible]4.[illegible]4	[illegible].2069	205
5.	[illegible]3.	1.5576	208
[illegible]	[illegible].86	1.744[illegible]	211
10.	21.75	[illegible].8818	212
[illegible]	[illegible]1.70	[illegible]	214
[illegible].84	55.[illegible]5	.7454	215
[illegible].82	[illegible].27	.717[illegible]	216
[illegible]	67.5	1.4742	218
7.	81.[illegible]	1.[illegible]	219
[illegible]	90.[illegible]	1.1161	257
5	1[illegible]4	1.0[illegible]20	305
10.	19[illegible].[illegible]1	1.71[illegible]3	224
[illegible]475	200.	.81[illegible]0	2[illegible]8
[illegible]	225.46	.6568	282
1.5	2[illegible]0.81	.[illegible]445	248
[illegible]198	285.00	.[illegible]049	227
[illegible]25	300.00	.7[illegible]48	229
2[illegible]0	4[illegible]7.5	.5[illegible]70	2[illegible]
[illegible]	500.	.[illegible]149	Bombay *
[illegible] (8[illegible])	[illegible]5.8[illegible]	4.7664 (8.10[illegible])	[illegible]01
[illegible] ([illegible])	1800	1.1966	Pt. Chicago *
[illegible] ([illegible])	[illegible]7.[illegible]	.7[illegible]7 ([illegible].7)	24[illegible]

* [illegible] Einstein [illegible] report

[redacted]

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[redacted]

April 18, 1945

Mr. J. Hirschfelder

K. T. Bainbridge

Freak Glass Breakage and Noise

Thank you for your memorandum of April 16 on freak glass breakage and noise. General Groves brought up this subject in a conversation April 18 and suggested that blast measurements should be made beyond the 10,000 yard points, possibly only in adjacent towns so that if any legal questions arise there will be some information available on actual blast pressure at the points in question. If elementary type blast gauges can be designed and built prior to the gadget shot, it would be profitable to have equipment of this type in Dr. Hempelmann's vehicles.

K. T. Bainbridge

KTB/bsa
cc - J. R. Oppenheimer
Capt. Jones
L. H. Hempelmann
J. H. Manley
W. G. Penney
file

[redacted]

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[redacted]

Capt. T. O. Jones May 2, 1945

K. Bainbridge

Legal Aspects of TR Tests

It is my understanding from conversations with Gen. Groves on 18 April that he was going to get additional legal talent to consider and act on the legal aspects of the TR tests. The purpose of this note is simply to call your attention to some of the items which should be discussed with Dr. Hempelmann and any legal talent.

1. There are some coal mines to the north west in the vicinity of Tokay and Carthage. Dr. Leet can help us on this if there is any worry about earth shock, as he is an expert on earth shock in the vicinity of quarry blasts and in his book he states that there is less motion and earth shock underground and it is harder to perceive a quarry blast while underground than it is while on the surface considering ground effects alone. My worry with respect to these mines is that they are marginal mines and are probably not shored up according to approved methods. A few men work these mines more or less on a shoe string, so that there may be a hazard and it should certainly be considered by your office whether or not these people should be warned to get out. Dr. Leet will be at Trinity May 4, 5, and 6.

2. You have maps available giving the surrounding towns, the nearest settlement of over 50 people is 28 miles away. The towns of interest are San Marcial, San Antonio, Socorro, Carizozzo, Oscuro, Three Rivers, Tularosa and Alamogordo.

3. There are occupied ranches, the nearest one is greater than 12 miles away.

4. There are Alamogordo base personnel located at bombing range camps and rescue camps throughout the region of the air base reserve. These personnel need not be removed for the May 7 shot but should be removed for the later shots.

5. Gen. Groves felt that the preliminary plans were insufficient on preparations for eviction of people in towns in case that should be necessary. He said it was not sufficient to have a group of MP's; that commissioned officers would have to be present; and he mentioned the possibility of officers from Y going down to man the cars in addition to the MP's in the cars and the physicists who would be responsible for radiation and 49 measurements.

6. We are trying to get Don Leet here as an authority on earth shock and its effects. He is probably the foremost authority on siesmographic work relating to small explosions, quarry blasts, etc., besides being a seismologist of first quality.

[redacted]

[redacted]

7. On blast problems we have several authorities connected with the project--J. Von Neumann, W. G. Penney, Ens. G. T. Reynolds, W. G. Marley, and J. O. Hirschfelder, who can advise on the possibility of windows being broken at a distance, etc. Hirschfelder has already made a summary of such phenomena for observed cases of explosions of munition dumps, powder and H. E. manufacturing plant accidents, etc.

8. On problems of dilution of 49 and fission products, Gen. Groves has already taken steps to get Professor Church here, who has worried about similar problems at W and Chicago.

9. It may be that sufficient 49 is left in the soil in the vicinity of the shot to make it hazardous for a considerable time after the shot. Measurements can be made of the concentration of the soil by H. L. Anderson and his group. If this land is heavily contaminated and must be fenced in for considerable time after the test, then certain legal problems will arise because some of this land is homestead entry land, some is vacant land, and some is state grazing lands.

K. BAINBRIDGE

KTB/bsa
cc - J. R. Oppenheimer
Dr. L. Hempelmann
J. O. Hirschfelder
Lt. E. A. Taylor
J. H. Williams
file

[redacted]

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[redacted]

Lt. D. H. Dailey

June 30, 1945

F. Oppenheimer, K. Bainbridge

Your memo on Trinity of June 30

Although the date of firing of the TR shot will depend on smooth weather conditions and the absence of any inversions at altitudes less than 10,000 ft., I doubt that we can plan to delay the shot by waiting for a specific wind direction. It would seem likely that the shot will be fired for any wind direction between NW and SW with the exception of a wind that would carry the cloud directly over Carrizozo.

Present predictions indicate that on the morning of the 14th the wind will carry the cloud south of Carrizozo, whereas on the 18th or 19th the cloud will go north of Carrizozo. It would therefore seem advisable at this time for your men to be familiar with the roads and ranches in either direction. Mr. Hubbard is confident that a day before the shot it will be possible to specify the wind direction within quite narrow limits.

F. OPPENHEIMER, K. BAINBRIDGE

FO/bsa
cc - J. R. Oppenheimer
Capt. T. O. Jones
Capt. J. F. Nolan
Dr. L. H. Hempelmann
file (2)

[redacted]

IV-J-3 [redacted]

INTER-OFFICE MEMORANDUM

DATE July 7, 1945

TO: Mr. J. G. Hoffman

FROM: Pfc. R. M. Brownell & T/5 C. S. Hornberger

SUBJECT: Suggested Handling of Film Badges for TR

Since during coming weeks film badges will be handled by persons who are unaccustomed to their use and care, the following suggestions seem advisable.

I. Care:

A. Heat:

The maximum temperature that the photographic emulsions can withstand is 55° C. for 12 hours without effect upon the latent image. It seems wise to establish a working maximum of 45° C. (110° F.) This means that they should be stored out of the direct sunlight and in a place where cooling air currents are not obstructed.

B. Shock:

These badges are ruggedly constructed and are capable of withstanding considerable mechanical force; however, the capsules attached to the special autopsy type badges can be crushed, therefore, these badges are packed in boxes of three and should be returned in these boxes.

C. Radiation:

Because of the importance of these badges for measuring the radiation received by personnel, it is obvious that great care should be taken in their shipment and storage to insure that there are no natural sources nearby. This consideration is especially important since there are to be a large number of natural sources shipped at the same time.

II. Distribution and Collection:

At the time the badges are distributed, the man in charge should record the name of each person and the number of the badge which he issued to him. This badge roster is obviously of primary importance and upon its completeness depends the advantage accruing to the project as a whole and to the individual members concerned.

Upon collection, the regular badges may just be thrown in a box and returned while observing the same conditions as to heat and sources (including contaminated wrappings) as during initial shipment. The special autopsy type badges should be returned packed three in a box in the original boxes. To facilitate repacking, the neck bands may be cut off so that they can be placed more easily in the boxes.

III. Wearing:

The final suggestion is that drastic measures be taken to assure that they are worn all the time.

cc: Capt. James F. Nolan [redacted]
H&B:CSN

Form 20

(Shoot offenders at sunrise for not wearing them.)

[redacted]

S. O. P.

TELEPHONE INSTRUCTIONS

A. Preliminary Phase

1. R. W. Traver, Santa Fe, N.M. - - - - - - #1347
2. Lt. Robert Taylor, Santa Fe, N.M. - - - #0115
3. Lt. Robert Taylor, (Call Denver Operator 102, ask for Long Distance 16000, Extension 541) (Use this within 50 miles of Trinity)

B. Final Phase

1. Call Albuquerque, N. M. #25751, #26266, or #21141.

C. Request Operator to place a Priority 3 on calls.

1. In an emergency after the shot, if a Priority 3 does not work, a Priority 2 request is authorized.

D. Conversation over telephones should be guarded. Remember Trinity and Site Y must not be identified with each other.

E. After the shot, Form #A will be used and report will be by Item numbers.

Camp

1) Another phone (party line)
(Carrizozo)
S-10,000 MacDonald - Ring 2

2) Soccoro #2

[redacted]

[redacted]

RADIO SHOP HEADQUARTERS

Present:

1. Anderson, G2

   First priority at Zero on long distance; rest of time to alternate as necessary with Warren.

2. Warren (Mod.)

   First priority on long distance at Zero plus 15 and from then on alternate with G2 on long distance telephone.

3. Allen

   Search light data plot.

Needs of Medical Group at Radio Shop - for Radio:

1. Radio to guard at Border North or Post 2 at Zero plus 15 to notify Hoffman thin monitors of their problem.

2. Radio to G2 one hour later at San Antonio as Hoffman goes through to locate course.

3. Radio to Post 4 at Zero plus one hour for Lofty 31.