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U.S. DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE

REPORT OF THE INVESTIGATION OF THE ACCIDENT AT THE MIDAS MYTH/MILAGRO TRAILER PARK ON RAINIER MESA AT NEVADA TEST SITE ON FEB. 15, 1984

DATE OF INVESTIGATION REPORT
APRIL 9, 1984

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I. SCOPE OF INVESTIGATION

Fourteen persons were injured, one fatally, when the ground upon which they were working collapsed, forming a subsidence crater in the recording trailer park of the MIDAS MYTH/MILAGRO nuclear weapons effects test on Rainier Mesa at the U.S. Department of Energy's Nevada Test Site on February 15, 1984. Those persons injured were contractor and laboratory employees from Reynolds Electrical and Engineering Co., Inc. (REECo), Pan American World Services, Inc. (PANAM), and the Los Alamos National Laboratory (LANL).

The Manager of the Nevada Operations office (NV) formally appointed a Type A Investigation Board, with DOE, Contractor, Laboratory, and Field Command Defense Nuclear Agency (FCDNA) technical advisors on February 16, 1984 (Chapter VII). The Board was charged with submitting a formal report on the circumstances, cause(s), and contributing factors, if any, of the occurrences leading to the injuries incurred in this accident. The investigation and report preparation were to be conducted in accordance with guidance provided by DOE Order 5484.1, Chapter II.

The Board was given authority to consult with, enlist the aid of, and take statements from any and all personnel whose authority, responsibility, function, and activity might directly or indirectly bear on the circumstances under investigation (Exhibit 1). The authority of the Board also included the right to control the accident site, equipment, and materials therein, until such time as the Board chose to relinquish such control.

II. SUMMARY

On February 15, 1984, at 0900 PST (all times hereinafter are PST), the MIDAS MYTH/MILAGRO event was detonated in T tunnel U12t.04, in Rainier Mesa at the Nevada Test Site (Figures 1 and 2). Approximately one hour later, at 1007 the Portal and Mesa Reentry Parties were released from Station 300. The Portal Reentry Party proceeded to the tunnel area while the Mesa Reentry Party continued on to the recording trailer park on the top of Rainier Mesa. Upon arrival at the trailer park, a radiation safety survey was made and no radioactivity was detected. The cable cutting team then began its task of cutting and sealing the cables that ran between the cable hole and the trailers.

At 1214 the ground upon which the personnel were working suddenly collapsed, forming a subsidence crater with a maximum depth of approximately 5.1 meters. Fourteen U.S. Government contractor and laboratory personnel were injured, one fatally.

Immediately following the trailer park collapse, those persons that fell and were in condition to do so, despite their injuries, emerged from the crater. Those persons who were part of the Mesa Reentry Party and who were standing on portions of the trailer park unaffected by the collapse, called for help via radio and telephone, and assisted the injured.

The first ambulance from Area 12 Camp with two paramedics arrived at the trailer park 30 minutes after the collapse; three more ambulances arrived shortly thereafter. The first Air Force helicopter arrived directly from the Area 6 helicopter pad 36 minutes after the collapse and a second helicopter with a physician from Mercury arrived one hour and ten minutes after the collapse. Two additional helicopters eventually participated in evacuation of the injured.

All injured personnel were examined at the trailer park by either a physician, a nurse, or a paramedic, and were treated and/or immobilized (i.e., with medication, splints, braces, or slings) and evacuated to Mercury by ambulance or helicopter. Evacuation of all injured from the trailer park was complete by 1507, or 2 hours, 53 minutes after the collapse occurred. Notification and briefings were provided to the news media (Exhibit 2).

Specific factors contributing to the accident may have been one or more of the following:

- The pervasive belief that nuclear tests in Rainier Mesa would not result in surface collapse.

- The close proximity of the cable hole and trailer park to the MIDAS MYTH/MILAGRO SGZ.

- Less than adequate action on the part of responsible officials to properly evaluate geophone signals which provided sufficient warning to withdraw personnel from the trailer park before collapse.

- A shallower scaled depth of burial and shorter scaled separation between a previously formed cavity and the MIDAS MYTH/MILAGRO event, than for other relevant Rainier Mesa tests.

- Proximity of SGZ to the edge of the Mesa.

- Compromise of the welded tuff caprock integrity due to ground shock loading and stress relief across joints from repeated nuclear detonations in proximity to the MIDAS MYTH/MILAGRO SGZ.

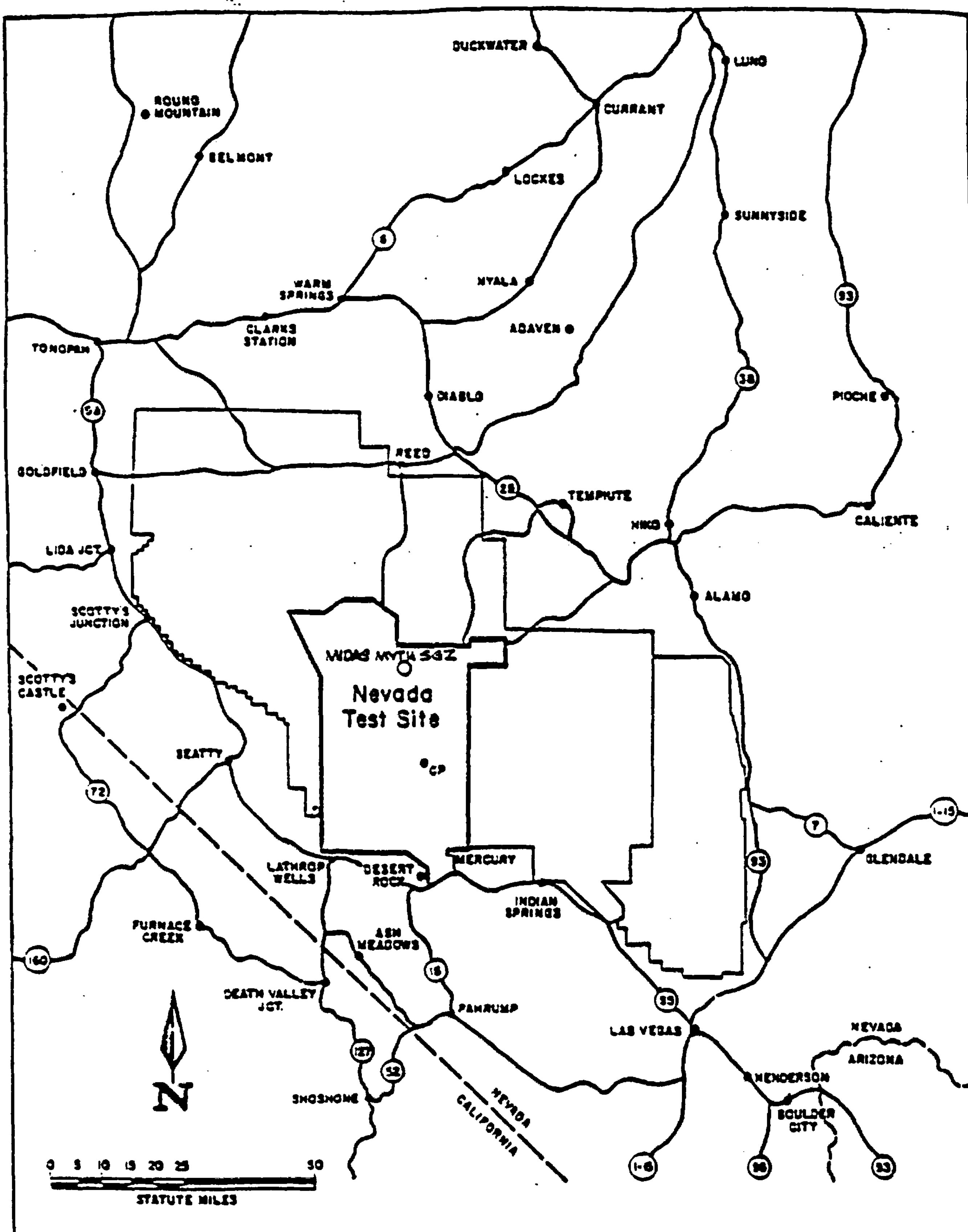


Figure 1 — Nevada Test Site Location Map

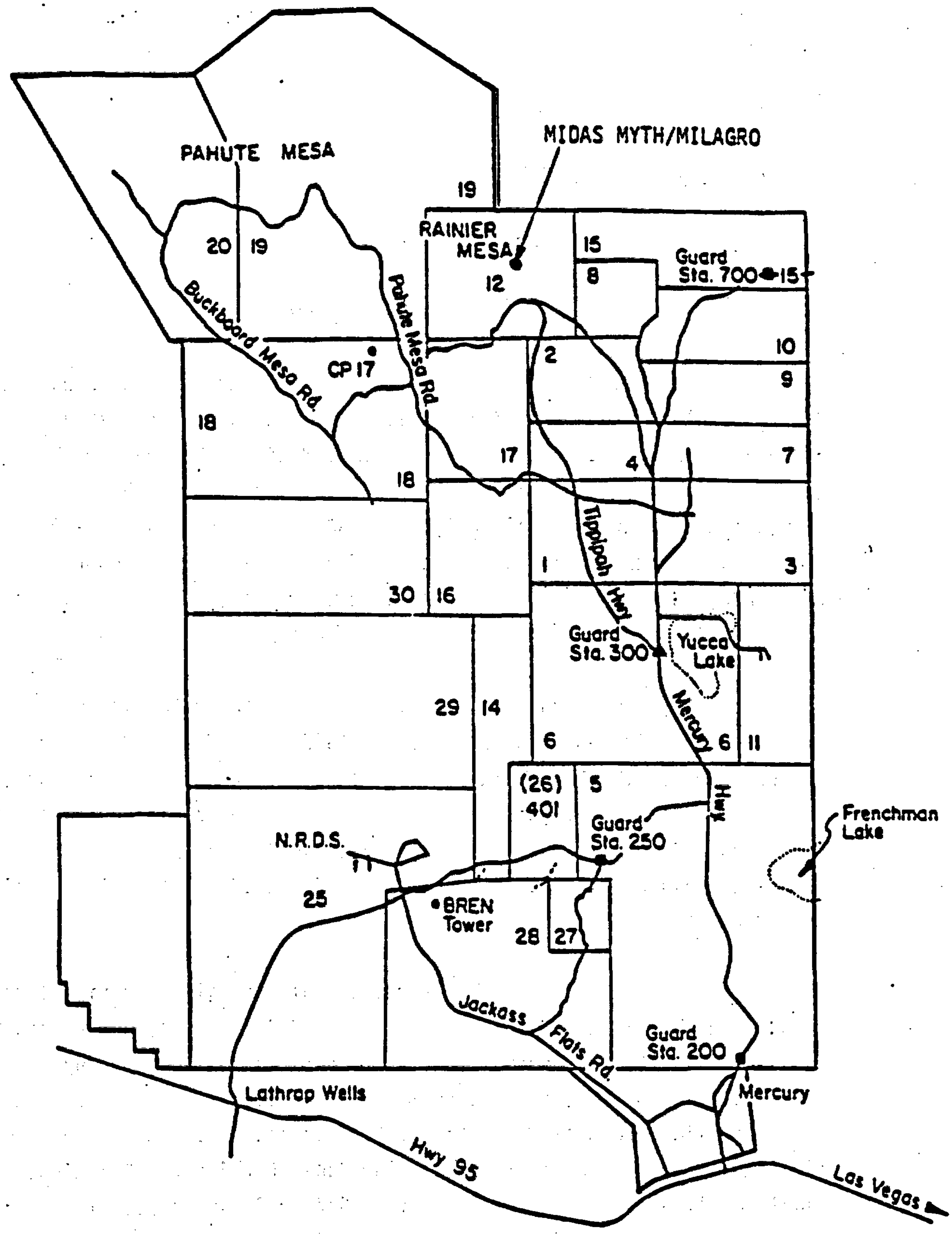


Figure 2 — Detail of Nevada Test Site

III. DISCUSSION OF FACTS

A. General Background

1. DOE Conduct of Nuclear Tests

Organization

The Nevada Test Site (NTS) is operated by the Department of Energy (DOE), Nevada Operations Office (NV), as an outdoor laboratory for the conduct of nuclear tests by the Los Alamos National Laboratory (LANL), the Lawrence Livermore National Laboratory (LLNL), the Sandia National Laboratories (SNL), and the Defense Nuclear Agency (DNA). The primary mission of NV is to support test operations and to provide for the planning, support, and conduct of authorized tests in the most economical fashion, subject to the overriding considerations of safety and successful containment.

Operations are carried out under the authority of the Department of Energy Organization Act of 1977, the 1963 Limited Test Ban Treaty policies and procedures, the Threshold Test Ban Treaty, the Peaceful Nuclear Explosives Treaty, and additional guidance as provided by the Assistant Secretary of Energy for Defense Programs. Operations are also subject to programmatic and detonation approvals provided by the Director, Office of Military Application, DOE Headquarters.

The Manager, NV, is responsible for all operational matters, conducting them in accordance with DOE and NV Directives, Orders and Notices, and within available funding. He is responsible for containment, safe conduct of tests, and post-test operations. He also retains approval for the release of all public information related to test operations. He provides for review of tests by the Threshold Treaty Review Panel (TTRP), the Containment Evaluation Panel (CEP), and the Nuclear Explosives Safety Study Group. The Manager, NV, manages the NTS, provides for the review of all tests, assures proper and clear assignment of responsibilities, adequacy of documentation, and appropriate receipt of and dissemination of information.

The scientific laboratory or agency sponsoring a nuclear test is responsible to the Manager, NV, for the design of systems for emplacement, stemming, and firing. Reviews of the physics of containment and ground response, and continuing scientific research by each laboratory and agency are required, also required are sufficient investigations to appropriately characterize the event site, and to evaluate its response to the detonation.

The sponsoring scientific laboratory, agency, or organization is given control of specified areas (such as ground zero areas) and is assigned primary responsibility for safety coordination.

Nuclear Testing

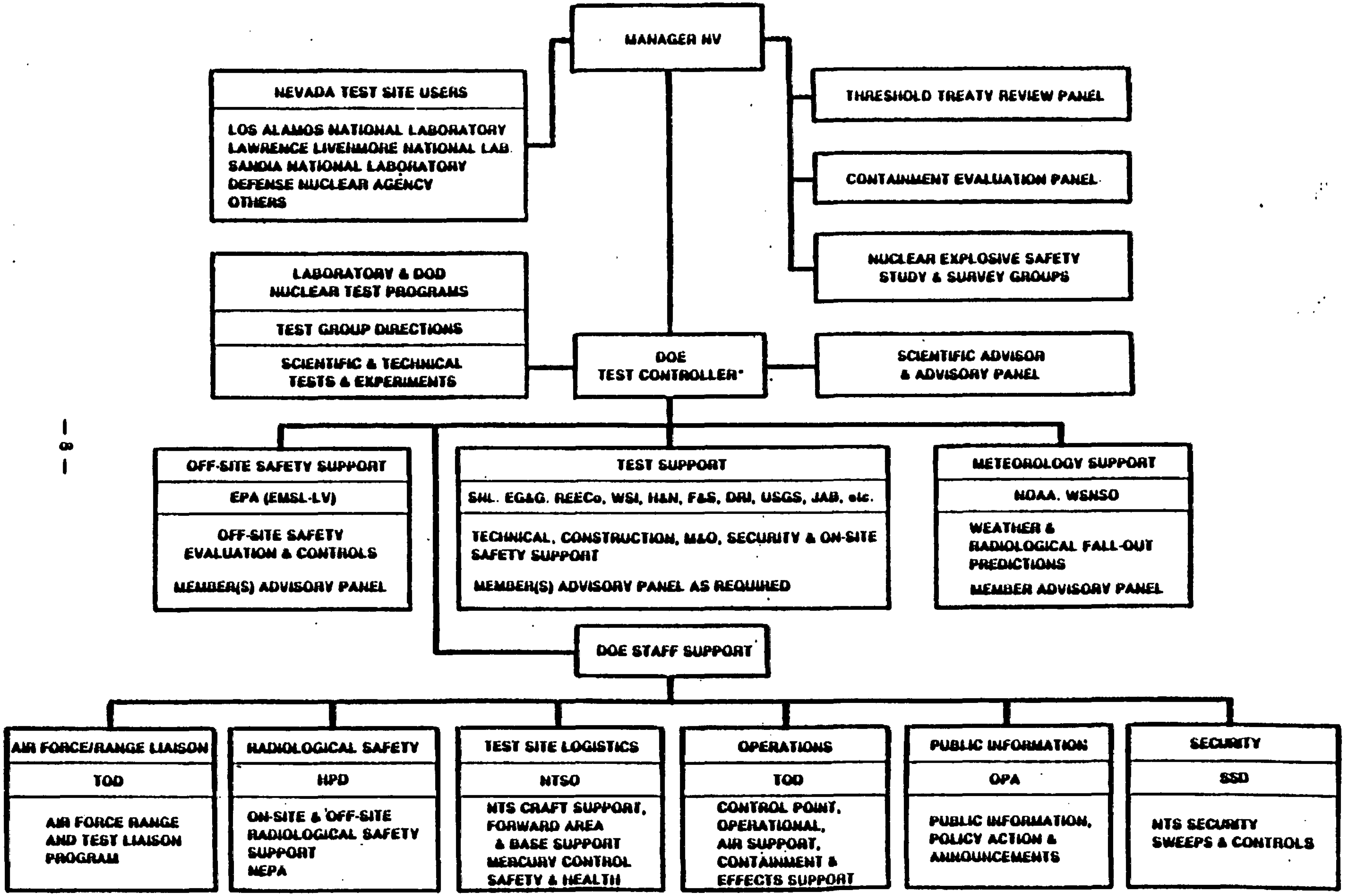
Test operations are conducted within the framework of a Nuclear Test Organization (NTO) (Figure 3). The NTO is a continuing task organization which is staffed by DOE, DOD, laboratory, contractor, and other federal agency personnel who participate in or provide support for test operations. The task organization for each nuclear test includes staffing by the testing laboratory or agency. The Manager, NV, heads the NTO.

A DOE Test Controller is appointed by the Manager, NV, and is assigned full responsibility for the safe conduct of the nuclear test.

A Scientific Advisory Panel, comprised of individuals who have combined expertise in the fields of underground testing phenomenology, meteorology, radiation medicine (an M.D.), and other subjects pertaining to the safety of a specific activity, is provided to the Test Controller for each test. The chairman of the Panel is the Scientific Advisor nominated by the testing laboratory and approved by the Manager, NV.

Test Group Directors (TGD) are assigned by the testing organization to direct fielding and technical aspects of experiments and tests.

UNITED STATES DEPARTMENT OF ENERGY
NUCLEAR TEST ORGANIZATION



* DESIGNATED FOR EACH TEST OR SPECIAL EXPERIMENT (ASSUMES OPERATIONAL CONTROL OF NTS DURING TEST OPERATIONAL PERIODS)

Figure 3 — Nuclear Test Organization

Government agencies supporting the NTO include EPA, NOAA, and the USGS (Figure 3).

The principal contractors supporting NTO operations and their primary responsibilities are:

<u>Reynolds Electrical & Engineering Co., Inc. (REECo)</u>

General support contractor furnishing field construction, drilling, mining, heavy equipment, housing, feeding, medical services, etc.

<u>EG&G, Inc. (EG&G)</u>

Technical support contractor furnishing timing and firing support, as well as mechanical and electronic diagnostic system support.

<u>Holmes & Narver, Inc. (H&N)</u>

Architect-Engineer contractor providing general A&E services.

<u>Fenix & Scisson, Inc. (F&S)</u>

Architect-Engineer contractor providing A&E services in drilling and mining operations.

<u>PANAM World Services, Inc. (PANAM)</u>

Photographic support services.

<u>Wackenhut Services, Inc. (WSI)</u>

Security services.

Responsibilities

Manager, NV--Coordinates preparation, planning, and execution of authorized nuclear tests, appoints the Test Controller, announces the test execution period, and heads the Nuclear Test Organization (NTO).

Test Controller--Assumes operational control of the NTS and the NTO during the test execution period. Responsible for the safe conduct of the nuclear test.

Scientific Advisor--Advises the Manager, NV, or the designated Test Controller on all applicable scientific and technical matters related to the safe conduct of each assigned test.

Advisory Panel--Evaluates containment, seismic shock, possible radiation releases, weather and area control plans . . . recommends to the Test Controller the advisability of proceeding with or delaying the particular activity under consideration. Panel is chaired by the Scientific Advisor.

Test Group Director--Acts as the official laboratory or DNA contact in all matters concerning the assigned nuclear test and is responsible to the Test Controller for the conduct of all personnel assigned by the testing agency.

The Director, Nevada Test Site Office (NTSO)--Responsible for the direction and control of construction and logistical support activities at the NTS and, during test execution period, supports the Test Controller directly in the field execution of experiments and test events.

The Director, NV Test Operations Division--Provides for the manning of the Operations Coordination Center and the services of the Test Operations Officer, Test Liaison Officer, Air Operations Officer, and support in the area of containment and effects and assures compliance with the National Environmental Policy Act.

The Director, NV Office of Public Affairs--Advises and assists the Test Controller with regard to informational aspects of public safety and public affairs generally, providing management of special projects as assigned.

The Director, NV Safeguards and Security Division--Assigns a security advisor to the Test Controller to provide coordination and resolution of security problems between the Test Group Directors, organizations and users in compliance with security policy.

The NV Health Physics Division--Provides a radiation safety advisor during test execution periods, coordinates and resolves radiological safety problems between the laboratories and other organizations and assures that the Test Controller is fully advised on radiological matters.

Further test support is provided to DOE and the testing organizations by the contractor organizations responsible for technical, construction, maintenance and operations, security, on-site safety and other support as required.

Test Execution

The Nuclear Test Organization (NTO) is directed by the Test Controller for the test execution period. A Test Controller's Advisory Panel under the chairmanship of the Scientific Advisor is assembled at the NTS. All other required elements of the NTO assemble at the request and direction of the Test Controller.

Prior to each scheduled nuclear test, a series of readiness briefings are held by the Test Controller. These are:

D-1 Day Containment Briefing. The Test Controller, Scientific Advisor and Panel, Sponsoring Agency Test Group Director (TGD), Nevada Test Site Office, REECo, H&N, and F&S representatives and laboratory containment specialists and others as appropriate review the as-built configuration versus the planned containment design for the test to determine if any significant deviations exist. If so, the Test Controller determines what further actions may be required. This briefing is normally held at the Control Point-1 (CP-1), NTS, one hour prior to the D-1 Readiness Briefing. Verbatim briefing transcripts are made (Exhibit 3).

D-1 Day Technical Briefing. The Test Controller, Scientific Advisor and Panel, with others as appropriate, are briefed by the Sponsoring Agency Test Group Director on the purpose of the test, the status of the prompt yield measurement systems (as appropriate), critical signals/operations and the preferred arming and execution time. Special security interests are described by the DOE Safeguards and Security Division and the NTS Security Branch. This briefing is normally held after the D-1 Day Containment Briefing. Normally minutes are not made of this briefing.

D-1 Day Readiness Briefing. The Test Controller, Scientific Advisor and Panel, Test Group Director, and supporting elements review the test readiness posture. Items reviewed include:

(1) Special Constraints.

(2) Technical Program Readiness. Presented by the sponsoring Laboratory Test Group Director or Test Director.

(3) Current weather conditions and predicted weather at scheduled shot time. Weather personnel status and plans. Presented by Weather Service Nuclear Support Office (WSNSO), National Oceanic and Atmospheric Administration (NOAA).

(4) Cloud trajectories, deposition pattern, and calculated exposures based on the appropriate release model and on the predicted weather conditions at shot time. Presented by WSNSO/NOAA.

(5) Calculated off-site whole body and thyroid doses to people within the postulated exposure pattern. Locations of people and milk cows in vulnerable positions within the pattern. Off-site monitor program status and plans. Such reviews are presented by Environmental Protection Agency/ Environmental Monitoring and Support Laboratory (EPA/EMSL).

(6) The on-site radiation monitor program status and plans, presented by the DOE Health Physics Division's Radiological Safety Advisor.

(7) Plans for NTS craft activities and emergency support plans, presented by the NTSO representative.

(8) On-site control and area clearance plans, manned and stay-in stations, air support missions, closed circuit television coverage, and any other special arrangements, presented by the Test Operations Officer, Test Operations Division.

After completion of reviews, the Test Controller's Advisory Panel deliberates and the Scientific Advisor presents the Panel's recommendations to the Test Controller to either proceed on schedule with plans, modified if appropriate, or to delay the test until acceptable readiness conditions are achieved. The time for the next readiness briefing is established and announced by the Test Controller. Verbatim briefing transcripts are made.

D-Day Readiness Briefing. The Test Controller, Scientific Advisor and Panel, Test Group Director, and supporting elements review updated readiness status and weather conditions. This briefing is held at the Operations Room, usually about two hours prior to the scheduled shot time. All subjects considered at the D-1 Readiness Briefing are updated. Actions previously authorized may be modified due to operational or weather constraints. The Test Controller's Advisory Panel considers the latest information available and provides its recommendations, through the Scientific Advisor, to the Test Controller to either proceed with the test or consider a delay. If the test is to proceed, the Test Controller grants the sponsoring agency permission to proceed.

The Test Controller, Scientific Advisor and Panel, with support elements then occupy the Operations Room to monitor weather conditions and operational developments on a continuous basis. As zero time approaches and conditions continue to prove favorable, the Test Controller authorizes the Sponsoring Agency to conduct the test as planned. The Test Controller can, if necessary, stop the test at any time during the countdown (usually 5 to 15 minutes in duration) as long as adequate reaction time is available to block the "Fire" signal.

Data Recovery (Reentry)

Recovery of event diagnostic data requires that technical and support personnel return to the test location as soon as it is determined that a safe reentry can be conducted. Specially trained reentry teams comprised of security, environmental monitoring, geological, and technical support personnel are held in readiness to return to the test area to recover data from recording trailers and other collection systems.

The Test Group Director, after determining under what conditions a safe reentry may be made, requests permission from the Test Controller to begin reentry and recovery.

The Test Controller, following consultation with the Scientific Advisor, authorizes reentry as soon as he determines it to be safe.

The Test Group Director then releases the reentry teams and directs reentry/recovery operations.

Reentry teams remain in communication, via radio and telephone, with the Test Group Director.

2. DOD Nuclear Weapons Effects Tests Planning and Execution

The Defense Nuclear Agency (DNA) develops a Five Year Nuclear Weapons Effects Test (NWET) Program that is reviewed, updated, and approved on a yearly basis. Each year, DNA requests that the military services, Defense Advanced Research Projects Agency (DARPA) and the Department of Energy (DOE) submit written requirements, covering the following five fiscal years, for information that can best be obtained from nuclear weapons effects tests. DNA sponsors a planning meeting at which test requirements are presented for review. As many of the requirements as possible are incorporated into the program within the limits of the anticipated DNA resources. The Five Year NWET Program contains such information as the following:

1. Specific events (by name or number)

2. Planned readiness dates.

3. General objectives for each event.

4. Tentative nuclear source requirements for each event.

5. Configuration: geometry (horizontal or vertical line-of-sight, cavity, etc.), environment (type and levels), and any unusual features.

The final version of this program is submitted by DNA to the Joint Chiefs of Staff (JCS) and the Under Secretary of Defense for Research and Engineering (USDRE) for review. Based on JCS and USDRE approval, DNA initiates planning of the specific event which begins with appointment of the test staffs, final identification of the source, and ordering of long lead time items.

The Test Group Staff is assigned from the Test Directorate, Field Command, Defense Nuclear Agency (FCDNA), located at Kirtland AFB in Albuquerque, New Mexico, and normally consists of the following personnel:

Test Group Director
Technical Director
Program Director
Test Group Engineer
Instrumentation Engineer
Safety Engineer
Test Manager/Program Analyst
Cable Coordinator
Structural Engineer
Administrative Support

The FCDNA Test Group Director (TGD) is appointed by and is responsible to the Director, Test Directorate, for all preparations for the test. Support is provided by DOE contractors and other agencies, who respond to the TGD and his staff for all test related operations.

Based on information determined in the Five Year NWET Program, DNA coordinates with DOE Office of Military Application (OMA) for device support. Test sources are selected based on technical requirements which vary from test to test. Both Los Alamos National Laboratory and Lawrence Livermore National Laboratory have provided about the same number of nuclear devices for past DOD events.

An initial description of the test bed is developed which defines the technical objectives of the event, source specifications, approximate exposure levels and areas, tentative schedule, and other information necessary for submission of proposals. DNA requests specific, detailed written experiment proposals for the event from the military services, DOD agencies, and DOE laboratories. This request gives the addressees preliminary planning information such as: source device specifications, readiness period, objectives of the test, and other information considered as pertinent for proposal preparation. Long lead time activities, including cable and instrument requirements, exploratory geology, drilling and mining of tentative sites, and procurement of certain hardware commence as early as possible. Experiment proposals for the event received from the military services, DOD agencies, and the DOE laboratories, include such information as: fielding agency, objective of the proposed experiments, justification, relationship to a specific weapon system or mission, and description of experiments. Once these proposals are reviewed and program recommended, project agencies are selected. These participating agencies submit Experiment Data Sheets containing the information necessary for detailed planning for test bed construction, instrumentation, logistic and operational support, and to refine schedules and cost estimates.

The Field Command Defense Nuclear Agency conducts the underground nuclear weapons effects tests at the Nevada Test Site (NTS) under a Memorandum of Agreement with the Department of Energy, Nevada Operations Office. MIDAS MYTH was a typical underground nuclear event using a Horizontal Line-of-Sight (HLOS) pipe system test bed located in the T tunnel complex in Rainier Mesa, Area 12 at the Nevada Test Site.

Early in the event development, the Containment Scientist, the test staff, and supporting agencies determine what aspects of the test may impact on containment. The following containment features are considered:

1. Geology of the site.

2. Geophysical properties of the site.

3. Containment structures.

4. Proximity to old working points and open tunnels.

5. Hardware and excavation geometry.

6. Device and zero room design.

7. Stemming design.

8. Design loads for the numerous closures.

9. Cables, Line-of-Sight (LOS) pipe and other potential conduits in the stemmed region.

10. Results of prior events with similar features.

The entire containment design is presented to the Containment Evaluation Panel (CEP) for review and approval.

The Director, Nevada Test Site Office is responsible to the Manager, Nevada Operations Office for industrial health and safety at the Nevada Test Site. The FCDNA TGD is assigned primary responsibility for safety coordination during the fielding of the event. The radiological safety responsibility is assigned to the FCDNA TGD by the Test Controller immediately after detonation of the device.

Responsibility for the planning and fielding of the MILAGRO experiment rested with Los Alamos National Laboratory (LANL), which also provided and detonated the device. MILAGRO was a large physics experiment using an extensive array of line-of-sight pipes underground. Data from the detectors located therein were brought via cable bundle to recording stations in a trailer park on Rainier Mesa. Within LANL, such experiments are the responsibility of the LANL Associate Director for National Security Programs (ADNSP). Responsibility for the conduct of the experiment is delegated by the ADNSP through the Deputy Associate Director for National Security Programs-Test Operations (DADNSP-TO) to the LANL Test Group Director. The TGD utilizes a staff of administrative and technical personnel from Los Alamos and from the Laboratory's permanent party in Nevada to field the experiment. Construction and engineering support are provided by DOE contractors. The LANL TGD is responsible to the Laboratory and to the Manager, Nevada Operations Office for the safety of Laboratory personnel. The magnitude of the MILAGRO experiment necessitated an interface document specifying areas of responsibility between LANL and FCDNA. A Memorandum of Agreement (Exhibit 4) delineated containment, design, construction, and funding responsibilities, and assigned the responsibility for Mesa safety coordination to LANL.

3. Geology of Rainier Mesa

Rainier Mesa (including Aqueduct Mesa) is a topographically high area formed by a 600+ meter thick series of volcanic tuffs. Those geologic units of particular significance to this investigation are the zeolitized tuffs (tunnel beds) above and below the Working Point (WP), the nonzeolitized, extremely weak and porous, vitric tuff (Paintbrush) just below the welded caprock (Rainier Mesa Member) and the welded caprock itself (Figure 4). The welded caprock above MIDAS MYTH is about 113 m thick. Other events, HURON LANDING, for example, had a thinner layer of caprock, only 60.4 m thick. The Paleozoic rocks, often of significance for ground motion considerations, are no closer to the MIDAS MYTH WP than 282 m and the water table is 314 m beneath the WP. The zeolitized tunnel beds in the MIDAS MYTH tunnel area are, however, nearly saturated and have the lowest gas-filled porosity (1.2 - 1.7 percent) ever measured for an effects test in Rainier Mesa.

Nearly all Rainier Mesa effects tests have been detonated in the tunnel bed units. One difference in the MIDAS MYTH stratigraphy from most other Rainier Mesa test locations is the densely welded nature of the tuff member (Tub Springs) 56 m beneath the WP. While the structure (faulting, folding, and jointing) was noted in the Containment Review as being more complex than in other portions of Rainier Mesa, there were no preshot observations regarding relative frequency of jointing in the welded caprock. The WP was located 361 m vertically below the surface, and 356 m from the nearest free surface on slope at the edge of Rainier Mesa (Exhibit 5).

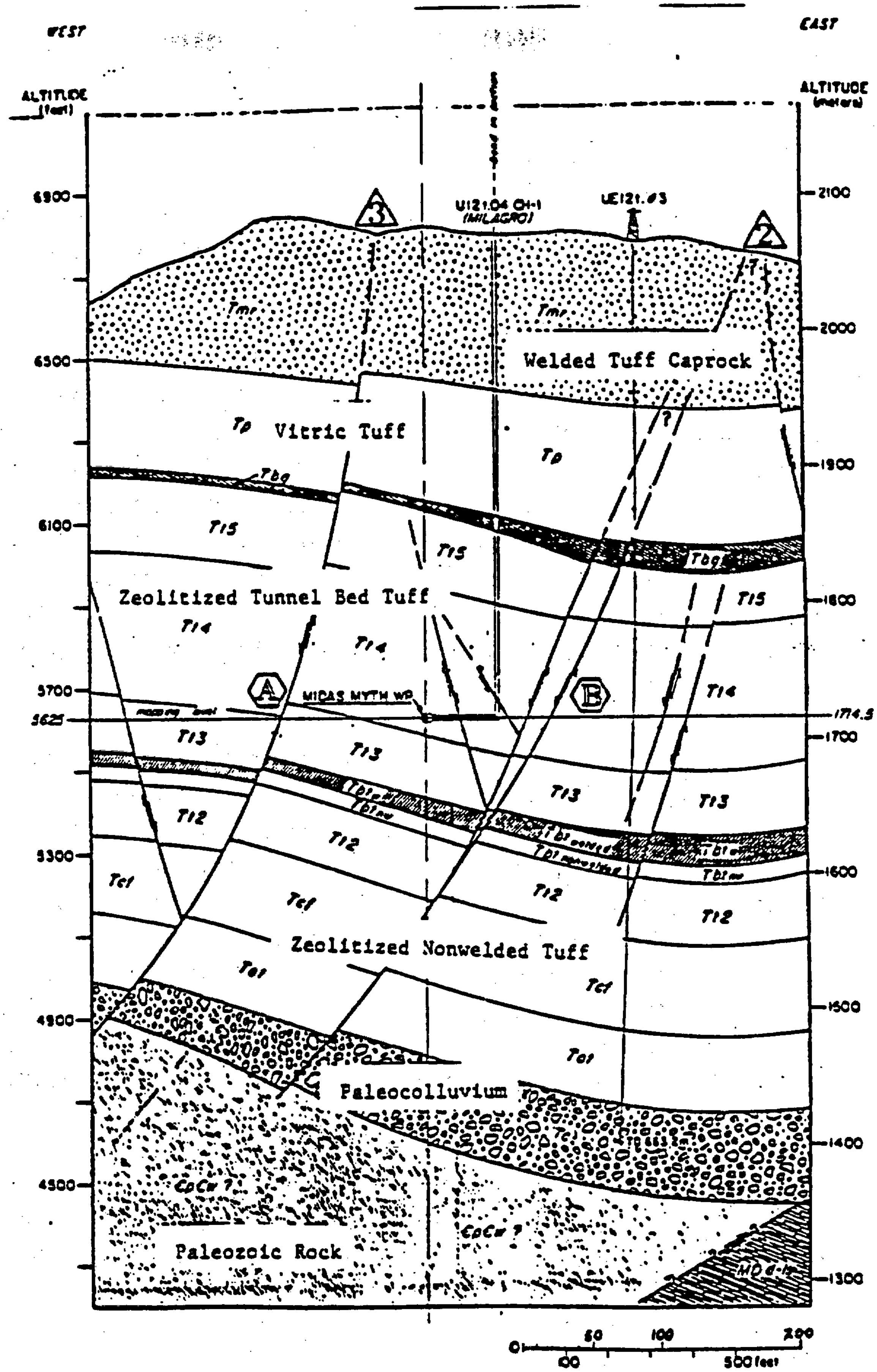


Figure 4: Cross-section through the MIDAS MYTH Working Point

4. Background of Phenomenological Experience

Many aspects of underground nuclear testing rely heavily upon the experience gained from previous tests. In the area of cavity collapse and chimney formation, this is especially so since prediction of this phenomenology has not been amenable to theoretical methods using basic principles. The experience most pertinent to the cavity collapse and subsidence crater that resulted from the MIDAS MYTH/MILAGRO event comes from those events conducted in the tunnel beds of Rainier Mesa. Tests in other tuff areas such as Pahute Mesa or Shoshone Mountain (Area 16), are less directly relevant because of differences in geology and/or yield of the tests, but do provide some additional insight. The tests in alluvial areas, such as Yucca Flats, are less pertinent to the chimney growth and surface subsidence aspects because chimney development in alluvium is different than in hard rock. Cavity collapse for events detonated in tuff below alluvium might be expected to show similar behavior to other tuff area events.

Forty-seven nuclear tests have been detonated in Rainier Mesa beginning with RAINIER in 1957. Many of the tests in the late 1950s and early 1960s, e.g., BLANCA, NEPTUNE, were of a different nature and were occasionally emplaced at shallower scaled depths of burial (SDOB) than tests in the last 15 or 20 years. These later tests were mostly tunnel emplaced effects tests. Prior to MIDAS MYTH/MILAGRO there were 27 of these events and they were all generally believed not to have chimneyed to the surface and not to have resulted in a surface subsidence. The only events in Rainier Mesa which were clearly considered to have chimneyed to the surface and/or cratered were emplaced at a shallower SDOB than used for later effects shots. These were NEPTUNE, BLANCA, and WINESKIN*.

The events DES MOINES* and PLATTE* had relatively shallow scaled depths of burial and did not form surface craters. However, they experienced a very prompt release of cavity pressure through the tunnel which may have altered their behavior.

*Yield information deleted.

The actual knowledge of cavity collapse and chimney height of the 27 "modern" events is incomplete. Information on the time of cavity collapse occurrence comes from monitoring ground motion with geophones. Often this cannot be ascertained because of the lack of clear-cut geophone signals. It is usually assumed, for those events, that cavity collapse was prompt and the seismic signals were masked by the primary ground shock. Subsequent mining reentry has shown cavity collapse did occur. The majority of modern Rainier events have shown a clear collapse indication, but collapse times range from less than an hour to more than 60 hours. All the events conducted in T tunnel have shown clear cavity collapse indications with the following times:

DIAMOND SCULLS	30.92 hours
MINT LEAF	62.23 hours
HUSKY PUP	5.07 hours
MIDAS MYTH/MILAGRO	3.23 hours

Cavity collapse results in upward growth of a rubble chimney as rock falls into the cavity void created by the explosion. The rock bulks as it fills the void and may fill the available volume and terminate growth if the depth is sufficient. The growth may also terminate if a mechanically competent bed of rock is encountered which can support the span of the void at the top of the chimney. This latter situation has generally been considered to be the case for Rainier Mesa events based on the few cases where vertical chimney dimensions have been established by drilling and which have shown an apical void above the rock rubble (Reference, Chimney Data Book, January 1975). The Rainier Mesa welded tuff which caps the Mesa is the unit which terminates chimney growth in these cases. A set of vertical survey observations, not widely known within the concerned test community, has shown that on the two Rainier Mesa events where the surveys were made (MINERS IRON* and HURON LANDING*), a broad depression, 50 to 100 m across and up to 0.6 m deep, has resulted from the events (Exhibit 6). It has also been established that the surface around MINERS IRON SGZ subsided another 1.2 m when HURON LANDING was fired 150 m away. It is not known whether these broad, shallow depressions have occurred on other events

*Yield information deleted.

because survey lines were not run and they would not be visually apparent. Such preshot and postshot survey lines were proposed for the MIDAS MYTH event (Exhibit 7). However, two other Rainier Mesa effects tests HUDSON SEAL* and DIDO QUEEN* with lesser scaled depths of burial have shown no apparent surface subsidence.

Another aspect of testing experience in Rainier Mesa relates to the proximity of an event to previous tests. This has usually been considered in light of containment concerns but may also have an effect on the degree to which ground shock may have altered the mechanical strength of the welded tuff caprock. Of the 25 Rainier Mesa tunnel effects tests conducted since MIDI MIST in 1967, 14 have had separations between working points of more than 304.8 m, and seven more had separations between 152.4 and 304.8 m. The remaining four events had less than 152.4 m of separation, but quite varied scaled separation (SS). These events were:

HURON LANDING to MINERS IRON*
MIDAS MYTH to HUSKY PUP*
HYBLA FAIR to HUSKY ACE*
HYBLA GOLD to DINING CAR*

Those with the smallest scaled separation, MINERS IRON, HURON LANDING, and MIDAS MYTH, are those known to exhibit surface subsidence.

All yield and depth of burial information was obtained from the LLNL Containment Data Base.

*Yield information deleted.

B. The Accident

The MIDAS MYTH event is the designation for a Defense Nuclear Agency (DNA) sponsored horizontal line-of-sight weapons effects test in U12t.04 tunnel of the Aqueduct Mesa section of Rainier Mesa at the Nevada Test Site (NTS). MILAGRO is a LANL add-on test to make measurements of the nuclear device. The working point of the device (below 20 kilotons)* was located 360.81 m below the top of the Mesa and 1,439 m from the T tunnel portal at Nevada State coordinates N 274,297 and E 195,493 (in meters) at a MSL elevation of 1,714.56 m. The T tunnel area is approximately 61 kilometers north of Mercury and 166 kilometers north of Las Vegas (Figures 1 and 2).

A Memorandum of Agreement between FCDNA and LANL, dated September 3, 1982 (Exhibit 4), delineated major areas of agreement and outlined responsibilities for the conduct of MIDAS MYTH/MILAGRO. DOE was not aware of, or a party to this Agreement.

As is the procedure with detonation authority for all nuclear events on the NTS, a Containment Evaluation Panel (CEP) met, discussed, and classified the MIDAS MYTH/MILAGRO containment characteristics as being "within the successful containment experience of previous Rainier Mesa tunnel events." (Reference Containment Review of the DNA MIDAS MYTH EVENT, October 1983.) The only mention of the probability of surface collapse by the CEP is included in the CEP Data Sheet as being "unlikely at design yield" (Figure 5).

Field Command Defense Nuclear Agency (FCDNA) in cooperation with LANL, prepared detailed Portal/Mesa and Tunnel Reentry Plans (Exhibits 8 and 9). Reentry coordination was the responsibility of FCDNA. These plans were reviewed by the DOE Test Controller and meetings were held to discuss specific needs of DNA and LANL for reentry. The purpose of reentry is to recover diagnostic data from the nuclear event, and timely reentry is desirable. There were two reentry parties for the MIDAS MYTH/MILAGRO event: one to return to the portal of the tunnel; the other to return to the recording trailer park on the top of Rainier Mesa over T tunnel.

*Yield information deleted.

Figure 5 is a sheet prepared for the Containment Evaluation Panel and contains a summary of the statistics for MIDAS MYTH, a No. 5 on this sheet is:

Surface Collapse at Design Yield

Likely ( ) Unlikely (X)

The Tunnel Reentry Plan (Exhibit 9) states that no entry into the tunnel past the Drift Protection Plug (DPP) would be made after detonation until underground cavity collapse was recorded by the safety geophone, or for a 24 hour period whichever came first. The tunnel and portal geophones play an important role in determining cavity collapse; in this case expected to be subsurface collapse because of the sparsity of surface subsidences on Rainier Mesa. There is no mention in the Portal/Mesa Reentry Plan (Exhibit 8) of a prohibition of reentry into the MIDAS MYTH/MILAGRO SGZ and trailer park area until a collapse (surface or subsurface) is recorded.

Before data retrieval is permitted on the Mesa, there is a FCDNA requirement to cut all cables at the cable head in the recording trailer park in order to preclude any surface created voltage which could conceivably detonate explosive gases generated in the tunnel by the device.

A mesa reentry party is comprised of several distinct elements, each with a particular function: a survey team of radiation monitors and industrial hygienists reenter first to conduct a safety check of the area to assure there are no hazards from radiation or explosive gases; then a geologic survey team inspects and records ground disturbance; a cable cutting team severs and seals all cables leading downhole; and finally upon completion of cable cutting, a team of laboratory technicians proceeds to recover event diagnostic data from the trailers (see Exhibit 16).

The MIDAS MYTH/MILAGRO D-1 Day Containment, Technical and Readiness briefings and the D-Day Readiness briefing were conducted as scheduled. From testimony, it was noted that there was no discussion at any of these briefings of possible postshot surface collapse, the location of the Rainier Mesa Trailer Park in relation to SGZ, or of possibility of injury to reentry personnel should there be a subsurface collapse.

At 0900, after a postponement of two hours, the device was detonated. Upon detonation, both the Remote Area Monitoring System (RAMS) units and the on site Reentry Safety Network (geophones) went out of service. It was determined that the entire RAMS and geophone transmission system within the tunnel and at the portal had been knocked off line by ground shock. Immediate steps were then taken to reactivate these systems. The loss of a number of the recording devices within the tunnel indicated significant underground damage.

The Reentry Safety Network for MIDAS MYTH/MILAGRO consisted of an array of geophones at the portal and inside of T tunnel which provides indications of seismic activity at those locations, including information on collapse of the cavity. Signals from the portal geophone and most RAMS were recovered, but the two tunnel geophones and some tunnel RAMS failed to respond. Because of the failure of the tunnel geophones, a permanently installed high gain geophone located some 3,018 m southwest of MIDAS MYTH SGZ on Rainier Mesa over N tunnel and in service, was patched in to display post detonation seismic activity on geophone monitors in the Operations Room and throughout the CP compound (Exhibit 10). This substitute geophone was part of an NTS-wide geophone array (Figure 6). Although the signals from the N tunnel mesa geophone and the T tunnel portal Reentry Safety Network are uncalibrated, they do provide relative frequency and amplitude of postshot, precollapse chimney growth activity, and identify cavity collapse. The Sandia National Laboratories (SNL) is responsible for operating the geophone system in support of all LANL and DNA events. All geophone signals are recorded at the CP.

At 1007, upon the request of the DNA Test Director, the DOE Test Controller, following consultation with his Scientific Advisor, and upon determining that there currently was no radiation problem, authorized the release of the reentry parties from Gate 300. At that time both the Test Controller and the Scientific Advisor were aware of the continuing seismic activity as indicated by the geophone record. The two reentry parties proceeded from Gate 300 on their assigned tasks. Because of rock fall on the Rainier Mesa Road above T portal, the Mesa Team proceeded via Pahute Mesa Road, Stockade Wash Road, and Holmes Road to the MILAGRO Trailer Park (Figures 7 and 8). The

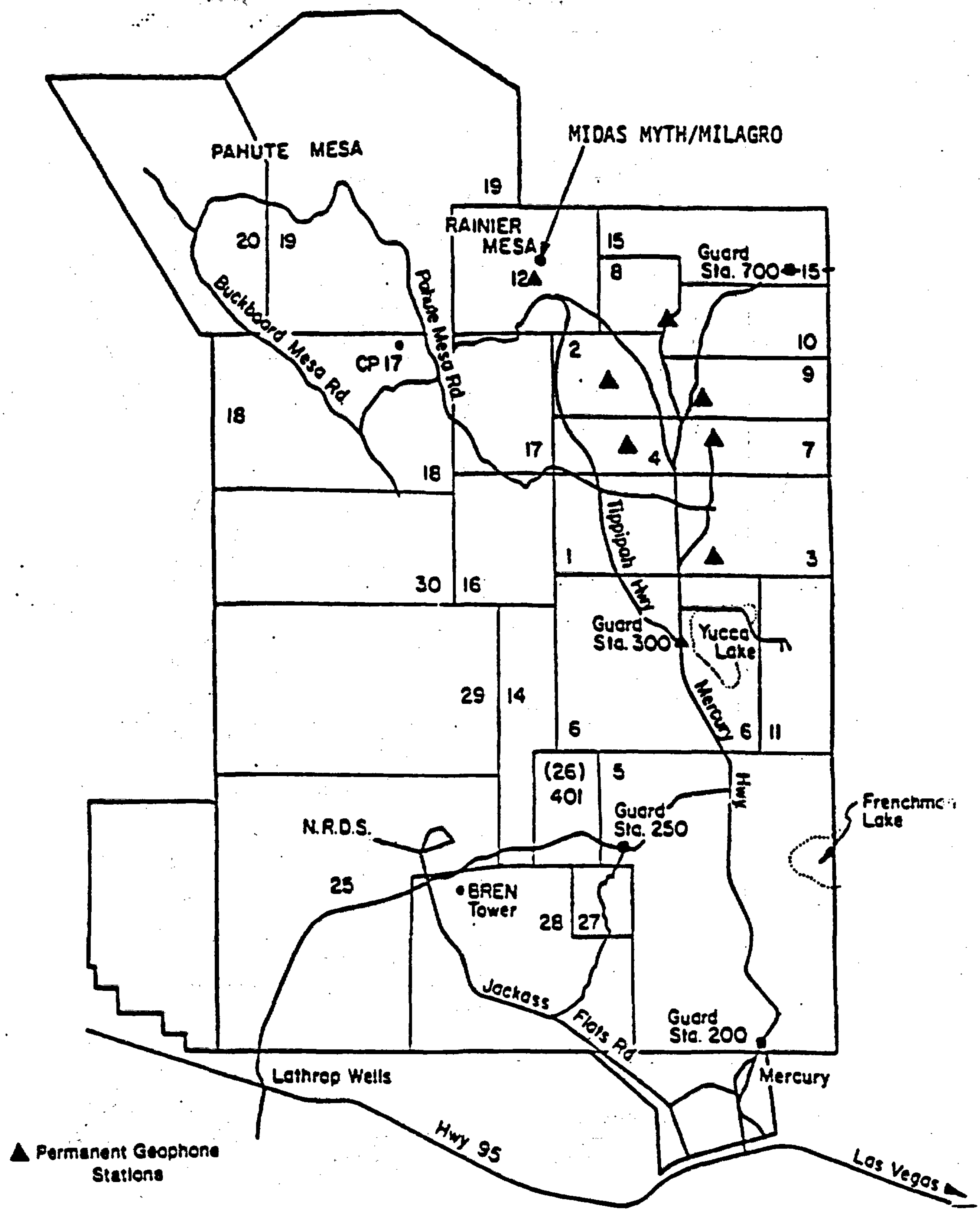


Figure 6 — NTS-Wide Permanent Geophone Array

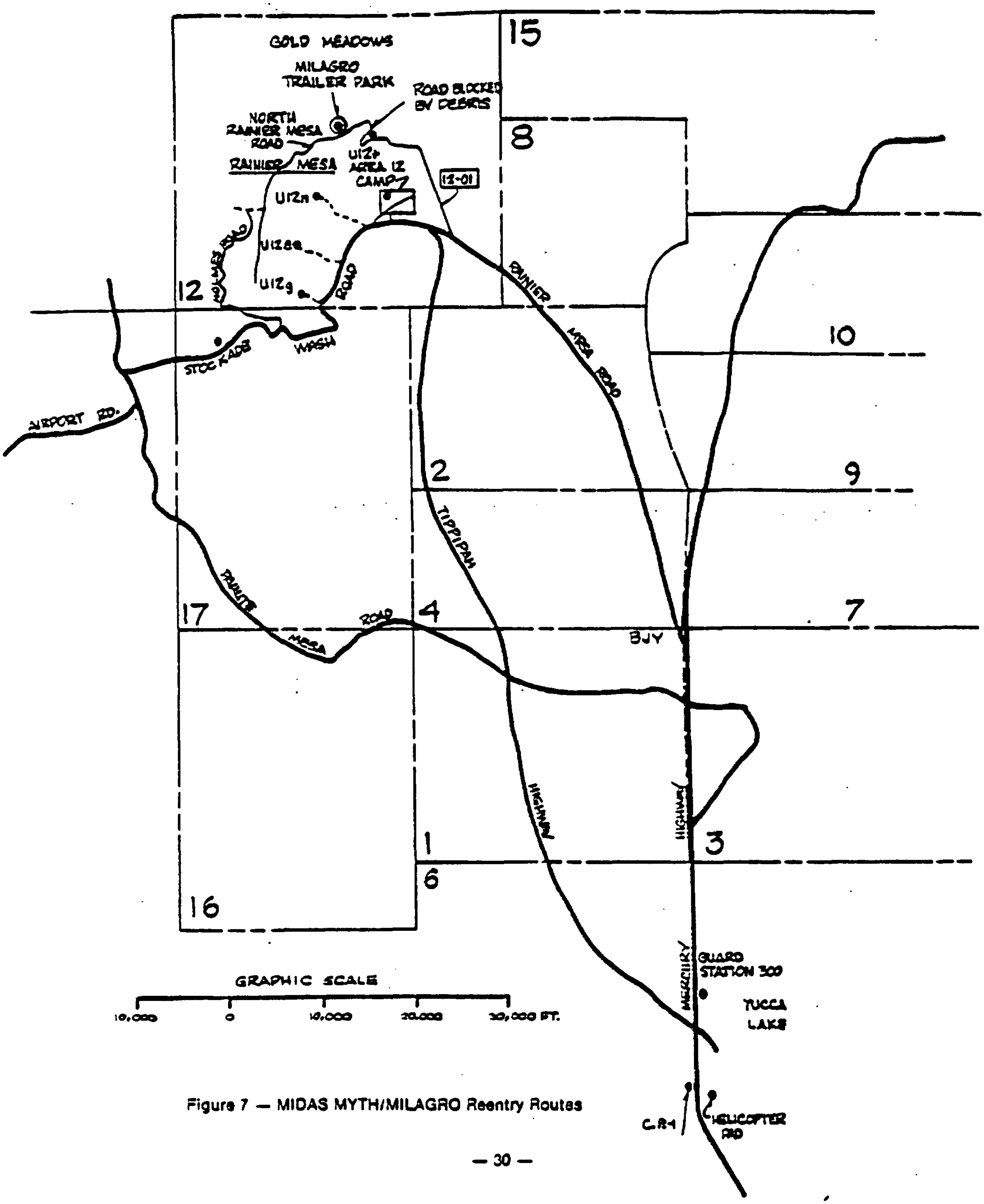


Figure 7 — MIDAS MYTH/MILAGRO Reentry Routes

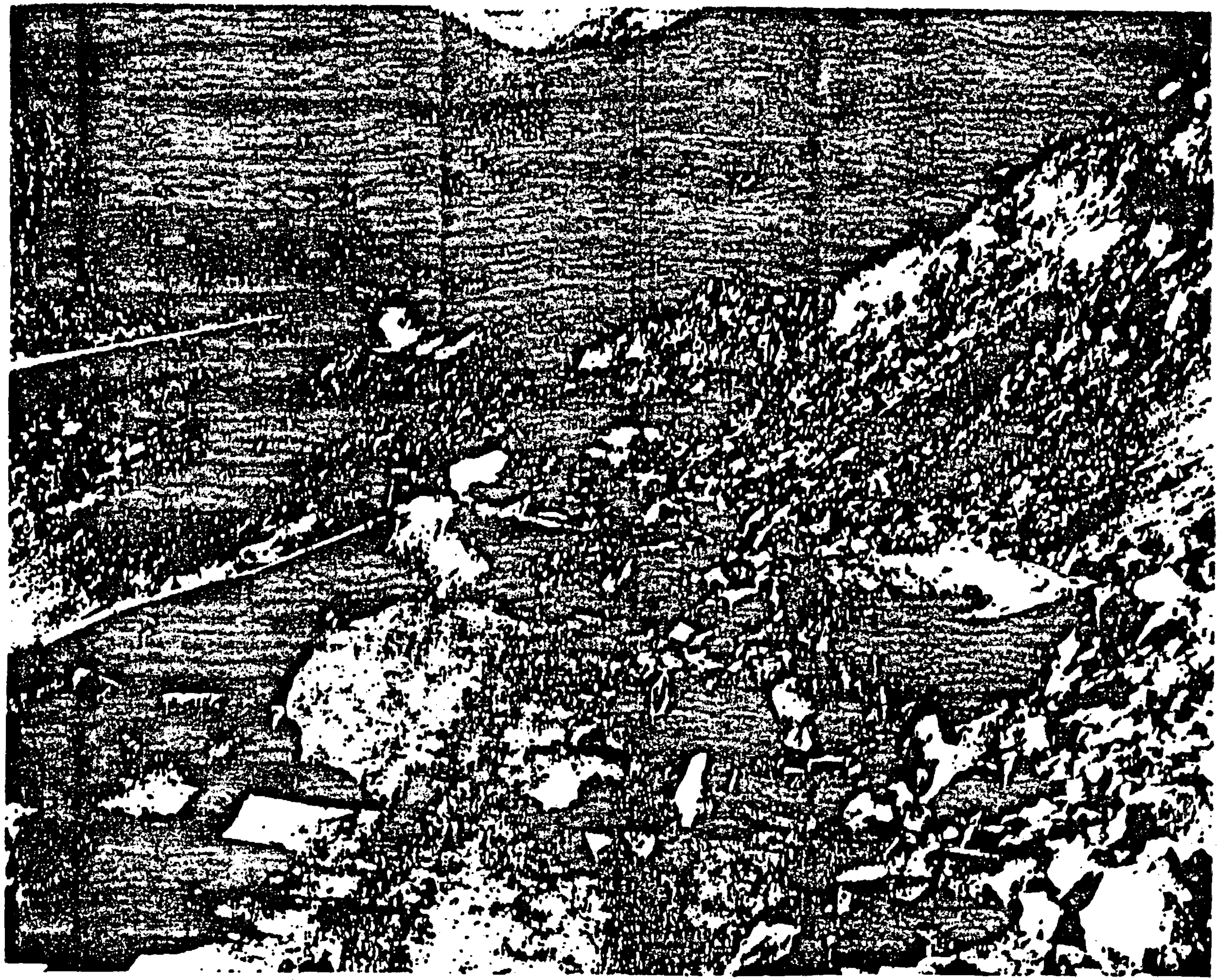


Figure 8 — Rainier Mesa Road Blockage Above T Portal

Mesa party arrived at the trailer park at approximately 1050 and commenced reentry activities without any further instructions from the Operations Room.

The LANL Recording Trailer Park on top of Rainier Mesa was located in close proximity to MIDAS MYTH SGZ. The distance between SGZ and the nearest LANL trailer (P-14-101) was 39.6 m. The distance between SGZ and the west trailer park fence was approximately 26 m. Such proximity of the recording trailers to SGZ was controlled by the requirement for minimum length cables extending to the surface from the LANL MILAGRO experiment. Testimony indicated that these diagnostic cables upon reaching the surface through a drilled and stemmed cable hole, could not have been terminated at recording vehicles more than an additional few meters away and provide desired data. Testimony from those siting the trailer park and those using the data from the recording trailers also indicated that while shock damage from the detonation was considered, there was minimal to no consideration given to the possibility of loss of the trailers and/or data due to cavity collapse because of the proximity of the trailer park to SGZ. The distance between the MILAGRO Trailer Park and MIDAS MYTH SGZ at 26 m is the nearest a trailer park has ever been to an SGZ for any NTS event (Figure 9).

Radiation and industrial hygiene surveys were initiated and completed by approximately 1110. No radiation or explosive gases were found. The cable cutting team then entered the trailer area and began cutting the diagnostic cables at the cable hole casing head. A Radiation Monitor and an Industrial Hygienist accompanied the cable cutting crew and monitored each cable as it was cut, to determine if there was radiation or gas leakage through the cables. Concurrently, the geologists proceeded to SGZ and began mapping the ground cracks created by the detonation. A photographer also began photographing the condition of the trailers and their shock mountings (Figures 10, 11 and 12). After completing the SGZ crack mapping, the geologists returned to the trailer pad and began to map cracks there. At 1214 when the crew had completed cutting 51 of the 139 cables, the ground surface collapsed and dropped 5.1 m at the deepest point (Figures 13, 14 and 15). At that time, there were 19 people in

TRAILER PARK PROXIMITY TO SGZs

TUNNEL NAME	TUNNEL NUMBER	NEAREST TRAILER PARK	SUBSIDENCE
TOME/MIDNIGHT ZEPHYR	U12n.18	Park not used; d to N Park = 3000'	
MINI JADE	U12n.12	Park not used; d to N Park = 1850'	
HURON LANDING/DIAMOND ACE	U12n.15	3050' to N Park	
MINERS IRON	U12n.11	2500' to N Park	
DIABLO HAWK	U12n.10A	350' to EMP; 700' to cable and interface holes	
MIGHTY EPIC	U12n.10	430' to auxilliary park 3550' to N Park	
HYBLA FAIR	U12n.09	1500' to N Park	
MING BLADE	U12n.08	2700' to N Park	
HUSKY ACE	U12n.07	1550' to N Park	
DIANA MIST	U12n.06	1550' to N Park	
MISTY NORTH	U12n.05	2400' to N Park	
HUDSON SEAL	U12n.04	1400' to N Park	
MIDI MIST	U12n.02	2000' to N Park	
MIDAS MYTH	U12t.04	170' to MILAGRO	****
HUSKY PUP	U12t.03	1300' to T Park	
DIAMOND SCULLS	U12t.02	2500' to T Park	
MINT LEAF	U12t.01	2075' to T Park	
HYBLA GOLD	U12e.20	2350' to E Park	
DINING CAR	U12e.18	2600' to E Park	
DIDO QUEEN	U12e.14	509' to HFR Park; 2400' to E Park	
HUDSON MOON	U12e.12	1850' to E Park	
DIESEL TRAIN	U12e.11	1700' to E Park	
DORSAL FIN	U12e.10	1300' to E Park	
ANTLER	U12e.03A	1750' to E Park (?)	
CAMPHOR	U12g.10	1650' to G Park (?)	
CYPRESS	U12g.09	1700' to G Park	
DOOR MIST	U12g.07	850' to G Park	
RED HOT	U12g.06	500' to G Park (?)	
MADISON	U12g.01	920' to special park	
WINESKIN	U12r	0'; (300' to LRL & 1300' to photo trailers)	****
CLEARWATER	U12q	0' or about 100' (?)	
YUBA	U12b.10	No Trailer Park	
CHENA	U12b.09	No Trailer Park	
FEATHER	U12b.08	No Trailer Park	
EVANS	U12b.04	No Trailer Park	

**** indicates major collapse/subsidence of the trailer park.

(?) indicates that the prk named was assumed to have been used since no drawings from the H&N library were available to confirm or deny usage.

The above data has been researched from drawings available in H&N library.

Figure 9: Trailer Park Locations on Rainier Mesa Events

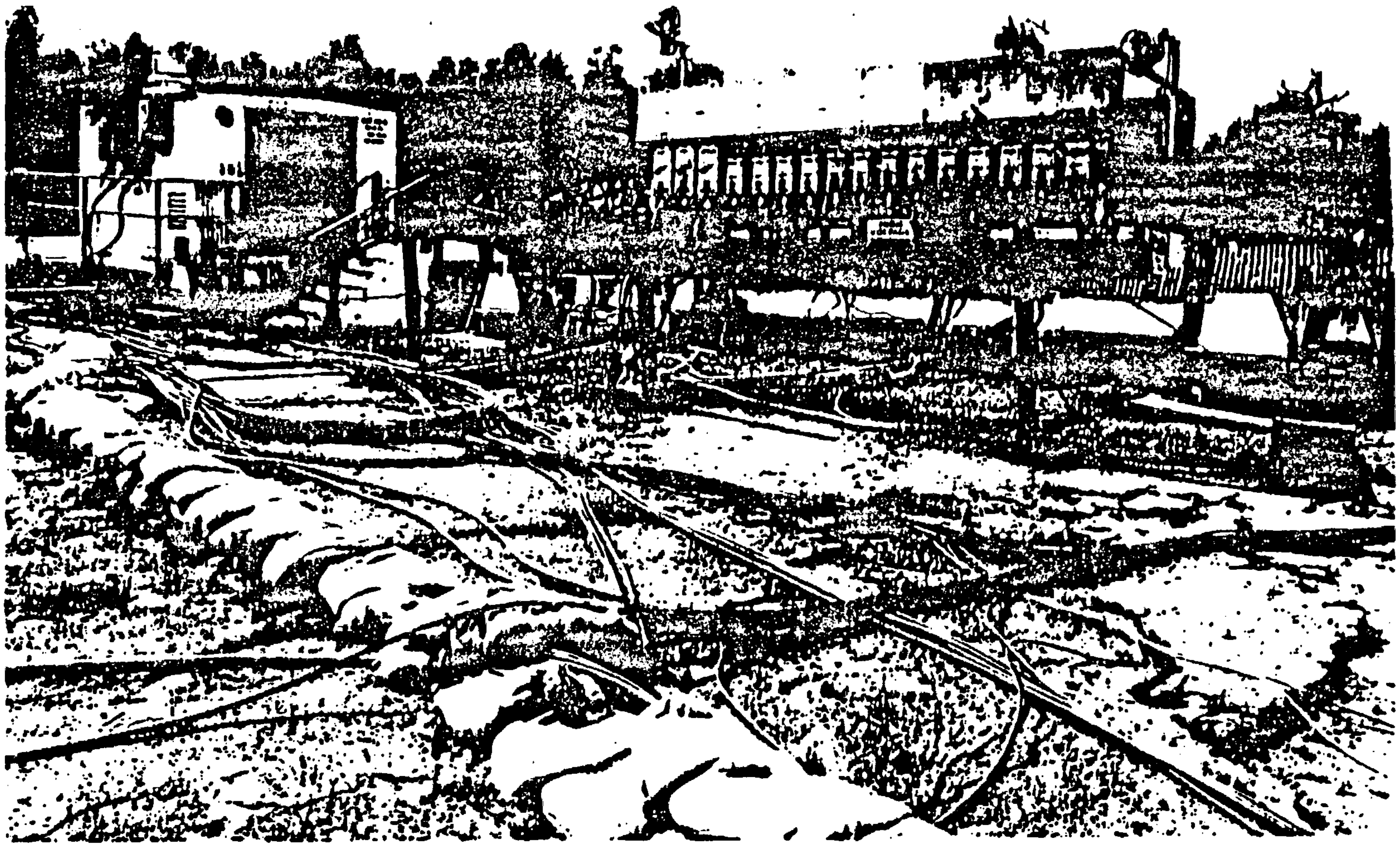


Figure 10 — MILAGRO Trailer Park Power Panel,
West End of Trailer P-14-101, Postshot, Prior to Collapse

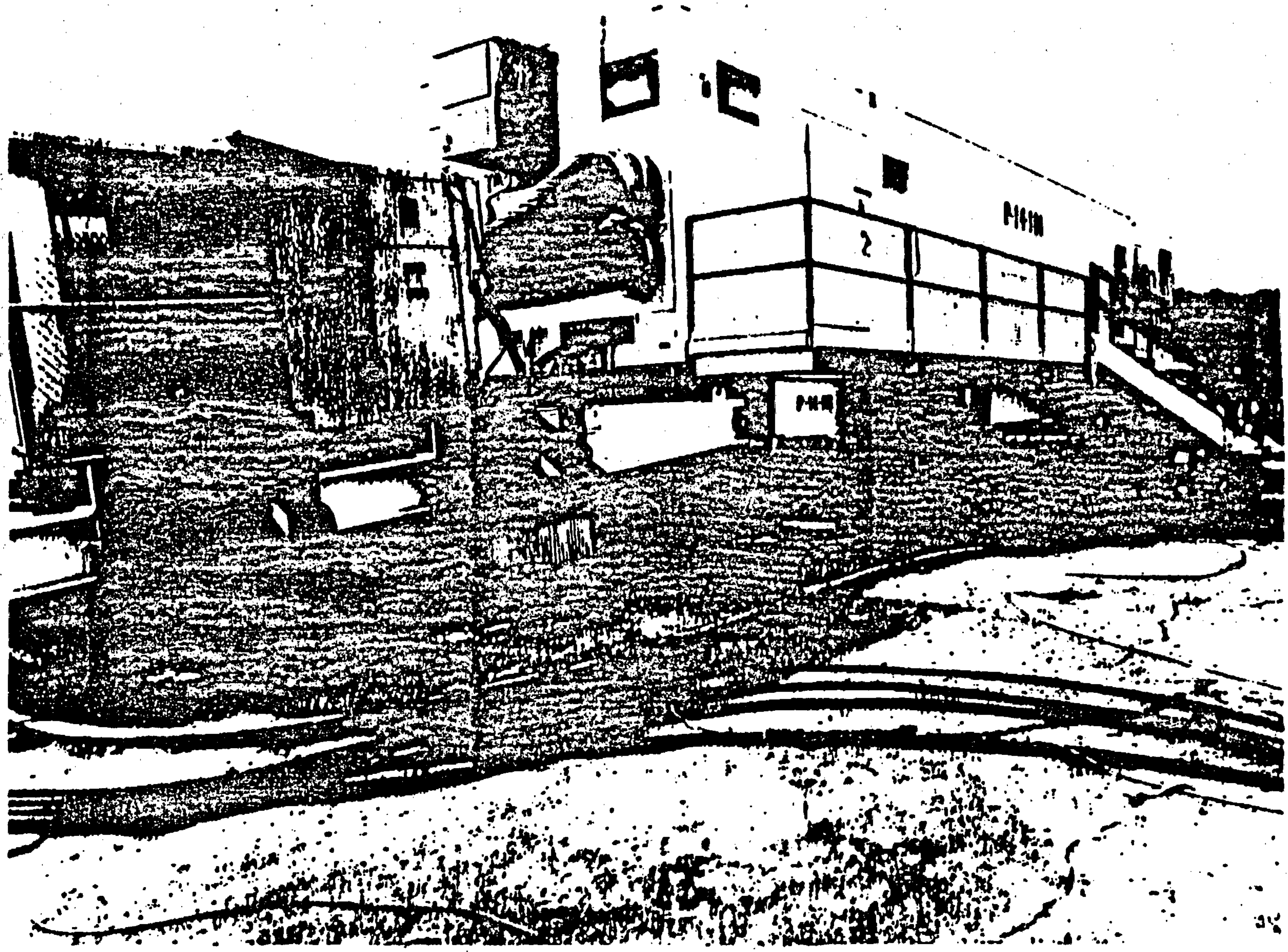


Figure 11 — MILAGRO Trailer Park, Trailer P-14-101 NW Corner, Postshot, Prior to Collapse

Figure 12 — MILAGRO Trailer Park Ground Crack, Postshot, Prior to Collapse

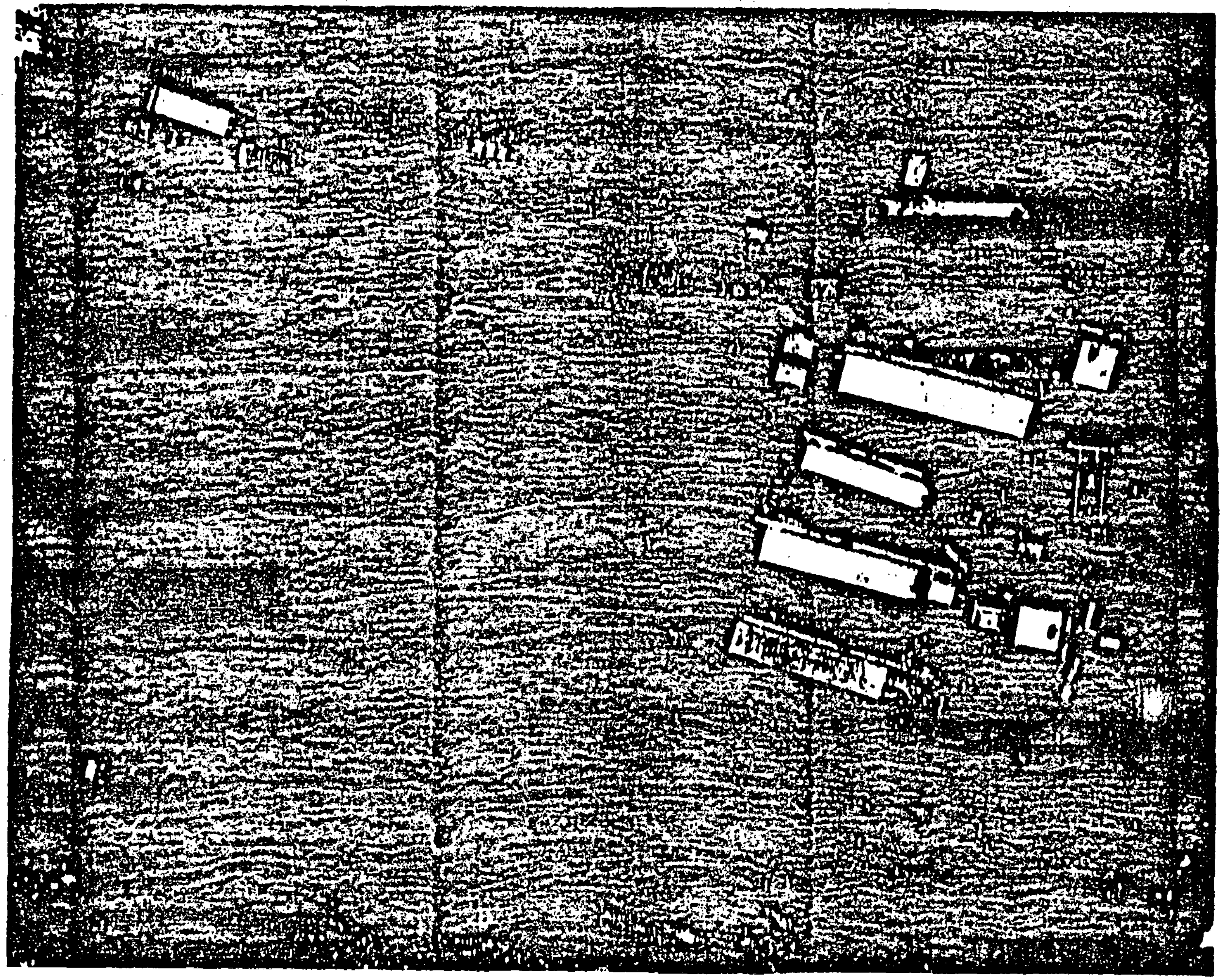


Figure 13 — MILAGRO Trailer Park Collapse Area

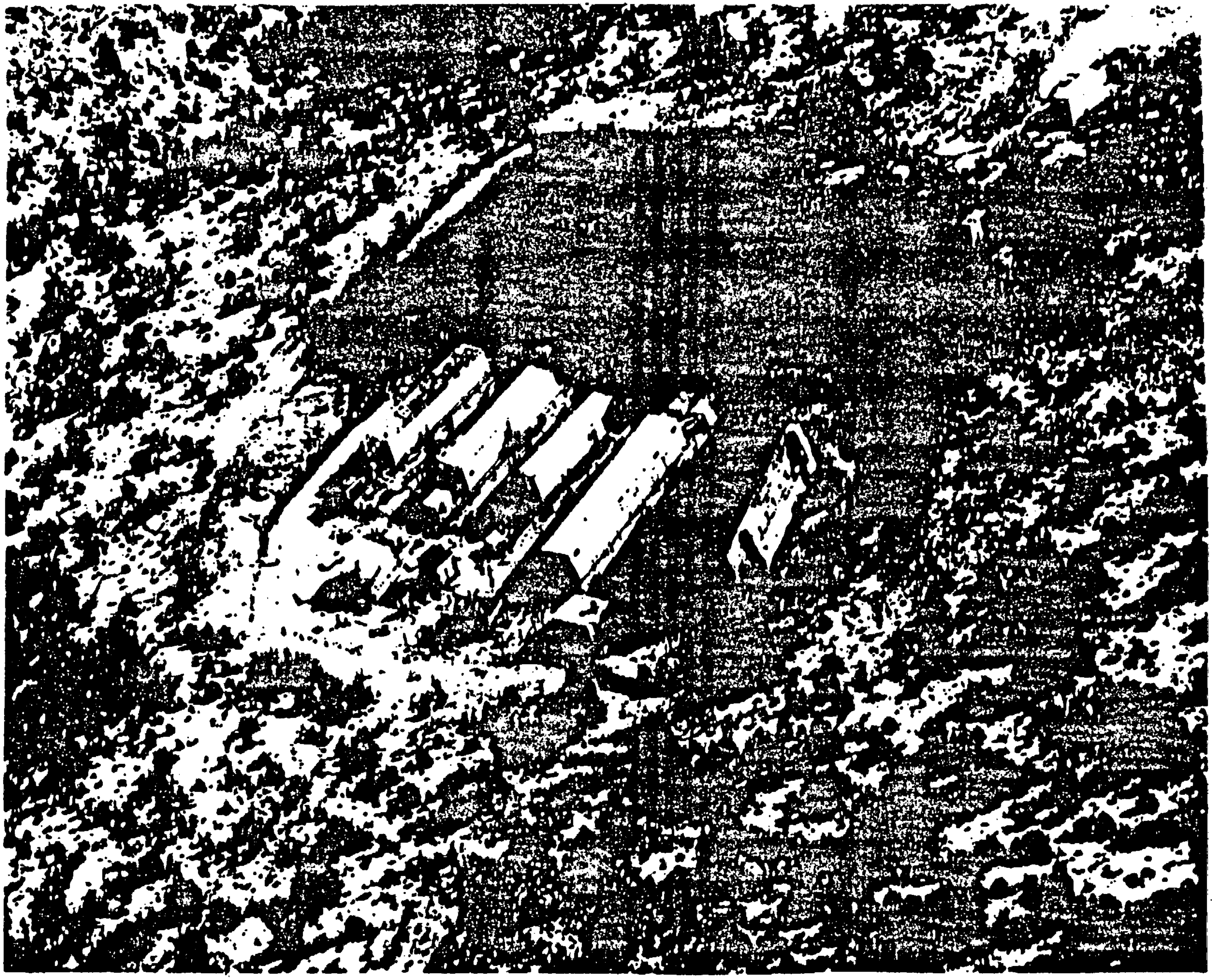


Figure 14 — MILAGRO Trailer Park,
Aerial View of Collapse from Southwest

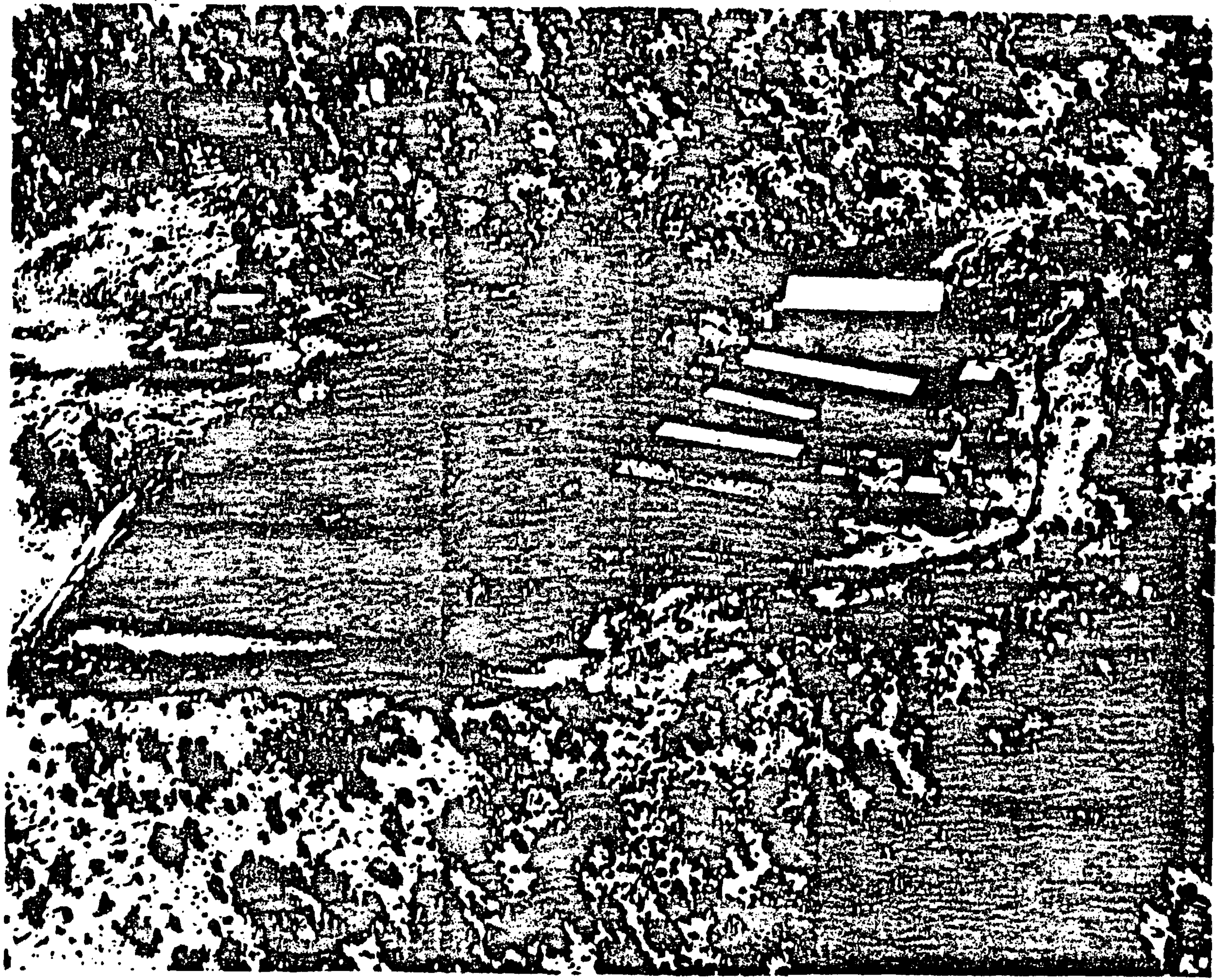
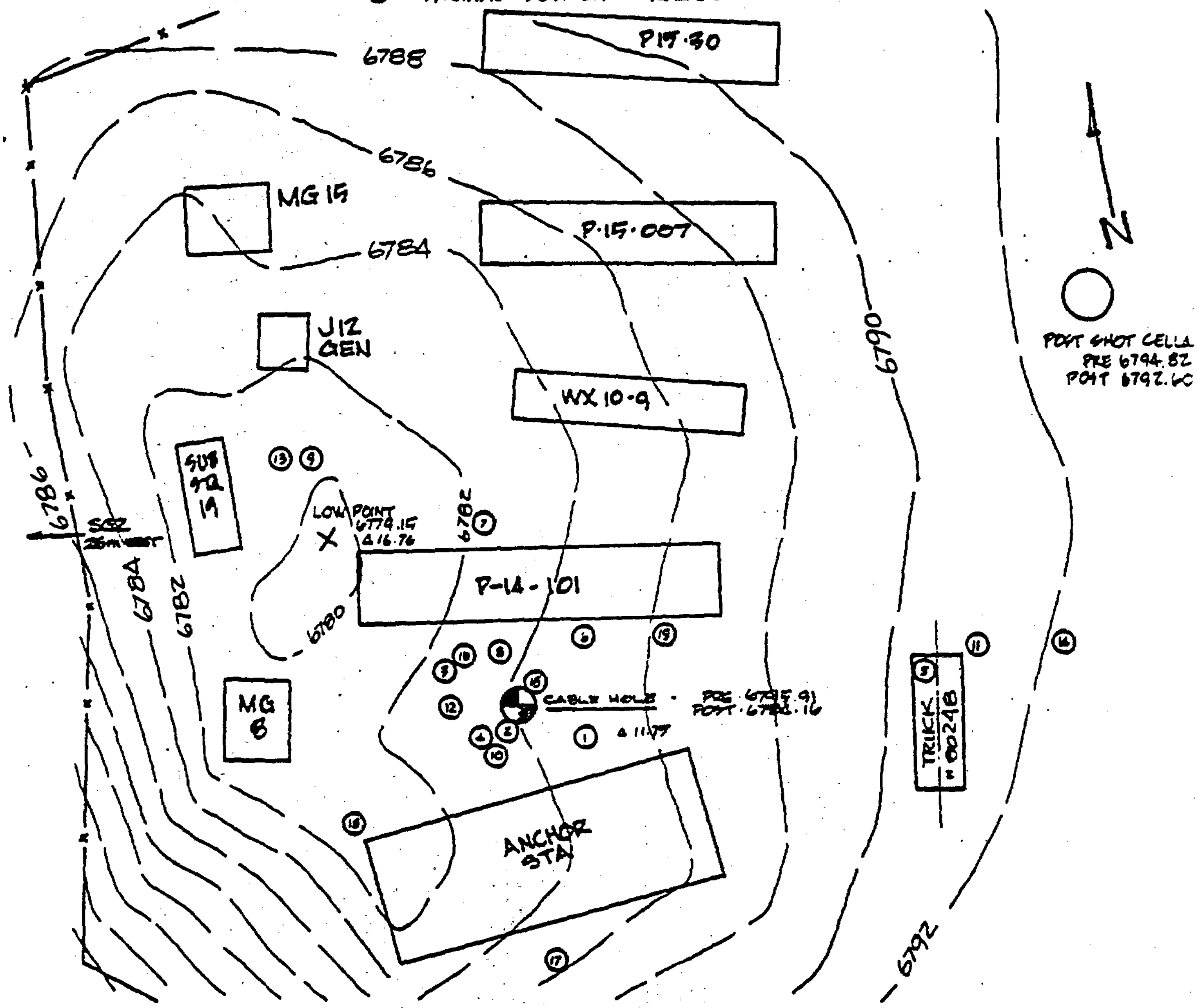


Figure 15 — MILAGRO Trailer Park, Aerial View of Collapse from the North

the trailer park. Fourteen were injured, one fatally. Most of the people injured were in the cable hole area and fell approximately 3.6 meters (Figures 16 through 25).

Throughout the entire period from detonation to collapse (except for 70 seconds following the detonation), continuous T tunnel seismic activity was indicated on the display in the Operations Room. There was increased seismic activity shown on the display from approximately 1150 until 1214. After collapse, no further event related seismic activity could be identified on the geophone record displays (Exhibit 10).

1	JOHN HELD	REECo	INJ
2	THURSTON SLACK	REECo	NI
3	CHARLES MIESCH	REECo	INJ · EXP.
4	DAVID REED	REECo	SL INJ
5	BOB FERGUSON	REECo	SL INJ
6	JAMES NOMELAND	REECo	SL INJ
7	JUAN PENA	LANL	INJ
8	J.L. SMITH	REECo	INJ
9	DALE COX	LANL	INJ
10	NOBEL SIMPSON	REECo	INJ
11	BILL MAYER	LANL	SL INJ
12	NATE LENCIONI	REECo	INJ
13	STEVE FOSTER	PAN AM	INJ
14	RICHARD SOLZANO	REECo	NI
15	ELIZABETH McDOWELL	REECo	INJ
16	KEN ENGLISH	REECo	INJ
17	DEAN TOWNSEND	F&S	NI
18	DICK ADAMS	EG&G	NI
19	THOMAS DOTSON	REECo	NI



NI = NOT INJURED
SL INJ = SLIGHTLY INJURED
INJ = INJURED

Figure 16 — MILAGRO Trailer Park, Collapse Contours and Personnel Location

Figure 17 — MILAGRO Trailer Park,
Post Collapse Damage, East Ends of Trailers

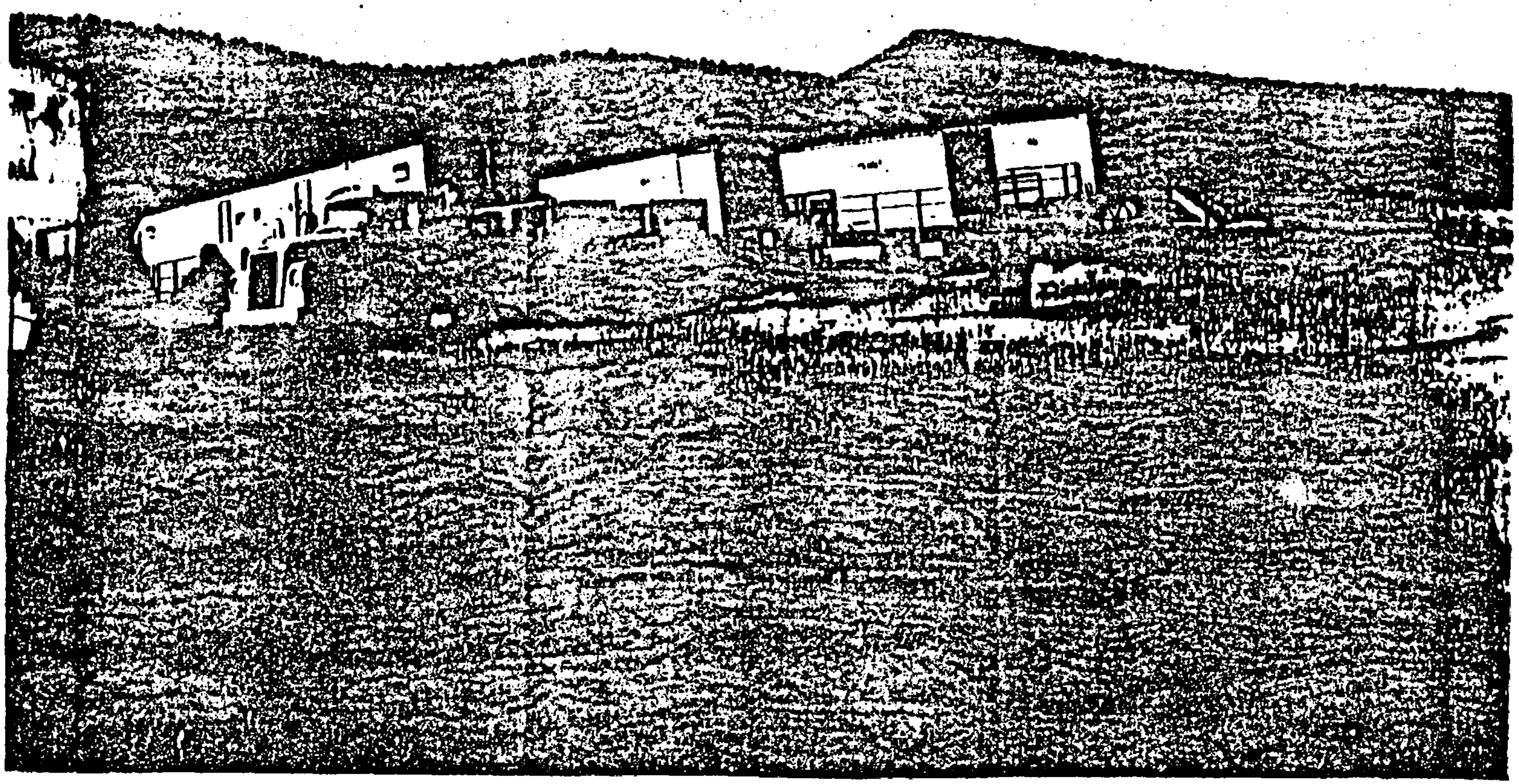


Figure 18 — MILAGRO Trailer Park, Post Collapse Damage, Surface Cracks, Southeast Ends of Trailers

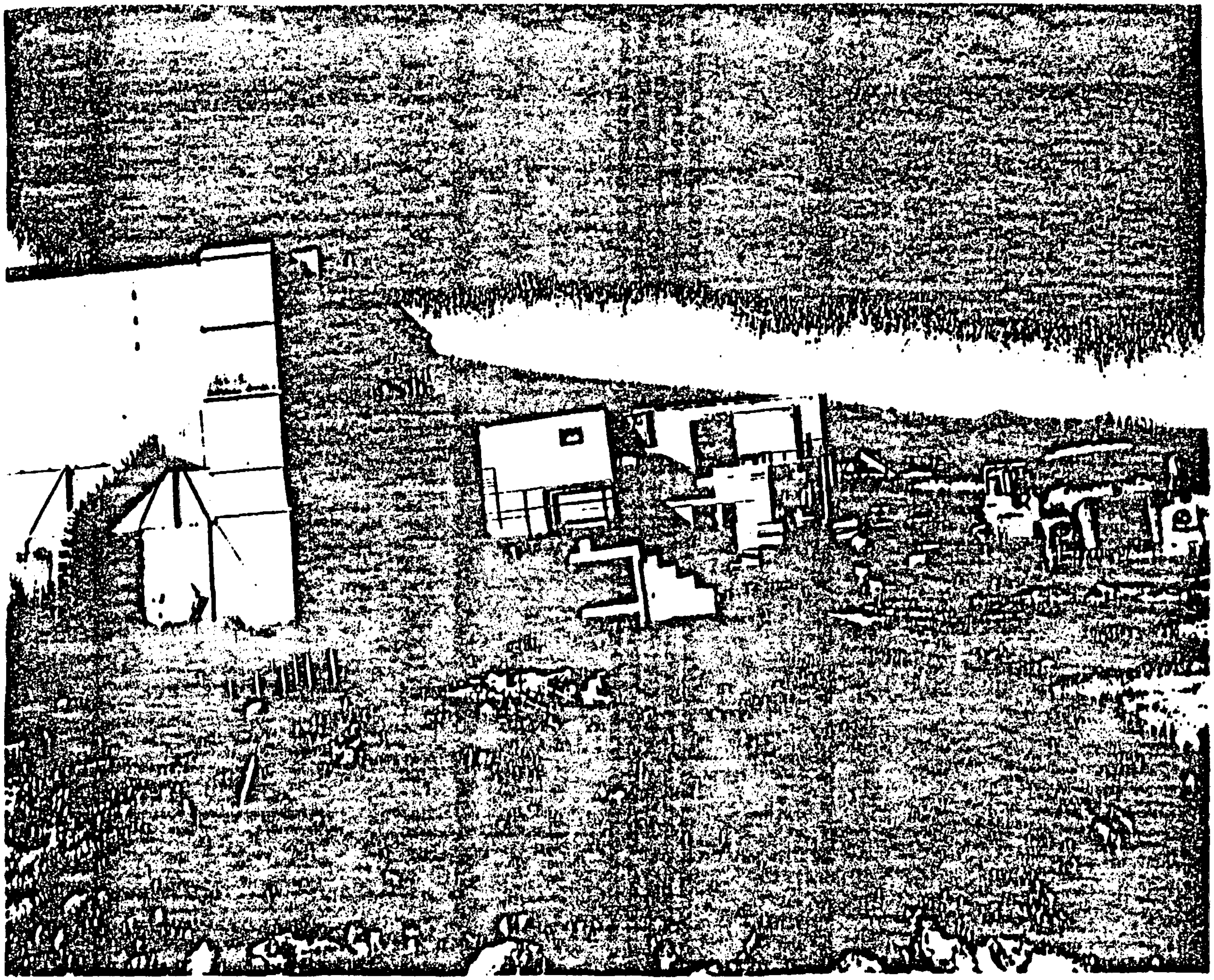


Figure 19 — MILAGRO Trailer Park, Post Collapse Damage, Southeast Corner of Anchor Station

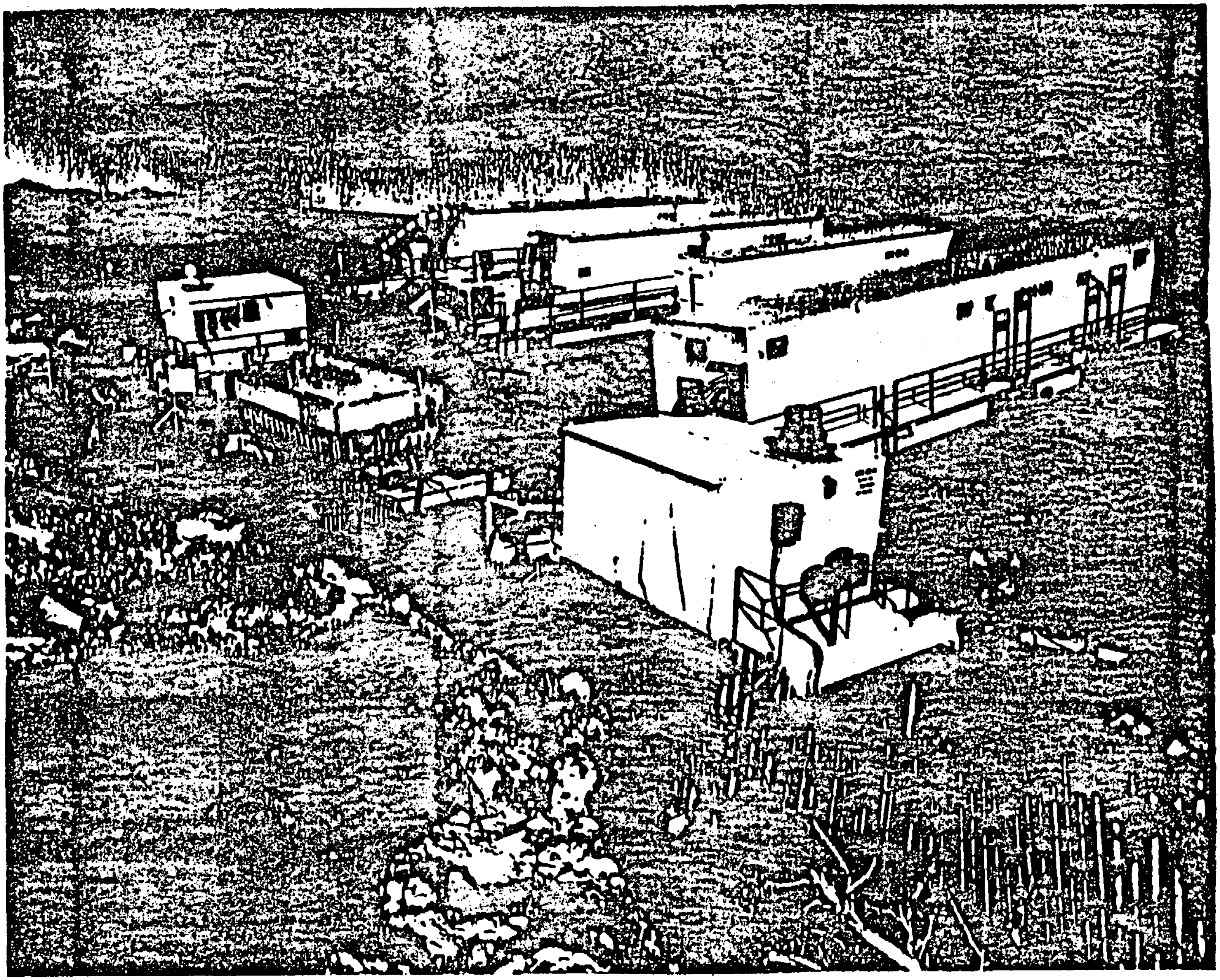


Figure 20 — MILAGRO Trailer Park, Post Collapse Damage, West Ends of Trailers and Cable Hole Area

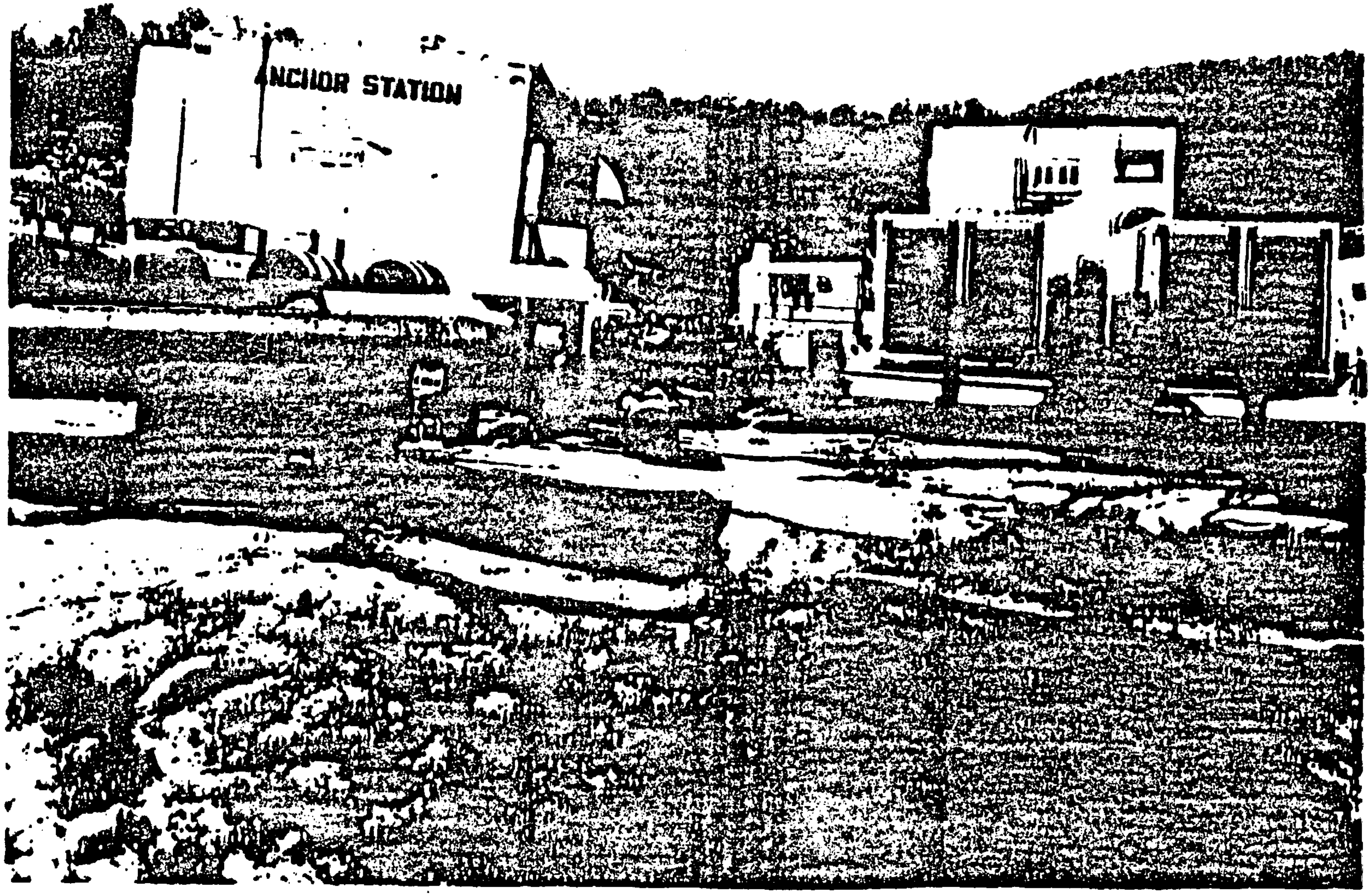


Figure 21 — MILAGRO Trailer Park, Post Collapse Damage, Cable Hole Area Between Anchor Station and P-14-101

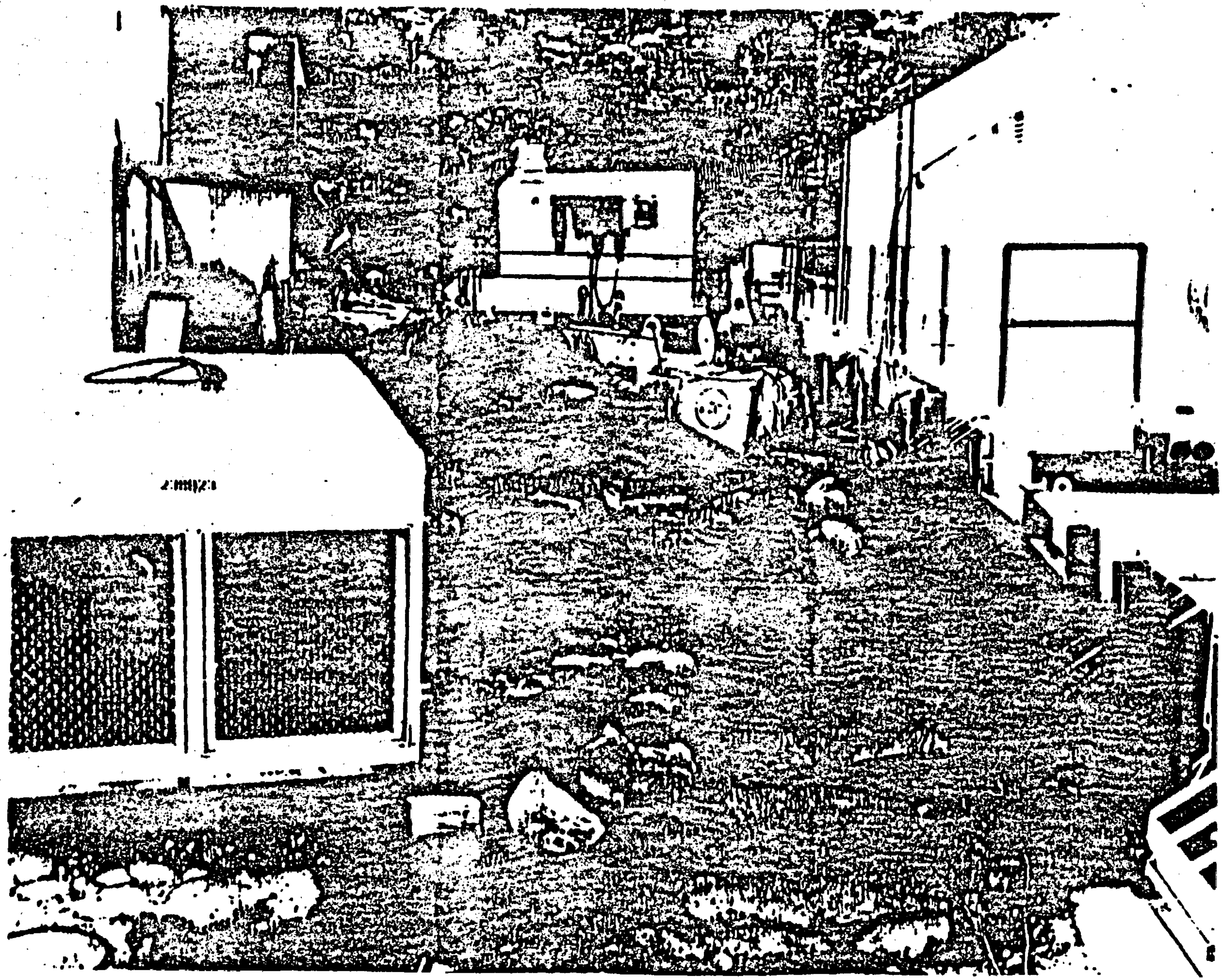


Figure 22 — MILAGRO Trailer Park, Post Collapse Damage, Cable Hole Area

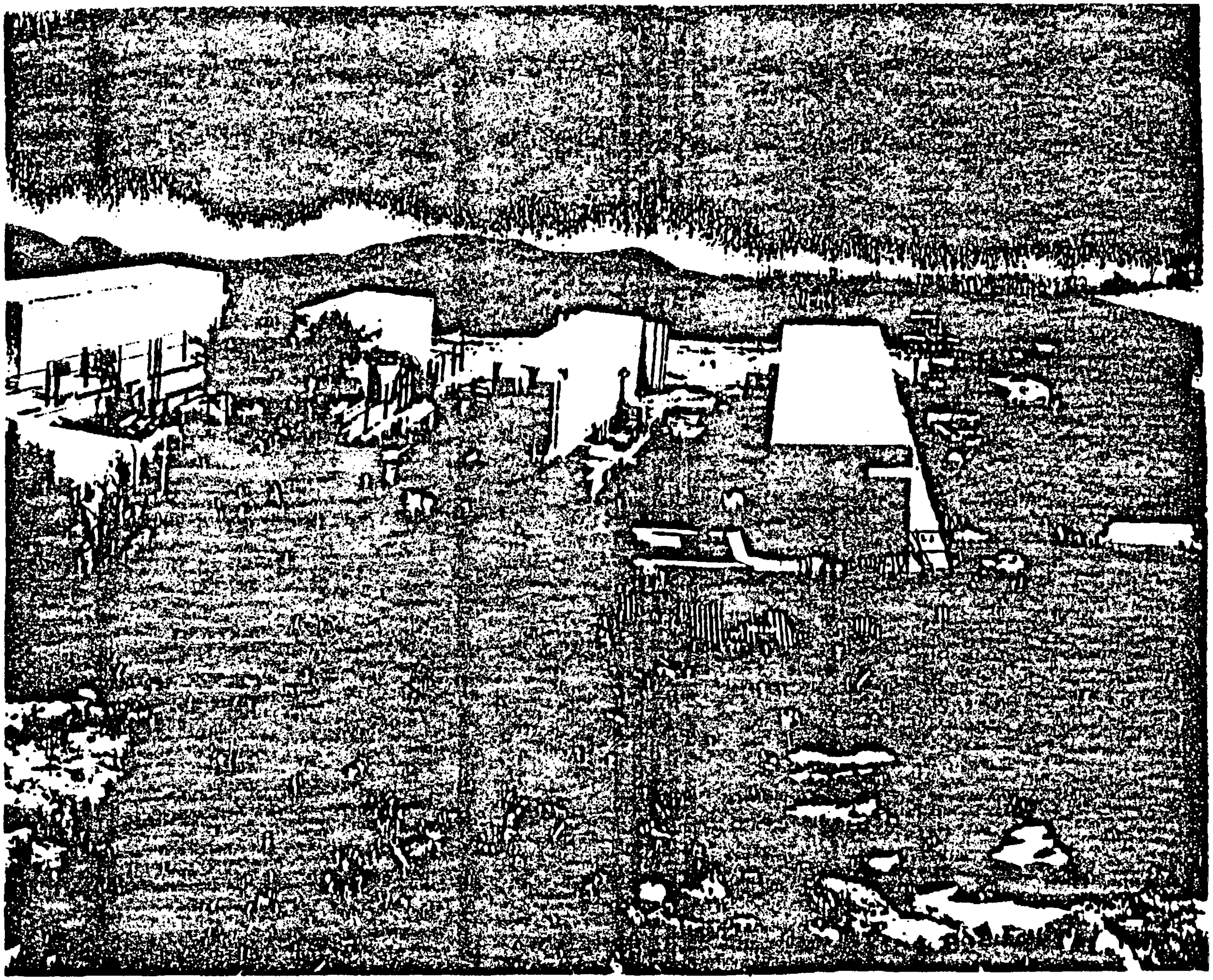


Figure 23 — MILAGRO Trailer Park, Post Collapse Damage, View from SGZ

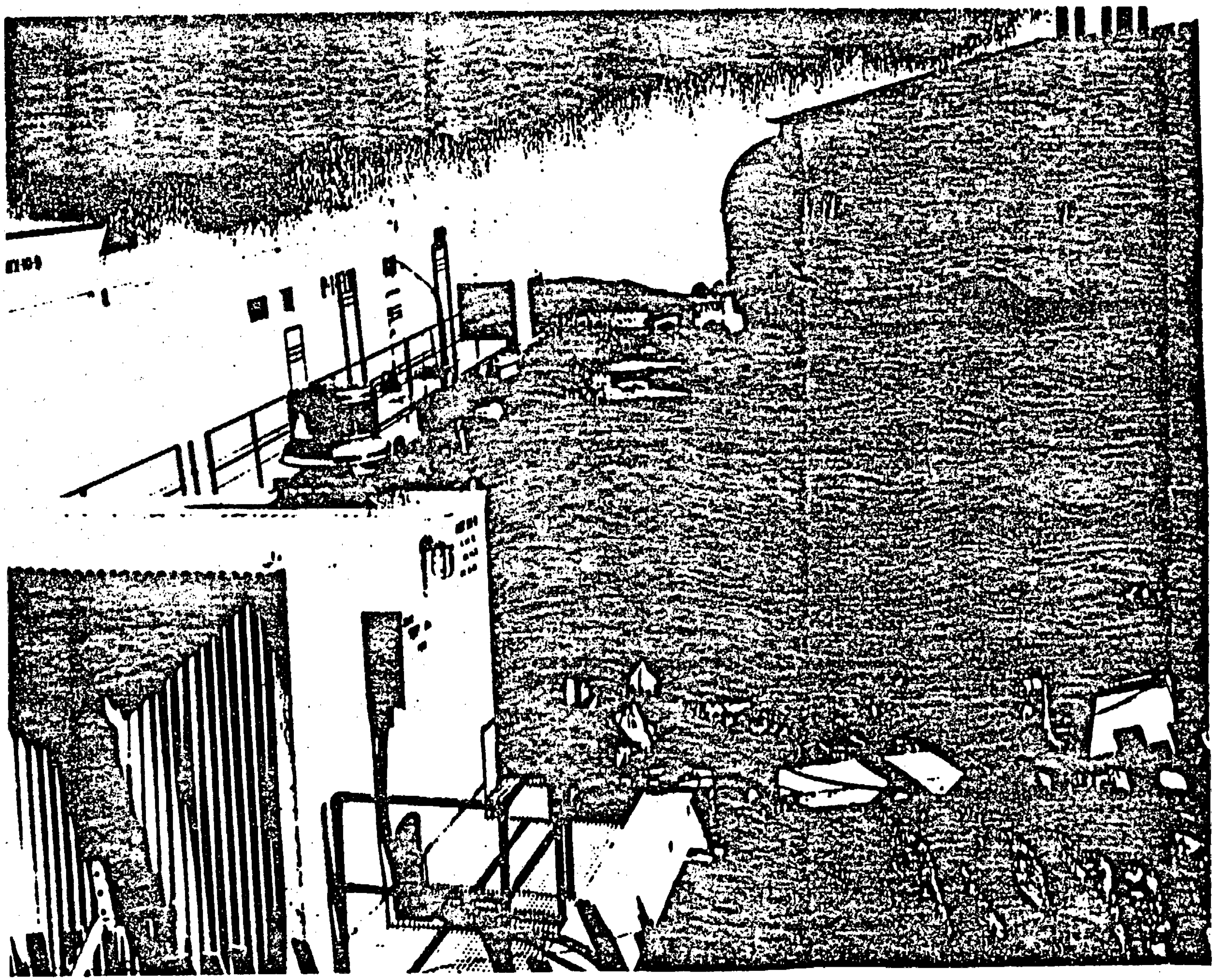


Figure 24 — MILAGRO Trailer Park, Post Collapse Damage,
Cable Hole Area

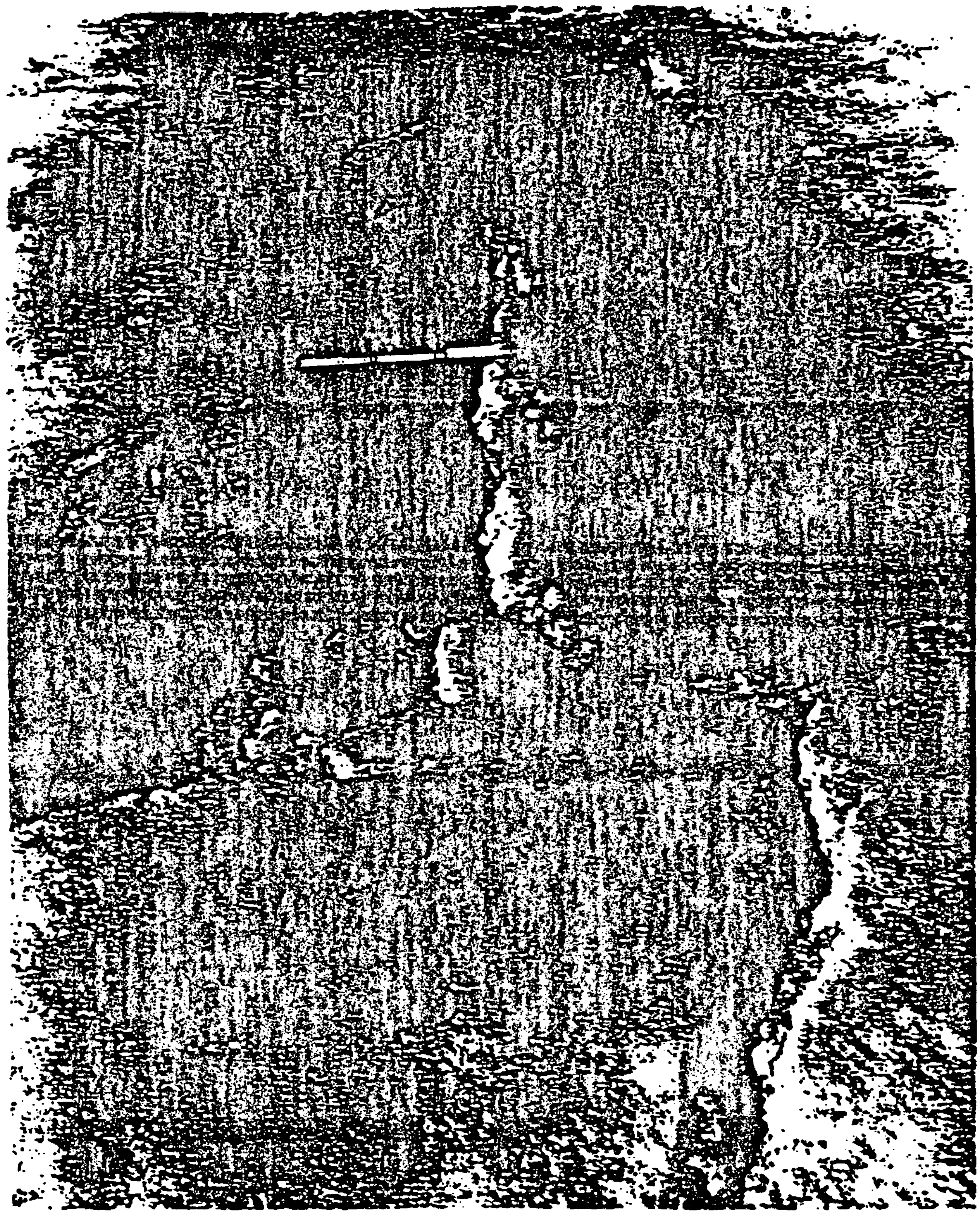


Figure 25 — MILAGRO Trailer Park, Post Collapse Damage, N-S Trending Crack Near Center

C. Post-accident Activity

Immediately upon notification of the accident at 1217 the Test Controller dispatched medical and evacuation assistance to the accident scene. As there was not an ambulance with the Mesa Reentry Party, an ambulance from Area 12 with two paramedics was ordered to proceed to the Mesa. Two USAF helicopters, which had been retained on-site by the Test Controller following the event were also ordered to proceed to the Mesa: one to fly directly to the scene, and the other to Mercury to pick up a physician before proceeding to the Mesa. A third USAF helicopter was requested, and the DOE Security helicopter was activated.

An ambulance from Area 12 with two paramedics, arrived on scene at 1246. Initial triage was conducted; additional ambulances and helicopters were requested. The first evacuation helicopter arrived at 1251 and the second helicopter with the physician on board arrived at 1340. Two additional ambulances arrived at 1304, and a fourth one at 1338.

The third USAF helicopter was first utilized as a TV camera platform in order to provide live coverage of on-scene activities for the Test Controller. It arrived at the trailer park for patient evacuation at 1400. The DOE helicopter arrived at 1432.

A total of fourteen injured were examined at the site of the accident and a field determination of the order of seriousness of the injured was made. Initial treatment was primarily to treat shock and immobilize fractures. The patients were then evacuated (Figures 26 and 27).

A total of nine medical personnel arrived at the accident site. These included a doctor, a nurse, and seven paramedics. Evacuation components consisted of four helicopters, four ambulances, and three other government vehicles.

The physician responding at the scene of the accident had not participated in any NTS forward area indoctrination, or mass evacuation training.

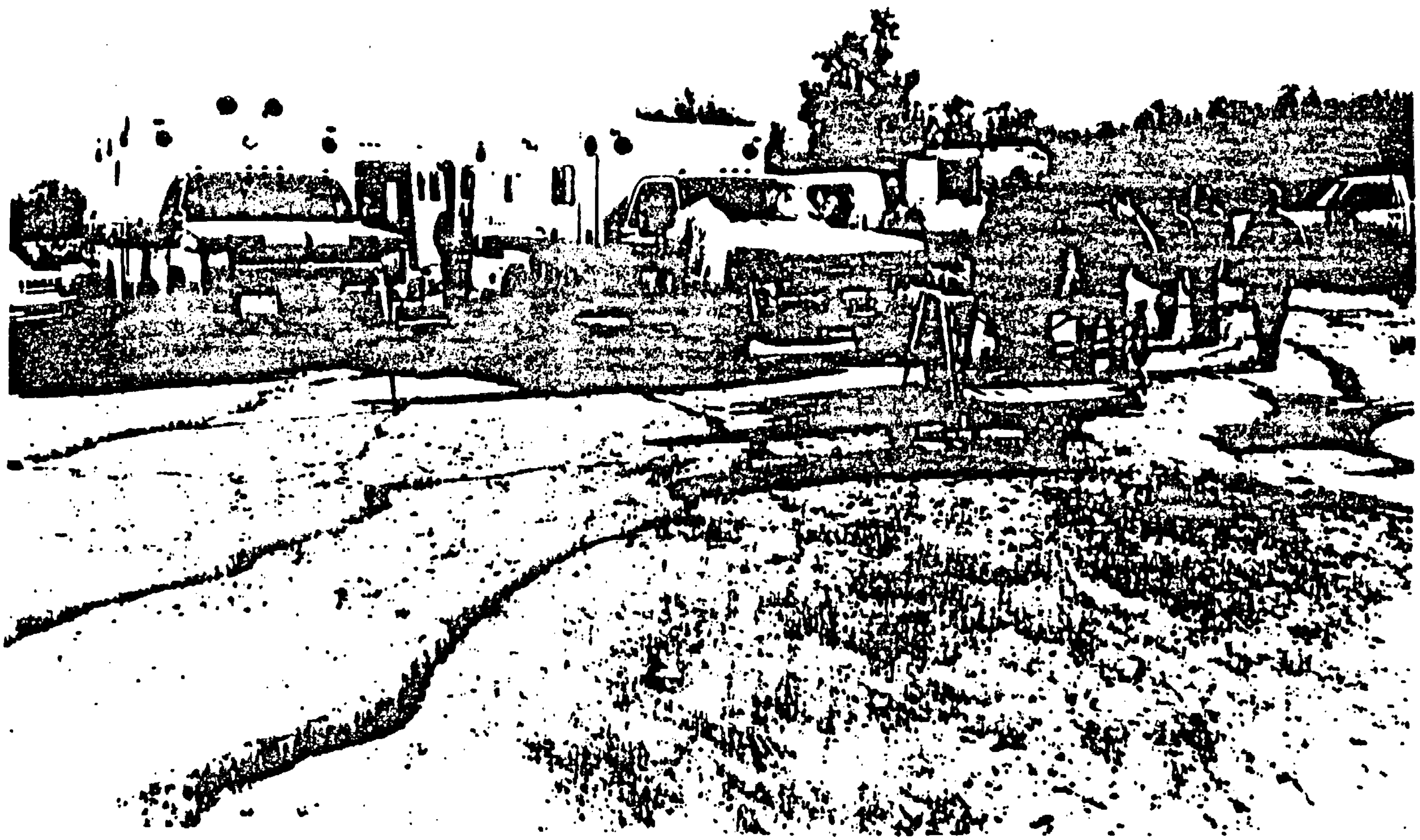


Figure 26 — MILAGRO Trailer Park Emergency Response

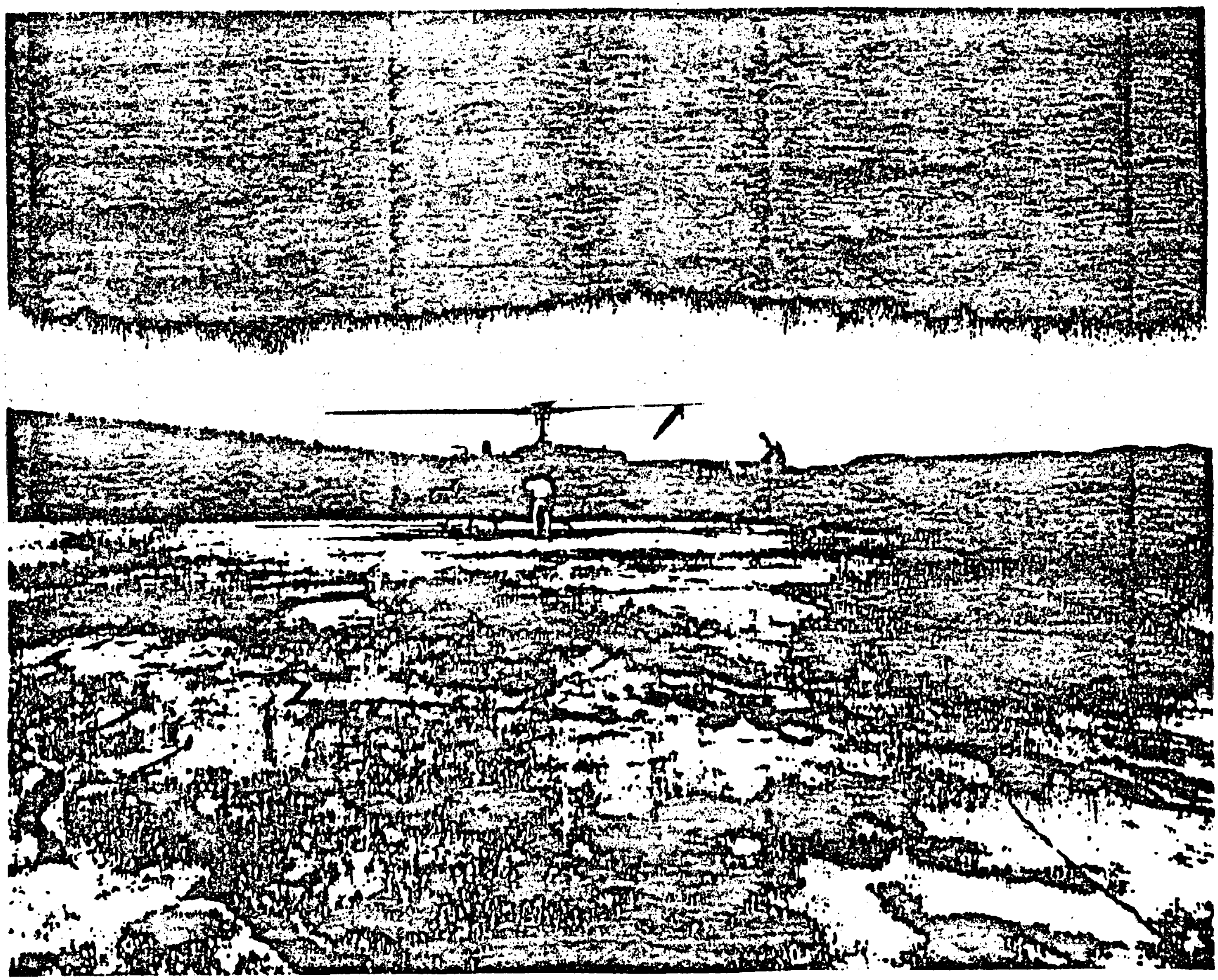


Figure 27 — MILAGRO Trailer Park Evacuation

The patients were sent from the accident site to the Medical Facility at Mercury where the patients were reexamined. The nine most seriously injured were transported to hospitals in Las Vegas for definitive treatment. All of the injured were surveyed for radiation contamination at the Mercury facility. None was detected.

The following five patients were transported via helicopter to Southern Nevada Memorial Hospital in Las Vegas:

[redacted] (REECo), compression fracture of Lumbar-1, possible minimal compression fracture of Thoracic-12 (seven days hospital stay).

[redacted] (LANL), compression fracture Lumbar-4, contusion and possible sprain of upper sternal region (6 days hospital stay).

[redacted] (REECo), compression fracture Lumbar-1 (9 days hospital stay).

[redacted] (PANAM), fractured pelvis (7 days hospital stay).

[redacted] (REECo), complication of multiple injuries, patient expired at 0230 March 4, 1984 (Exhibit 11).

The following four patients were transported via ambulance to Valley Hospital Medical Center:

[redacted] (REECo), anterior dislocation left shoulder (4 days hospital stay).

[redacted] (REECo), injury, left foot, with fractures of 2nd and 3rd metatarsal, as well as dislocation of 4th and 5th metatarso-phalangeal joints (7 days hospital stay).

[redacted] (REECo), fracture right foot, 2nd metatarsal, possible fracture, right os calcis (4 days hospital stay).

[redacted] (REECo), facial injury and concussion (3 days hospital stay).

The following three individuals reported to Mercury Medical via government vehicle with no hospitalization necessary:

[redacted]k (REECo), no obvious injury.

[redacted] (REECo), x-rayed lumbar-spine and bilateral hips.

[redacted] REECo), back strain, right thumb strain.

One patient reported to Southern Nevada Memorial Hospital the evening of the accident, but not admitted:

[redacted] (REECo), fractured rib and sprained wrist.

Two patients reported to a REECo Medical Facility:

[redacted] (REECo), sprain of left knee, contusion anterior portion of the left leg.

[redacted] (LANL), contusion and abrasion of right knee.

The sequence of patient evacuation from site of accident to point of definitive care follows:

<u>1214 Accident Occurred</u>.

Patients immediately removed from accident site to a level portion of the trailer park.

1246--ambulance with two paramedics arrived. The two paramedics started triage.

Sefox #62 Helicopter.

1251--arrived at trailer park. Two most seriously injured were placed in #62. Patient load limited by the lack of compatible helicopter litters.

The Test Panel medical member recommended that the first helicopter should be ordered to Mercury Medical. However, upon being advised that a physician was on the second helicopter and enroute to the scene, he suggested that the patients on the first helicopter be examined prior to leaving the trailer park. The physician, who was to examine the patients in the first helicopter, was never informed of this, nor did he see these patients prior to their leaving for Mercury Medical.

1345--departed for Mercury Medical with English, Miesch, and paramedic White. (Paramedic Ellis told pilot to leave for Mercury.)

1405--arrived at Mercury helo pad, injured transported to Mercury Medical via ambulance.

1413--departed for refueling at CP.

1459--arrived at trailer park.

1507--departed trailer park with injured Lencioni (no medical person on board).

1530--landed at Mercury helo pad, patient transported via ambulance to Mercury Medical.

1552--patients Miesch and Simpson transported via ambulance from Mercury Medical to helicopter. Departed Mercury with two injured for Southern Nevada Memorial Hospital, accompanied by Dr. Indupalli.

1623--arrived Southern Nevada Memorial Hospital.

SEFOX #05 Helicopter

1247--arrived at Mercury helo pad to pick up medical personnel.

1258--departed Mercury with Dr. Parenti, RN McFee and paramedic Pyzyna.

1340--arrived trailer park.

1403--airborne with injured Foster, Simpson, and Smith. Medical personnel RN McFee and paramedic LaRocco.

1411--arrived Mercury helo pad, injured transported to Mercury Medical via ambulance.

1425--departed Mercury for refueling at CP.

1534--arrived Mercury helo pad.

1621--Patients Foster, English, and Cox transported via ambulance from Mercury Medical to helicopter. Departed Mercury for Southern Nevada Memorial Hospital accompanied by paramedic Tucker.

1655--arrived Southern Nevada Memorial Hospital.

SEFOX #41 Helicopter

1400--landed at trailer park and off-loaded camera crew and equipment.

1417--departed trailer park with injured Held, Pena, and Reed, accompanied by paramedic Pyzyna.

1441--arrived Mercury helo pad, injured transported via ambulance to Mercury Medical.

DOE Security Helicopter

1432--arrived trailer park.

1439--departed with McDowell, accompanied by paramedic Tucker.

1500--arrived Mercury helo pad, injured transported to Mercury Medical via ambulance.

AMBULANCES

1246--first ambulance arrived trailer park.

1304--second and third ambulances arrived trailer park.

1338--fourth ambulance arrived trailer park.

1430--first ambulance departed trailer park with Cox, accompanied by Dr. Parenti and paramedic Buckles.

1507--second, third and fourth ambulances departed without any injured.

1535--first ambulance arrived Mercury Medical.

1710--two ambulances departed Mercury Medical for Valley Hospital, one with McDowell and Held, accompanied by paramedic Givens, and the other with Pena and Lencioni, accompanied by paramedic Childers.

1810--two ambulances arrived at Valley Hospital with four injured.

In summary, the patients who were evacuated by helicopter from the trailer park and eventually to the hospital via helicopter were moved as follows:

1. From site of injury to level portion of trailer park.

2. Trailer park to helicopter.

3. Helicopter to ambulance at Mercury pad.

4. Ambulance to Mercury Medical.

5. Mercury Medical to ambulance.

6. Ambulance to helicopter.

7. Helicopter to Southern Nevada Memorial Hospital.

D. Safety

The Manager, NV, has the overall responsibility for the health and safety of personnel on the NTS.

The Test Controller, as the Manager's representative, is responsible for overall health and safety during test execution periods.

The Director, NTSO, is responsible to assure that a specific assignment for occupational health and safety coordination is made for each specific area at the NTS.

The Director, Health Physics Division, is responsible for the delegation of primary radiological safety responsibility within the Ground Zero area to the Laboratory or other Test Group Directors when the device is in the field and during postshot operations.

The Memorandum of Agreement between FCDNA and LANL, dated September 3, 1982, specified that for MIDAS MYTH/MILAGRO, LANL would accept responsibility for Mesa safety coordination (Exhibit 4) and DNA would accept responsibility for underground and portal safety coordination. DOE was not informed of this Memorandum of Agreement.

DOE transferred safety and health coordination responsibility for MIDAS MYTH, T tunnel to FCDNA on November 15, 1983 (Exhibit 12).

DOE did not transfer safety and health coordination responsibility for the MILAGRO trailer park to LANL.

LANL accepted delegation of radiological safety responsibility on February 1, 1984 for the GZ area (Exhibit 13).

LANL transferred the radiological safety responsibility for the GZ area to FCDNA, via the DOE, on February 15, 1984 (Exhibit 13).

IV. ANALYSIS

The Board determined that a number of factors combined to form the causal basis for the accident. An outline of the key factors and relationships is represented in Figure 28, the Events and Causal Factors Chart.

A. Geotechnical Aspects of the Accident

The Board learned that there was a pervasive belief within the DOE/DNA test community that DNA tunnel effects shots in Rainier Mesa had not and would not chimney to the surface of the Mesa. The broad, shallow depressions observed on survey lines above the MINERS IRON and HURON LANDING events and the subsequent additional subsidence on MINERS IRON were not made generally known until after the MIDAS MYTH event. It was assumed these initial shallow depressions were due to ground shock compaction of the vitrified tuff below the welded caprock with subsequent sag of the caprock into the resultant void space. A reasonable interpretation of the secondary collapse on MINERS IRON, however, is that additional chimney growth is responsible for the renewed surface subsidence.

Subsequent to the MIDAS MYTH event an empirical analysis of surface subsidence craters on Rainier Mesa was developed as an addition to an already existing study of Pahute Mesa events and Yucca Flat events which were emplaced deep enough to be detonated in tuff. These analyses are: (1) Yucca Flat (Figure 29), (2) Pahute Mesa (Figure 30), and (3) Rainier Mesa (Figure 31 and 32). The analysis shows that Rainier tests with scaled depths of burial near MIDAS MYTH might chimney to the surface if they were to behave like Yucca Flat events in tuff (Figure 32) but would not be expected to chimney to the surface if they behaved like Pahute Mesa events (Figure 31). The Rainier Mesa events would have reasonably been expected to exhibit chimney growth more similar to Pahute Mesa than Yucca Flat events because the Yucca Flat tests always have a large thickness of "low bulking" alluvium above them. The lesser bulking of unconsolidated alluvium results in greater chimney heights.

Figure 29 is a graph showing the scaled depth of burial that would give a 50 percent possibility of collapse in Yucca Flat.

Figure 30 is a graph showing that SDOB that would give a 50 percent possibility of collapse on Pahute Mesa.

Figure 31 is a graph of Rainier Mesa tests showing the SDOB that would indicate a 50 percent possibility of collapse if they behaved like those on Pahute Mesa. Figure 31 was prepared after the MIDAS MYTH event.

Figure 32 is a graph of Rainier Mesa tests showing the SDOB that would indicate a 50 percent possibility of collapse if they behaved like Yucca Flat events. This indicates that MIDAS MYTH SDOB lies essentially on the 50 percent probability line. Figure 32 was prepared after the MIDAS MYTH/MILAGRO event.

The Board considered it appropriate to examine the circumstances of the MIDAS MYTH/MILAGRO event that may have contributed to the unexpected surface collapse. While it is not possible to establish with certainty that any one factor or set of factors was responsible, the investigation has revealed several aspects of this test that were at or beyond the limits of previous experience. These aspects and their relevance are itemized as follows:

- The yield of the MIDAS MYTH device was examined in view of the anomalously extensive damage to the tunnel and the fact that the surface above the event subsided. From seismic yield determinations by the LLNL (Exhibit 14) and the SNL (Exhibit 15), MIDAS MYTH was determined to be below its maximum credible yield*. In addition, and considered a more credible determination of yield, the LANL Prompt Review (of diagnostics) also indicates a yield in the design range. However, FCDNA plans to obtain a sample of cavity debris by drilling for chemical analysis for a final yield determination.

- The scaled depth of MIDAS MYTH/MILAGRO* was shallower than for any of the modern Rainier Mesa events. This could lead to a larger void beneath the welded tuff caprock as the chimney grew upward and consequently a greater likelihood that the chimney would extend into or through the caprock.

- The separation between MIDAS MYTH/MILAGRO and HUSKY PUP was less, in terms of scaled distance, than for any previous tests in modern Rainier experience. This proximity could have subjected the overlying rock, especially the welded tuff caprock which often supports the void at the top of these Rainier Mesa chimneys, to more motion and consequent disruption than is normal, thereby lessening its mechanical strength.

- The location of MIDAS MYTH/MILAGRO was such that surface ground zero was near the topographic edge of the Mesa. Several other DNA tests have had a similar geometry. This proximity to the edge of the Mesa,

*Yield information deleted.

however, could have resulted in relief of horizontal stresses in the welded caprock, both before and during primary ground motion. As a result, this stress relief could have allowed the vertical joints in the caprock to open or allowed easier relative motion.

- Observed damage in the tunnel was much greater than anticipated based on all prior tunnel experience. A comparison was made of MIDAS MYTH underground damage to that experienced on previous events (Figures 33-42). The nearly saturated zeolitized tuff beds in the MIDAS MYTH tunnel have the lowest gas filled porosity (1.2-1.7%) ever measured for an effects test in Rainier Mesa. This could be expected to result in greater coupling of energy into ground motion (Exhibit 5). These observations are not inconsistent with formation of a somewhat larger cavity than normally expected. A larger cavity would tend to result in higher chimney growth.

In summary, there was a preponderance of experience before MIDAS MYTH/MILAGRO which led the testing community to believe that while a distinct cavity collapse would occur, a surface crater would not develop from this cavity collapse. Inquiry subsequent to the event and analysis of existing data have disclosed information not commonly known and have provided results which indicate the possibility of surface cratering for this scaled depth of burial in Rainier Mesa. The analyses and evaluations performed before the event focused on containment and radiological safety. There was no consideration of hazards to personnel on the Mesa, that would arise from cavity collapse phenomena.

Figure 33 — MIDAS MYTH Underground Tunnel Damage, U121.04 Bypass Drift

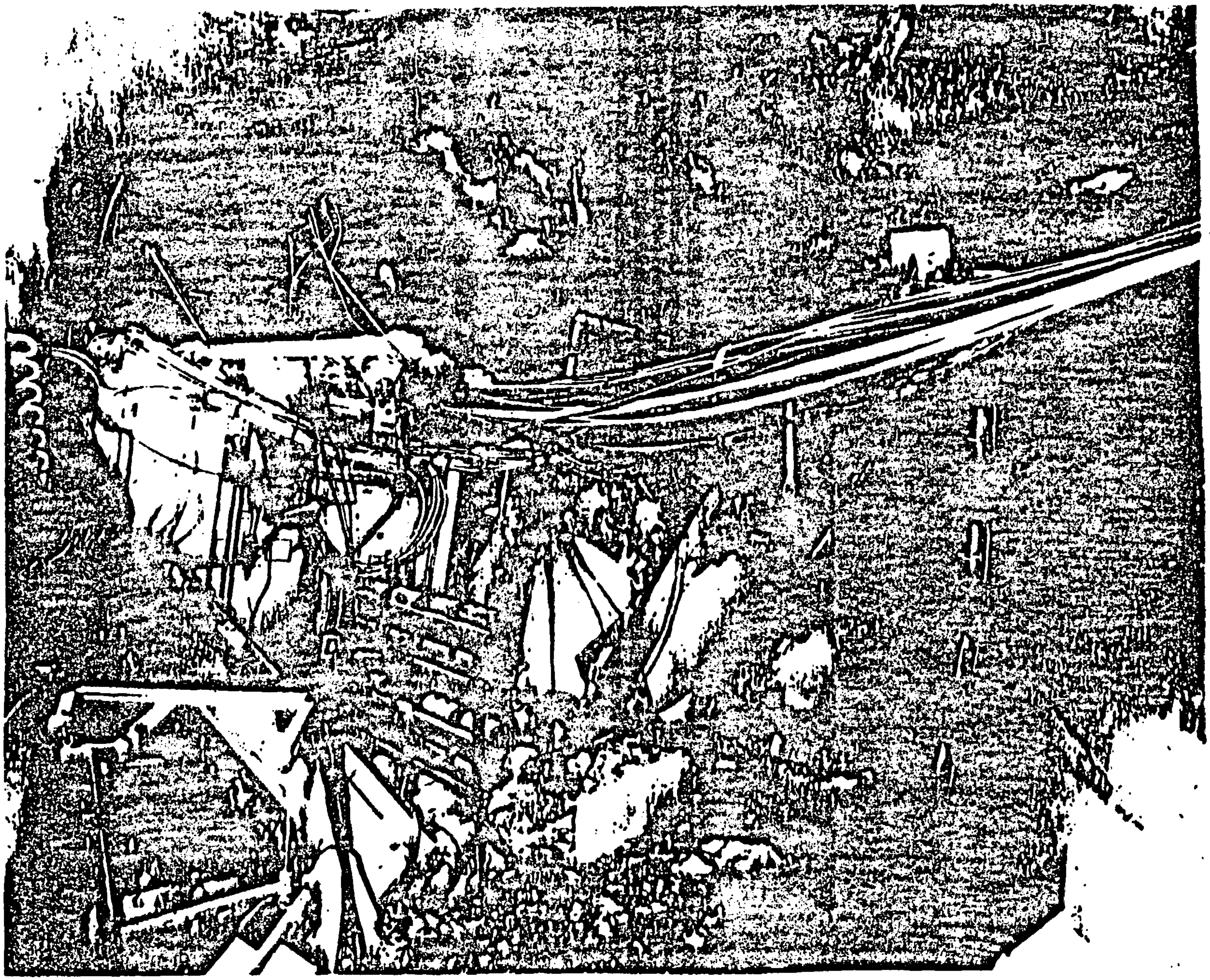


Figure 34 — MIDAS MYTH Underground Damage, U12t.05 Drift and Alcove

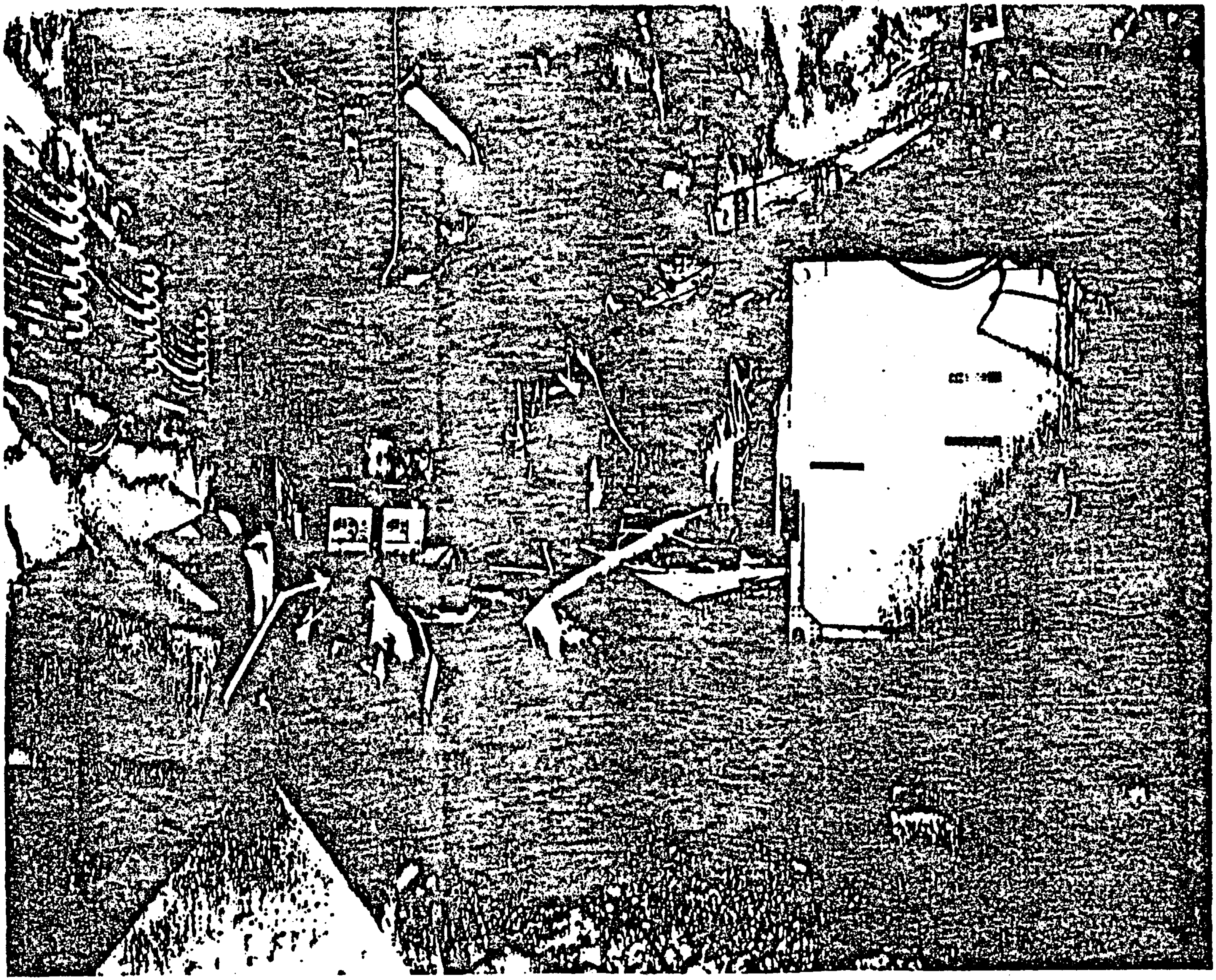


Figure 35 — MIDAS MYTH Underground Damage,
U121.04 Main Alcove Entrance

Figure 36 — MIDAS MYTH Underground Damage,
Portal End of Main Alcove

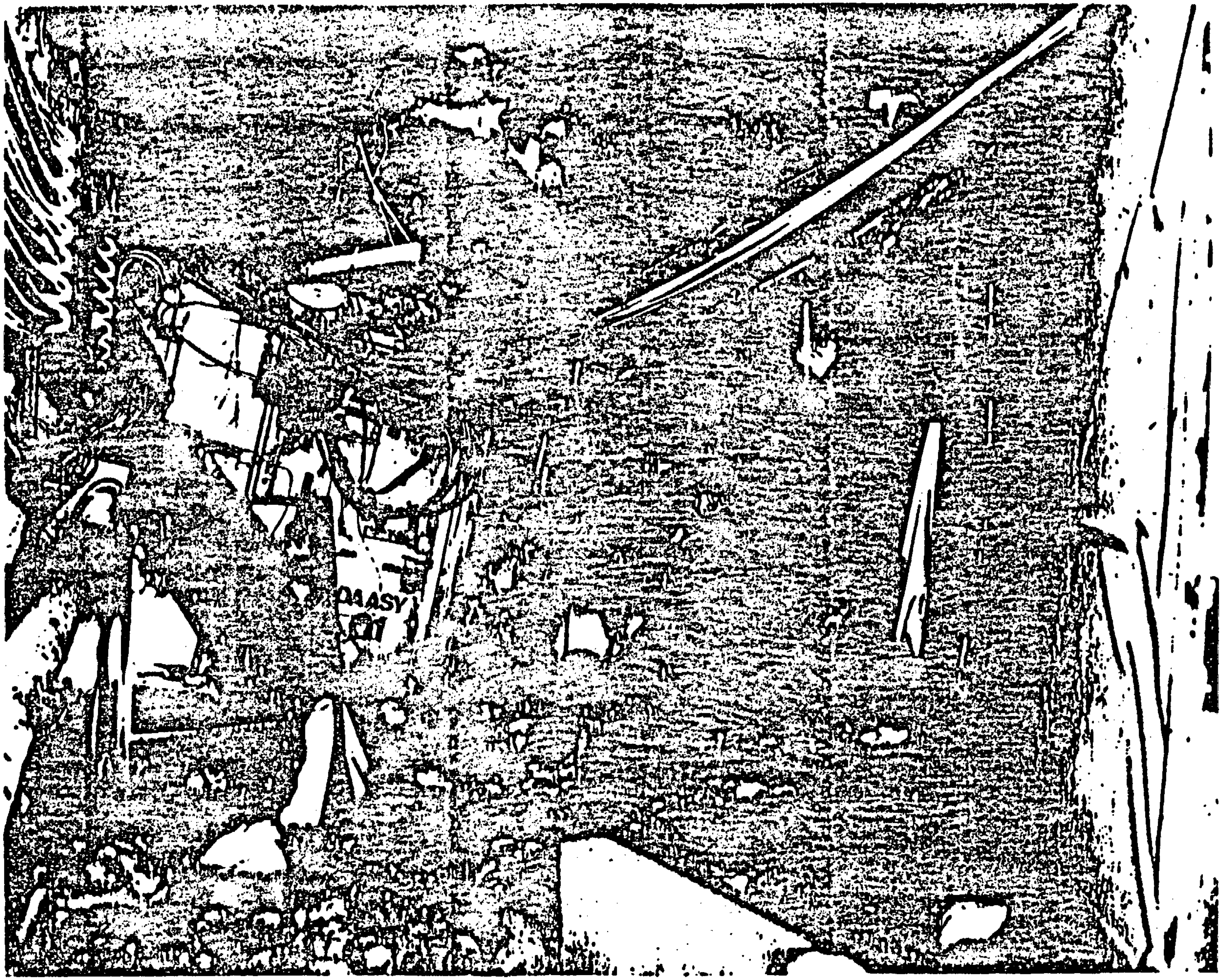


Figure 37 — MIDAS MYTH Underground Damage,
Pillar between 05 Drift and Main Alcove

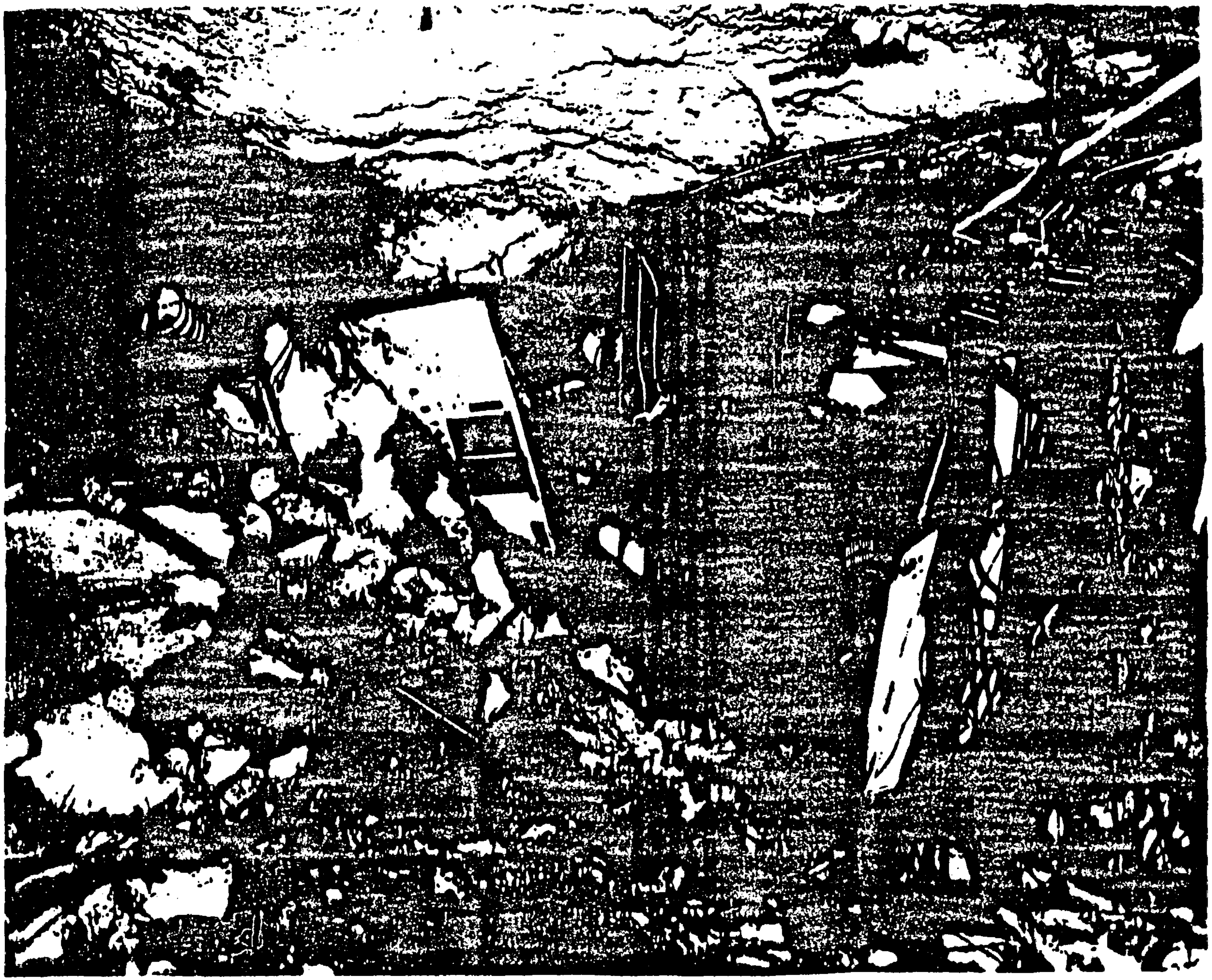


Figure 38 — MIDAS MYTH Underground Damage, Main Instrumentation Alcove

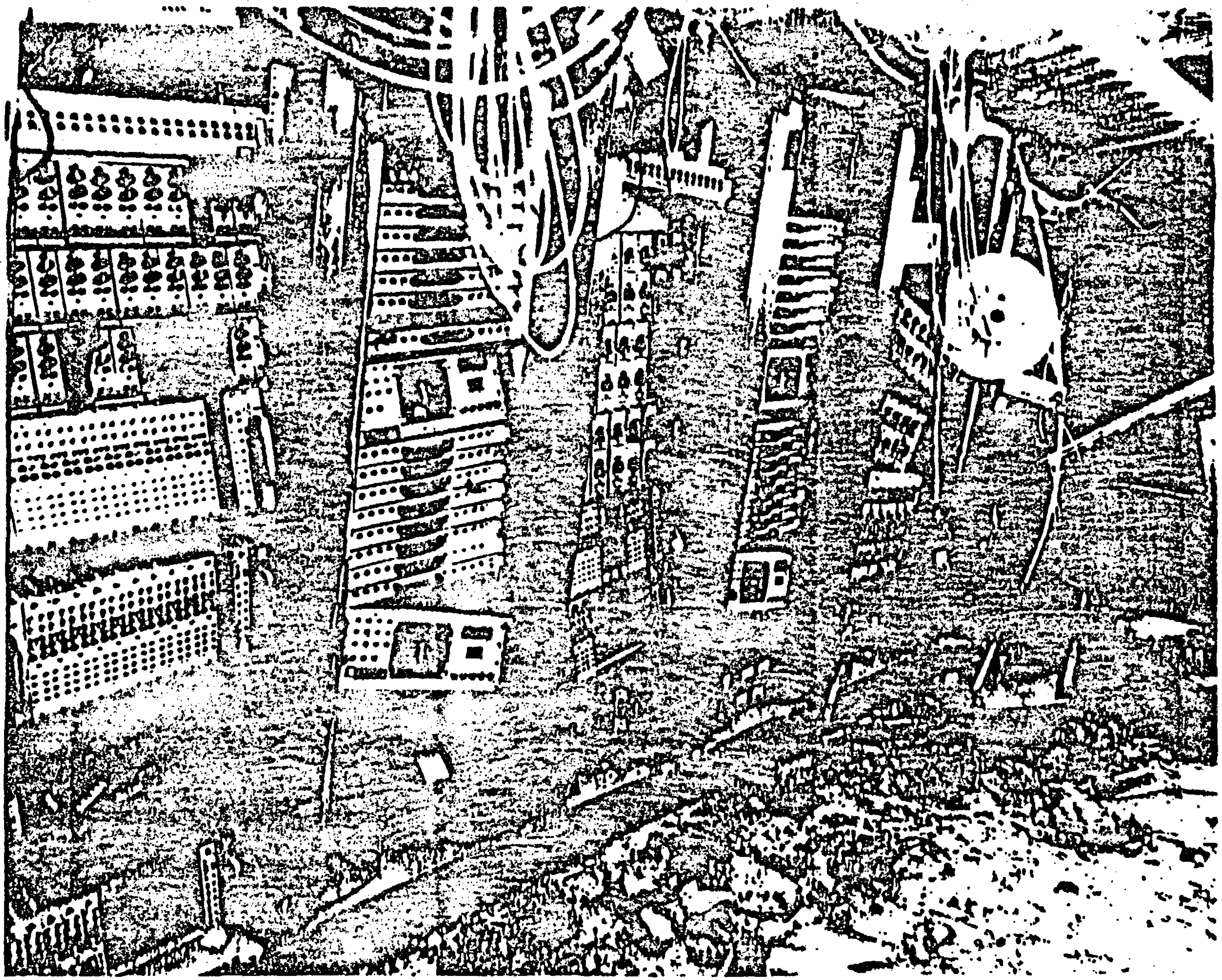


Figure 39 — MIDAS MYTH Underground Damage,
Alcove I-3 Instrumentation Racks

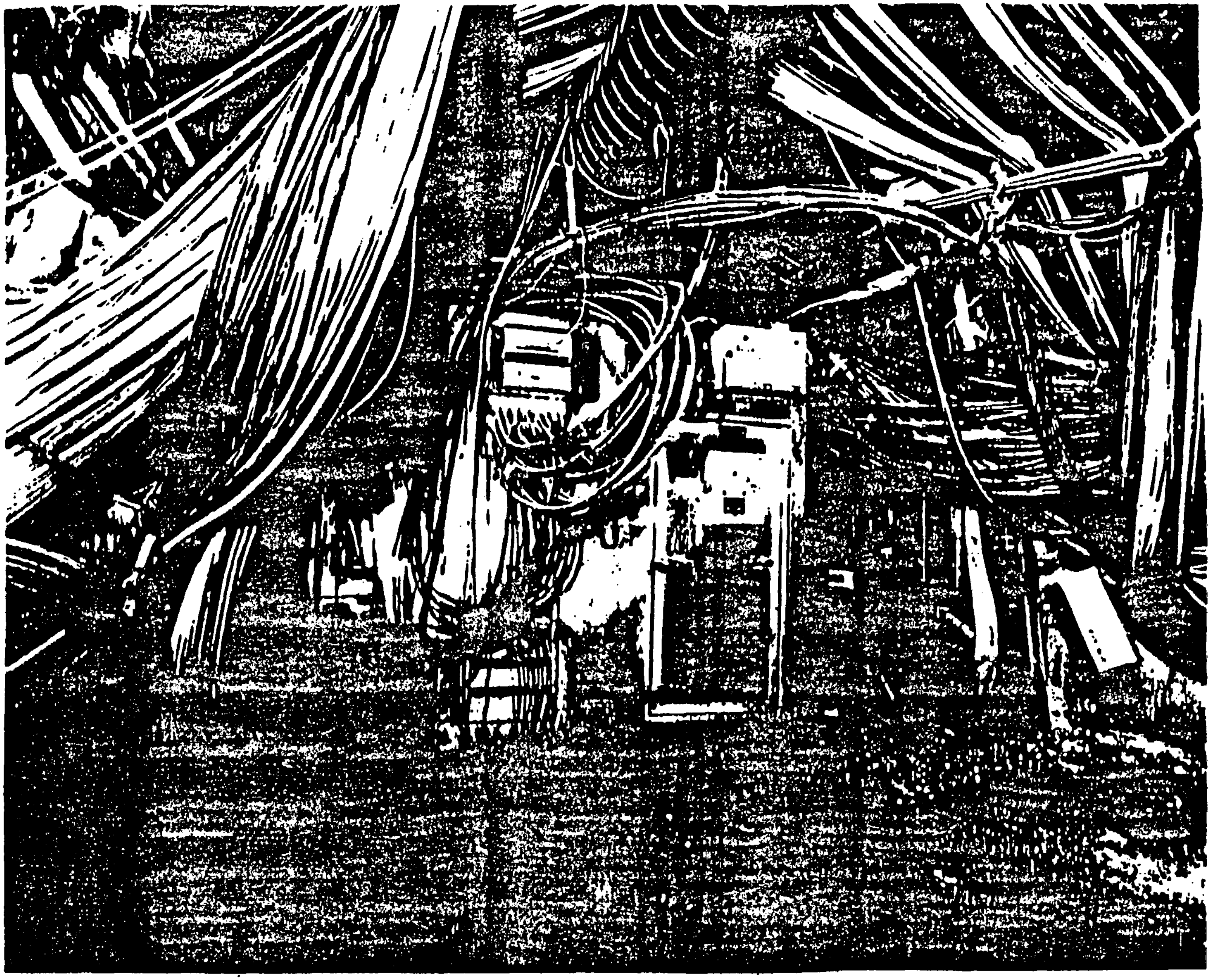


Figure 40 — Previous Tunnel Event Postshot Damage, MINERS IRON ROSES Trailers

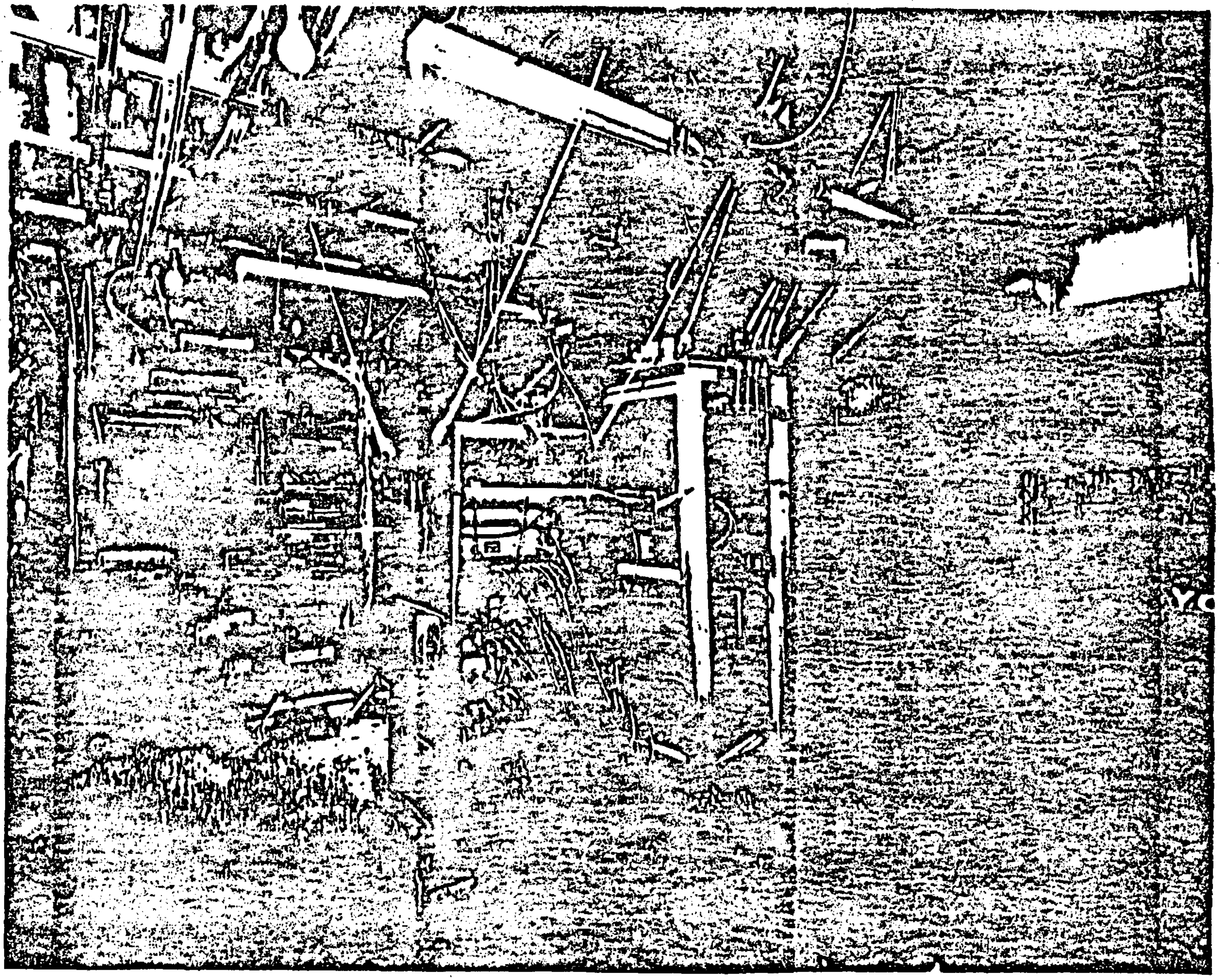


Figure 41 — Previous Tunnel Event Postshot Damage, MINERS IRON Instrumentation Alcove

Figure 42 — Previous Tunnel Event Postshot Damage, HURON LANDING Instrumentation Alcove

B. The Accident

The Board has learned that there were several factors in the MIDAS MYTH/MILAGRO location which caused it to be different from other tunnel events. Each of these caused this event to be less conservative than other events conducted in that area. At the maximum credible yield, it had the shallowest scaled depth of burial of any modern Rainier tunnel experiment. It also had the lowest scaled separation from any modern previous event in Rainier Mesa. The trailer park was located essentially at SGZ.

It appeared to the Board that any single one of these factors should have been a flag to indicate to the Test Controller, the Scientific Advisor, the Test Group Directors, and others that extra precautions should be used in post-detonation operations. It became apparent to the Board that the Test Controller and his Panel were almost totally absorbed with the possibility of the postshot release of radioactive material and had no thought of possible injuries from collapse-generated ground motion.

A nuclear explosive safety study was conducted. An NV panel reviewed containment. There were containment, technical and readiness briefings. The Test Controller's Advisory Panel deliberated and made recommendations. However, none of these activities included a safety review of such depth so as to highlight and question any of the factors discussed above.

There was a Memorandum of Agreement between DNA and LANL which included a statement that LANL would accept responsibility for Mesa safety coordination when fielding commenced. The Memorandum also provided that all postshot reentry and recovery efforts would be approved by the Test Controller and would be conducted under the control of FCDNA. DOE was not informed of this Memorandum of Agreement. The safety and health coordination responsibility for Mesa operations was not formally transferred from DOE to LANL. The Board learned that it is a practice for the testing organization, rather than DOE, to initiate the action which transfers the safety and health coordination responsibility.

The FCDNA Test Group Director asked for permission to go to the tunnel portal and to reenter the Mesa Trailer Park to cut cables although he noted continued activity on the geophone record display. He believed that it was not necessary to determine if cavity collapse had occurred until tunnel reentry was to be undertaken.

The LANL Test Group Director believed that the initial reentry party activity on the Mesa was a FCDNA requirement. He saw no need to be concerned about cavity collapse at the time permission was requested for the Mesa party to reenter the area, even though there were LANL personnel in that party.

The Scientific Advisor and the Test Controller agreed that although collapse might occur, the ground motion would not constitute an unacceptable hazard to people in the trailer park. This attitude so prevailed that even at 15 to 20 minutes before collapse when the geophones displayed a clear indication of imminent collapse, no steps were taken to alert the trailer park occupants. The underground cavity collapse was not believed to constitute a real hazard to the Trailer Park Reentry Team. Even after safety geophone signals indicated cavity collapse and this fact was generally recognized by the Test Controller's Advisory Panel, there was no apparent concern for consequences to the Reentry Team until notification of surface collapse and personnel injuries was received.

The Board believes that there was inadequate consideration by the Test Controller and Scientific Advisor of the postshot seismic activity as displayed on the safety geophone reentry system when the decision was made to permit reentry to the trailer park. It was learned that for Yucca Flat events, LANL and LLNL procedures do not permit reentry into recording trailer parks as long as there are seismic signals indicating continued chimney growth toward probable collapse. If a surface collapse does not ensue within a reasonable period reentry is made under stringent safety procedures. There must be constant observation of the geophone signal and an adequate system for alerting people in the trailer park that a collapse may occur, thus giving them time to protect themselves from any earth movement. In the case of Rainier Mesa underground tunnel events, reentry to mesa recording trailer park historically had not been controlled by interpretation of geophone signals even though the tunnel reentry procedures require a 24 hour delay if there has not been a clear signal of collapse on the geophones. For Rainier Mesa tunnel events, the trailer parks have been typically located 300 to 450 meters from surface ground zero. Thus, if collapse occurred, whether surface or underground, the trailer park and reentry personnel were far removed from ground zero and the location of the collapse.

In the case of MIDAS MYTH/MILAGRO, the near point of the recording trailer park was about 26m from surface ground zero. The MIDAS MYTH/MILAGRO trailer park area partially overlapped the expected cavity, that is, the perimeter of the trailer park was inside one cavity radius at the surface. Although there was a study made to determine that the trailers and data recording devices could survive the initial ground shock, there was no consideration given to people being in the trailer park at collapse time, and thus no thought given to the possibility of injury.

The Scientific Advisor testified that, in his opinion, a subsurface collapse did not constitute a hazard that he thought was unacceptable.

In summary, the Board noted that permission was given to reenter the trailer park without restraint except for the previously approved MIDAS MYTH/MILAGRO Portal and Mesa Reentry/Recovery Plan which contained no reference to any sort of collapse. There was no discussion of the possibility of injury to people in the trailer park from surface or subsurface collapse. Overriding opinion that there would be no collapse at or near surface ground zero and a seeming lack of recognition that the trailer park was essentially over ground zero led to an unfortunate decision to allow early reentry to the trailer park.

C. Post-Accident Activity

The initial medical response at the trailer park was good. It appeared that individual performance by the medical personnel was outstanding. The first two paramedics at the site of the accident started triage at 1246. However, communication was a major problem. Because of the noise level when helicopters were at the trailer park the paramedics, nurse and doctor could only communicate by shouting at very close range. There were no radio handpacks. The capability for patching radio communication between the people in the trailer park and the helicopters was not recognized or utilized. The helicopter Sefox #05 did not have headsets and therefore the medical personnel on board were unable to receive any messages or communicate with the crew.

The first helicopter, Sefox #62 arrived at 1251. The two most seriously injured were placed aboard shortly thereafter. The helicopter was held at the trailer park upon the recommendation of the test panel medical member pending the arrival of a physician from Mercury Medical to check the most seriously injured. The doctor arrived in the second helicopter at 1340, but was not informed that he was to examine these patients, nor did he do so. At 1345, #62 finally departed for Mercury Medical upon the orders of a paramedic, having been at the trailer park 54 minutes, a seemingly long waiting period. Helicopter #62 arrived at Mercury at 1405, but could have gone directly to Southern Nevada Memorial Hospital, bypassing Mercury Medical, had it left the trailer park as soon as it was loaded. Due to the delay at the trailer park, refueling was desired.

There appeared to be a decided lack of direction at the scene of the accident. The FCDNA Mesa Reentry Team leader appears to have assumed the role of telephone talker, relaying information to the Operations Room. Arriving medical and evacuation personnel could not identify the person in charge and control and direction to the helicopters appeared nonexistent. Thus, the first helicopter was unnecessarily delayed for at least thirty minutes after having been loaded with patients. Directions from the Operations Room concerning physician examination of patients, holding of helicopters and routing of helicopters, seemed to contribute significantly to the delay and confusion. The instructions from the Operations Room were passed to the helicopters, but were not passed to the personnel at the scene, and these personnel had no radio contact with the helicopters.

The evacuation of the injured did not seem to be executed in a timely manner. There appeared to be sole reliance on evacuation by helicopter. There were three ambulances on scene at 1304. All of the patients that remained following the loading of the first helicopter could have been evacuated by ambulance and delivered to Mercury Medical in approximately one hour.

There did not seem to be a program for training REECo Occupational Physicians in NTS operations, nuclear testing, or mass casualty evacuation.

There was apparently no labeling or tagging of patients which added to the difficulty of the situation, especially as to types of injury, medications administered, etc. As a result many of the injured were examined over and over by different medical personnel, i.e., one patient finally asked them to stop checking her.

The litters were not compatible with Air Force helicopter hardware, thereby reducing the patient load and compromising comfort of travel.

There appeared to be an inordinate amount of handling or moving of the patients, (i.e., from trailer park to helicopter to ambulance to Mercury Medical facility to ambulance to helicopter to Southern Nevada Memorial Hospital).

It appeared that there were medical procedures unnecessarily performed at Mercury Medical since they were done at the hospitals in Las Vegas.

There was a problem at the entry to the trailer park with vehicles blocking the road.

V. CONCLUSIONS

A. Probable Causes

- The immediate cause of the accident was the collapse of the ground at the recording trailer park while occupied by reentry personnel.

- A contributory cause was the location of the cable head and the recording trailer park in close proximity to SGZ.

- Another contributory cause was the pervasive belief that there would be no surface collapse from a Rainier Tunnel Experiment. This allowed a decision to permit workers to be in the area which collapsed.

- An apparent cause of the surface expression of the cavity collapse is that this SDOB exceeded the threshold at which collapse could be a possibility and perhaps was augmented by the low scaled separation from HUSKY PUP.

B. Findings

- This was the only diagnostic trailer park ever to partially overlap the expected cavity, i.e., inside one cavity radius at the surface.

- MIDAS MYTH/MILAGRO and HUSKY PUP had the smallest scaled separation of working points for any events on the Mesa.

- At the maximum credible yield, MIDAS MYTH/MILAGRO had the shallowest scaled depth of burial of any modern Rainier Mesa event.

- The integrity of the welded tuff caprock of Rainier Mesa may have been compromised by repeated nuclear detonations.

- There were data existing prior to the event which indicated the possibility of a surface collapse.

- A LANL study to examine trailer survivability from initial ground shock did not consider surface collapse, or the safety of reentry personnel who might be in the trailer park.

- DOE does not transfer safety and health coordination responsibility until requested to do so by the testing organization.

- A safety review encompassing all aspects of the event was not conducted.

- FCDNA did not inform DOE of the agreement reached with LANL on the conduct of MIDAS MYTH/MILAGRO.

- DOE did not assign safety and health coordination responsibility for Rainier Mesa operations.

- The only concern expressed by the Test Controller and Scientific Advisor when considering release of the reentry parties was the possibility of a radioactive release.

- Permission was given to reenter the trailer park without any consideration of the possibility of injury to the reentry party from subsurface or surface collapse.

- The FCDNA Test Group Director was concerned with cavity collapse for tunnel reentry but not for Mesa reentry.

- The LANL Test Group Director assumed that FCDNA was responsible for reentry personnel and, thus, did not follow the LANL normal practice for reentry of trailer parks prior to collapse.

- At release of the reentry party from Gate 300, the Test Controller and Scientific Advisor interpreted signals from the geophone record as indicating continued seismic activity. However, no instructions were given to obtain an updated status of seismic activity before entering the trailer park.

- The Test Controller and Scientific Advisor observed increased geophone activity at 15 to 20 minutes prior to collapse and concluded that subsurface collapse was imminent, but no effort was made to warn people in the trailer park of the possibility of ground motion.

- An ambulance and paramedic did not accompany the Mesa Reentry Party.

- Initial medical response to the accident was good.

- Lack of communication among medical personnel and the fact that no single individual coordinated all phases of the evacuation at the trailer park resulted in repeated examination of some of the injured.

- Lack of adequate communication between the Operations Room, medical personnel and evacuation personnel, resulted in undue delay in evacuation of the injured, i.e., over four hours before the first of the injured arrived in Las Vegas.

- Other than RERO, there have been no mass casualty drills involving the REECo medical staff.

- The handling and moving of the patients were excessive.

- REECo Occupational Physicians have little knowledge of hazards connected with nuclear testing and test site work places.

- The injured were not tagged or labeled so as to identify type of injury, medication given, etc.

- NTS litters were not compatible for optimum use in Air Force helicopters.

- The wind sock installed at the trailer park facilitated helicopter operations.

- The location of the helicopter pad at Mercury necessitates the use of an ambulance for transfer to the Medical Facility.

- Notification of news media and subsequent announcements and briefings were handled in a professional and timely manner.

C. Judgment of Needs

There needs to be:

Further investigation into the impact of this unexpected occurrence on the fielding of future tunnel experiments in Rainier Mesa.

DOE participation in, or notification of, agreements between testing agencies concerning operations at the Nevada Test Site.

Review and possible revision of the procedure used to assign safety and health coordination responsibilities pre and postshot.

A comprehensive safety review for each event conducted by or for the Test Controller.

A clear assignment made with responsibility for safety geophone monitoring, interpreting, and communicating the status of seismic activity to those responsible for reentries.

A written procedure for safely entering Surface Ground Zero proximity after detonation, if a clear signal of collapse has not been seen.

Periodic mass casualty drills.

A program to require REECo Occupational Physicians to become more familiar with test site work places and various hazards connected with test operations.

A requirement that an ambulance and paramedic(s) accompany reentry teams into remote areas.

A standard tagging procedure to identify injury, medication administered, etc.

A system for improved communications among:

1. Medical personnel
2. Medical personnel and person in charge at accident site
3. Person in charge at accident site and Operations Room
4. Accident site personnel and evacuation vehicle operators

A person in charge at the scene and a means to identify that person to all involved.

A review of evacuation practices concerning the movement and handling of patients.

A study to determine the feasibility and desirability of constructing a helicopter pad adjacent to the Mercury Medical facility.

A standing requirement that work sites have a wind sock nearby in case there is an accident and it is desirable to use a helicopter.

An acquisition of litters compatible with military helicopter hardware. These should then be available to all areas of NTS.

VI. SIGNATURES

The investigation was conducted and the report prepared by:

Robert H. Thalgott, Chairman
Consultant to DOE

C. J. Smits, Member
Deputy Director
Contracts and Property Division
Nevada Operations Office

Ronald T. Stearns, Secretary
Chief, Measurements & Detection Branch
Nuclear Systems Division
Nevada Operations Office

Representatives and Advisors follow:

Harry R. Seymour, NV
Safety Specialist

Roy C. Baumann
Assistant Chief Counsel
DOE Nevada Operations Office

Kenneth M. Oswald
Lawrence Livermore National Laboratory

LCDR Kenneth K. Miles, USN
Field Command, Defense Nuclear Agency

Collin W. Dunnam
Manager, Occupational Safety & Fire Protection
REECo

Robert H. Campbell
Los Alamos National Laboratory
Consultant

Wendell D. Weart
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Maxwell E. Kaye, M.D.
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FEB 16 1984

Robert H. Thalgott, Las Vegas, NV
C. John Smits, Dir., CPD, NV
Ronald T. Stearns, Chief, Measurements &
Detection Br., NSD, NV

INVESTIGATION BOARD - SUBSIDENCE AT U12T, THE NEVADA TEST SITE, FEBRUARY 15, 1984

You are hereby appointed members of a Board to conduct a Type A investigation and submit a formal report on the circumstances, cause(s) and contributing factors, if any, of the occurrence leading to the injury of contractor employees in the MIDAS-MYTH/MILAGRO trailer park in Area 12 at the Nevada Test Site, February 15, 1984.

Mr. Thalgott will serve as Chairman of the Board, and Mr. Stearns will serve as Secretary. The investigation and report will be in accordance with the provisions of DOE Order 5484.1, Chapter II.

The following organizations are invited to designate a representative to participate in the investigation:

Field Command, Defense Nuclear Agency
Los Alamos National Laboratory
Sandia National Laboratory
Lawrence Livermore National Laboratory

The individuals listed below will serve as advisors to the Board during the investigation:

Harry R. Seymour, Jr., Safety Advisor
Collin W. Dunnam, Safety Advisor
Michael A. Marelli, Radiological Advisor
Roy C. Baumann, Legal Advisor
Maxwell E. Kaye, M.D., Medical Advisor

The Board may call on any other technical advisors or consultants deemed necessary by the Chairman.

In the conduct of the investigation, the Board shall have the authority to consult with, enlist the aid of, and take statements from any and all personnel whose authority, responsibility, function and activity might directly or indirectly bear on the circumstances under investigation. The authority of the Board also includes the right to control the accident site, equipment and materials therein until such time as the Board chooses to relinquish such control to proper authority.

Shed R. Elliott, Director, Safety and Health Division, NV, is the Board's point of contact in this office and will assist the Board as necessary, review the draft report for completeness prior to publication, and coordinate arrangements for management briefings as requested.

The report of the investigation is to be submitted to me with appropriate recommendations by March 28, 1984.

Thomas R. Clark
Thomas R. Clark
Manager

cc:
R. C. Amick, CC, NV
J. R. Gilpin, AMA, NV
H. D. Cunningham, REECo, Las Vegas
Commander, Field Command, DNA, Kirtland AFB, NM
W. P. Wolff, LANL, Mercury, NV
R. H. Ide, LLNL (L-50), Livermore, CA
B. G. Edwards, SNL, Mercury, NV
G. E. Schweitzer, EPA, Las Vegas
J. W. LaComb, DOD/DNA/Mercury, NV
K. L. Groves, FC/DNA, FCY, Kirtland AFB, NM
H. R. Seymour, Jr., DOE/NTS
C. W. Dunnam, REECo, NTS
M. A. Marelli, HPD, NV
R. C. Baumann, OCC, NV
M. E. Kaye, MD, EPA
R. C. Reed, PanAm, Mercury, NV
D. E. Patterson, DOE/HQ (EP-32) GTN
Col. J. T. Weathers, USA, DOE/HQ (DP-226) GTN
R. W. Taft, AMES, NV
S. R. Elliott, SHD, NV

GLOSSARY

1. Persons testifying before the Board
2. Summary of Public Affairs actions
3. Containment Briefing, D-1
4. Memorandum of Agreement between FCDNA and LANL
5. Generalized Geology of Rainier and Aqueduct Mesas and Selected H Los sites
6. Surface Effects of the HURON LANDING/DIAMOND ACE (U12n.15) Event
7. Proposed Surface Investigation for the MIDAS MYTH (U12t.04) Event
8. MIDAS MYTH Portal and Mesa Reentry/Recovery Plan
9. MIDAS MYTH Tunnel Reentry/Recovery Plan
10. N tunnel/Mesa Safety Geophone Record for MIDAS MYTH
11. State of Nevada--Certificate of Death
12. Safety and Health Coordination Transfer of Responsibility
13. Delegation of Radiological Safety Coordination Responsibility
14. LLNL seismic yield determination for MIDAS MYTH/MILAGRO
15. SNL/NTS MIDAS MYTH Seismic Yield Estimate

EXHIBIT 1

Paul P. Orkild, USGS, Weapons Coordinator

Juan R. Pena, REECo, Radiation Safe Monitor

J. L. Smith, REECo, Operations Superintendent

Noble Simpson, REECo, Laborer

William J. Mayer, LANL, Staff Engineer

Elmer J. Sowder, Jr., LANL, Test Director, Test Operations Office

Nathan M. Lencioni, REECo, Industrial Hygienist

Dale L. Cox, LANL, Event Engineer

Stephen C. Foster, PANAM, Photographer

Elizabeth M. McDowell, REECo, Radiation Monitor

James W. Shugart, REECo, Supervisor, Radiological Field Superintendent

Darwin Hoskin, REECo, Environmental Sciences

Richard Solzano, REECo, Radiation Safe Monitor

Kenneth R. English, REECo, Teamster

Clarence R. Mehl, SNL, Division Supervisor of Effects Experiments

Leonard Kreisler, M.D., REECo, Medical Director

Darrell W. McIndoe, M.D., Self-employed, Medical Member of Test Controller's Advisory Panel

Persons Testifying Before the Board

Lt. Commander Kenneth K. Miles, USN, FCDNA FCTS, Test Directorate, Safety

Carter Broyles, PhD, SNL, Scientific Advisor to the Test Controller for MIDAS MYTH/MILAGRO

Dick P. Adams, EG&G, assigned to FCDNA, Cable Coordinator

Robert M. Nelson, Jr., DOE Assistant Manager for Operations, appointed Test Controller for MIDAS MYTH/MILAGRO

Walter P. Wolff, LANL, Test Group Director, MILAGRO

Russell B. Buchanan, LANL, Staff Member, Health, Safety & Environment, Seismic Group 1

Anthony J. Parenti, M.D., REECo Medical Occupational Physician

Leo T. Brady, SNL, Technical Staff Associate assigned to NTS Staff

Joseph B. LaComb, DOD/FCDNA, Chief, Construction Division

Joseph H. Dryden, DOE, Director, Nevada Test Site Office

Major Jerry D. Wilcox, USAF, FCDNA, Test Group Director, MIDAS MYTH Event

Carl Keller, FCDNA, Containment Scientist

Jeffrey L. Ellis, REECo, Paramedic

Darrell McPherson, DOE, Mining Safety Specialist

Dean R. Townsend, F&S Inc., Chief, Geology Section

Barbara A. McFee, RN, REECo, Chief Nurse

Collin Dunnam, REECo, Manager, Occupational Safety and Fire Protection

William W. White, REECo, Paramedic

Linden Kelly, H&N, Consultant

Thomas A. Weaver, PhD, LANL, Deputy Group Leader of Geophysics Group

EXHIBIT

1

Jack W. House, PhD, LANL, Program Manager for Containment

Robert L. Ghee, WSI Sergeant

Thomas Kunkle, PhD, LANL, Staff Member

Arlin R. Givens, Jr., LANL, Associate Group Leader

Stanley Anson, REECo Medical Administrator

John D. Stewart, DOE, Acting Branch Chief, Operations Management Branch

Lafayette McMorris, WSI, Sensitive Assignment Specialist

James K. Magruder, DOE, Director, Nuclear Systems Division

Capt. Robert S. Clegg, 4460th Helicopter Squadron, Pilot and Flight Commander

Maj. Peter G. Graf, 4460th Helicopter Squadron, Assistant Operations Officer

1st Lt. Glen R. Schumacher, 4460th Helicopter Squadron, Pilot

Capt. Jerald H. Friddell, 4460th Helicopter Squadron, Pilot

James H. Metcalf, SNL, Staff Member in the Environmental Health Department

Frank E. Dow, FCDNA, Program Manager

Paul J. Mudra, DOE, Director, Test Operations Division

William G. Pyzyna, REECo, Paramedic

John H. Held, REECo, Labor Foreman

Thurston W. Slack, REECo Laborer

David L. Reed, REECo Laborer

Robert L. Ferguson, REECo Laborer

James T. Nomeland, REECo, Wireman

Billy C. Moore, DOE, Deputy Assistant Manager for Operations ization test we did leak check, checking all the drill holes to the mesa and checked along the fault traces, etc., to see if we could see traces of gas on the mesa. Basically, the leak test or pressure test of the plug was successful. We saw some minor leaks under the skin of the trainway at the working point end which we had anticipated based on the first test. We did see some leaks through the grout tubes we had in the plug but not on the portal side. They were all forward of the keyway and we were not surpirsed.

We drilled those out and put sodium silicate on them just to be safe.

The grout in the gas seal plug trainway broke at 3160 with Waterways and 2982 with H&N with an average of 2971 psi. The criteria for the plug in that trainway is 2000 psi so it is in good shape.

Once again, I will be getting a report on this pour and the main drift protection plug in the morning.

Once again, on the penetrations, the seal plates, as on the protection plug, we had to put plastic steel on this also.

Vertical drill holes: At the CEP we presented that we would cut cables off in old cable holes and weld plates, both on top and bottom of the casings. That has been accomplished and plates have been welded on and the void behind the plate has been pressure grouted to make sure the plates have been capped.

Drill hole #6: We did find it and we ran a wire line down 20', welded a cap on it and pressure grouted the hole to try and squeeze it. All we concluded is that we have a drill hole with 20' of grout in it and a welded cap on it.

The remaining drill holes, other than those, we did some work on. We extended the surface casing top 3 to 4 feet to enable us to find the drill holes. We put up steel posts with a hole designation sign.

We did that because of some problems we have had in the past where with 2 feet of snow on the mesa the collar pipe is not high enough making it hard to find the drill hole. These extensions have been welded and inner capped.

The LANL cable hole was stemmed as told to the CEP. I looked at some of the grout data we had this morning and found that it was between 2000 and 2500 psi. There is no reason for the hole to have changed.

As far as the drill holes are concerned, a representative from F&S and one from H&N will go to the mesa before dark this evening to double check these collars to make sure no one has disturbed them. That check will be made this evening and we will report on it in the morning.

One addition that LANL did make was a post shot cellar on their pad which is 2.6 meters deep.

The gas seal door: The big one is just closed, little one still open. Once the button-up crew and Arming Party is through, we will close it and intend to start pressurizing it and hopefully have that volume between the gas seal door and gas seal plug at 10 psi at readiness time.

One thing I might point out, since it was asked this morning, Jerry alluded to it, is that we do have a series of shield walls and what we call convection walls in the tunnel. When we constructed the shield walls we paid a bit of attention to getting the cables separated as much as possible. What that does is isolate the LOS pipe drift from the remainder of the tunnel complex so that if we saw a situation like on Huron Landing where we had a minor seepage in the LOS pipe drift, perhaps these convection walls would contain it.

This is not a containment thing, but it might assist you when you are looking at the RAMS readings, comparing RAMS here and here, it might explain some of the phenomena that may be going on.

Additionally, there is a wall in the by-pass drift should we have a seepage there.

That is all I have unless you have questions.

No questions.

Dr. Broyles: May we now have statements from the contractor representatives?

J. Morrison (F&S): We concur with the presentation.

R. Ritchey (H&N): Speaking for Midas Myth, we concur.

L. Ryan (H&N): Speaking for Milagro, H&N concurs.

Bud Edwards (REECo): REECo concurs.

CONTAINMENT SCIENTISTS:

T. A. Weaver (LANL): The emplaced stemming and containment features for the Midas Myth event are essentially as presented to and approved by the CEP.

EXHIBIT 2

MIDAS MYTH/MILAGRO SUBSIDENCE
February 15, 1984

SUMMARY OF ACTIONS/RESPONSES
Taken By The
NV OFFICE OF PUBLIC AFFAIRS
On February 15-17, 1984

WEDNESDAY, FEBRUARY 15, 1984

The Midas Myth/Milagro underground nuclear test was conducted at 9 a.m. on February 15, 1984. Tentative plans were to post-announce the test at 10 a.m. However, at about 9:15 a.m. several telephone calls were received from persons stating they had felt "an earth movement" and wanting to know if a test had been conducted at the Nevada Test Site (NTS). It was then decided to postannounce the test at 9:35 a.m. and the local media were notified by phone. A confirming news release was mailed that morning.

At approximately 12:30 p.m., Robert M. Nelson, assistant manager for NV Operations and test controller for the Midas Myth/Milagro weapons effects test, alerted the NV Office of Public Affairs (OPA) that a subsidence occurred at approximately 12:15 p.m. and that some members of the reentry crew were injured. The NV/OPA staff in Las Vegas drafted a preliminary news announcement based on available data. The staff also alerted the DOE/HQ press secretary's office and the press representative for the DOE Office of Military Application.

David F. Miller, Director of the NV/OPA, arrived about 2:15 p.m. from Control Point 1 where he had served as the OPA representative for the 9 a.m. Midas Myth/Milagro T-Tunnel Test. Miller revised and updated the draft announcement and obtained NV Manager Thomas R. Clark's approval to issue it.
The OPA staff began reading the announcement to the local news media, including the wire services, about 4 p.m. and responding to other media inquiries that were backlogged. From about 2 p.m. until the 4 p.m. announcement, the NV/OPA staff only confirmed that there had been a subsidence with injuries.

The OPA staff remained on duty until 9 p.m. and answered about 100 total media inquiries. The OPA Director gave interviews to two local television stations and the Las Vegas Sun newspaper in the NV lobby about 4:30 p.m., and a live local TV interview at 6 p.m. At 8:15 p.m., the OPA staff telephoned the status and disposition of the injured to the media. Media calls after 9 p.m. were routed to the NV/EOC for re-routing to the home telephone numbers of the public affairs specialists.

EXHIBIT

2

THURSDAY, FEBRUARY 16, 1984

At 7:30 a.m. Thursday, February 16, the NV Manager, OPA Director and others reviewed the video tape of the helicopter medical evacuation and the Manager approved its release to the media. Media interest was intense and the Manager approved holding a press conference at 12 noon, using the video tape and NTS map to explain what happened. OPA staff prepared press information packets and copies of the tape for release at the conference. The packet included all previously released materials, the Manager's statement about the investigation panel and a written explanation of the video scenes. OPA responded to about 70 media calls throughout the day.

NV Manager Clark met with approximately 35 reporters, including representatives from Associated Press, United Press International, Cable Network News, Los Angeles Times, New York Times, CBS, NBC and ABC television networks, at a press conference at noon on February 16. The Manager's responses brought a turning point in the flood of news media telephone calls by reaffirming earlier OPA statements that there was no escape of radiation into the atmosphere and convincing reporters that the yield range of the test was less than 20 kilotons.

This point is significant because a geologist at the University of Nevada (Las Vegas) told newsmen that the test yield range "was around 100 kilotons," and the Soviet TASS news agency accused the U.S. of violating the 1974 Threshold Test Ban agreement. The next day newsmen reported that a university spokesman downgraded the earlier statement by saying that the yield range was less than 20 kilotons according to university instruments.

Copies of the video tape were distributed to television newsmen at the press conference. Efforts to obtain "still" photographs for newsmen on February 16 by helicopters and ground crews were prevented by strong winds and blowing snow.

FRIDAY, FEBRUARY 17, 1984

The NV/OPA staff responded to about 40 telephone calls and originated about 30 calls to update wire services, local media and others requesting updates. A news release was also produced and distributed that named the newly appointed NV investigating panel and advisory personnel assigned to work with the panel.

One of the problems is that this represents 3 specimens but they are all from the same batch of grout so they are not showing a variety of batches. The numbers on the bottom here are more representative.

The one thing I have arranged to do is have H&N go in today with their core drill and take 3' of core out of the gas seal plug so we will have core breaks early tomrrow morning. We also have specimens left in these three placements, both at Waterways and H&N, which they will break in the morning, and they will call me at the CP at 4 A.M. to tell me what they look like.

I don't think this is a problem. I have talked with Waterways and am a little concerned about the grout strength at 7 days. I want to look at it tomorrow to make sure it is not a real trend.

It is impossible to know everything but it is spurious, to say the least.

The exception to what we presented to the CEP is that there was a TAPS and MAC firing box located here. We said we would embed that directly in grout. LANL asked us to put a box around this and pour protexulate around it to give it further moisture protection; so, we added a box 3' deep and 5' square and poured a foot of protexulate around the firing box. There is a very small volumn right there that is not grout. This is not unusual. Typically, we either have a stack of sand bags at that area to protect the cables or some such protection.

All of the valves in the stemming region are working at the moment, as best we know. It is our plan, when we button up in this region tonight, to turn the PDPs on, the positive displacement pumps, close the drain line valves and let the pumps pump deadhead until we see the high water light come on.

We will then open the valves, pump the water out and then close ~~it~~ (the valves) again.

The reason for this is that the pumps are so good they will pull a negative pressure of about 2 psi if we left them on to pump continually. This evening we will exercise 4 of the 8 valves and get them in a readiness position.

The discussion at the CEP regarding these valves - it was the concensus that if either one of the two valves in a line were closed that it would be suitable to proceed.

The way things are presently scheduled for in the morning is that the valve closures of the LANL chill water line will start at minus 25 minutes, they should be closed early, within 5 minutes, and that should give 5 minutes to call here to tell the panel the valves are all closed.

Based on our more recent experience with these valves, there is no reason to think they will not close. We will have a 15 minute countdown but will be aware of what the situation is before start of countdown.

Vessel #2: This is all of the tunnel volume inside 3 drift protection plugs. At the CEP we did note that we had to add 8 cables through the trainway of the main lift drift protection plug. Those have been accomplished. The gas blocks are our typical type of pipe gas blocks with bulkhead connector. The cables were presented to the CEP.

The grout in the trainway through this plug broke at 3540 and 3535 psi with the two different agencies this morning and that is in keeping with what we would expect. Criteria is 2000 psi.

The 0.7 plug, discussed at the CEP, has been emplaced. The concrete in this plug broke at 5200 psi this morning and is well above criteria.

The mechanical plug and cable plug are as they were presented to the CEP with penetrations being in accordance to what was presented. No major changes.

There is one minor change in the penetrations; in that, at the CEP we said a steel plate would be continually welded all the way around, but because of the location of some of the vistanex tubes coming out of the penetration, we were unable to get to stretches of 2" to 4" by the plate to weld them on. As a result we then put plastic steel on those stretches and there is one on each of these penetrations, about 2" to 4" of plastic steel.

Plastic steel is suitable emplacement for this kind of application and is not of concern. However, it is an exception to what was precisely said at the CEP.

Vessel #3: All of the tunnel volume inside the gas seal plug designed for 500 psi or 500 degrees f.

Since the CEP, we had to add 4 cables to the trainway of the gas seal plug; added three reentry power cables and one RAMS cable through the trainway. Those gas blocks are of the same design as those replaced in the trainway of the drift protection plug. It is the standard technique of pipe gas blocks we use with bulkhead feed-through connectors.

Since the CEP we did do the second pressure test of the plug because of the number of penetrations we put through. During that pressur-

EXHIBIT 3

CONTAINMENT BRIEFING
MIDAS MYTH/MILAGRO
U12t.04 Tunnel
1300 Hours, February 14, 1984

TEST CONTROLLER: R. M. Nelson, Jr., DOE
SCIENTIFIC ADVISOR: Dr. C. D. Broyles, SNL
ADVISORY PANEL: R. W. Titus, WSNSO; C. F. Costa, EPA; Dr. D. W. McIndoe, Medical Advisor
TEST GROUP DIRECTOR: W. P. Wolff, LANL
TEST DIRECTOR: Maj. J. D. Wilcox, DNA
: J. W. LaComb, DOD/DNA

Dr. Broyles: This is the Containment Briefing for the Midas Myth/ Milagro event to be conducted in U12t.04 tunnel. We will start right off and turn the presentation over to the DNA Test Director, Major Wilcox.

Wilcox: We tried hard to come through with readiness on Valentine's Day so I will have to apologize for not having made that exactly. Since we have slipped in the past no one knows whether that is Valentine's Day readiness or just another broken heart. So we will go for tomorrow or make adjustments.

Midas Myth is in many respects like the Huron Landing event. Same LOS shot; the pipe is the same taper, same closures as Huron Landing at same positions and distances.

There are some differences in the way the pipe is constructed here. The test chamber is to 13' OD at approximately the 800' position.

We have a vacumn scatterer and we have a total of 24 roses recording underground with the great difference being no mesa recording but fiber optics to the portal recording station.

We have a convection barrier in the by-pass drift which is a new innovation.

I will turn this over to Joe LaComb who will brief the as-built and containment aspects.

LaComb: As everyone is aware, we generally evaluate tunnel events with a 3 Vessel concept. Today I will walk through the briefing starting with Vessel #1.

This is what we have defined as Vessel #1 for Midas Myth. All of the tunnel and media surrounding the working point, both horizontally and vertically from the working point.

In walking down the pipe string, to bring you up date, the pipe was installed when we presented it to the CEP. The GSAC and MAC have been pressurized for several weeks. The pressure has been hold-

EXHIBIT

3

good, something over 14.8 ~~K~~si. They are in good shape.

The Taps, unlike Huron Landing, we have gone back to the old Torque specs for closing the plug in the door; so, hopefully, we will not have a calibrated leak in the Taps door.

Next viewgraph: Looking at the stemming plan for Midas Myth, I will first walk down the pipe drift. Basically, this was completed to this point and out through here when we briefed the CEP. I reviewed all of the data from the breaks this morning.

The D -1 breaks were done yesterday because of the multitude of tests we have to handle. Everything looks like it is in good shape in the pipe drift.

We have one spurious test result here with the superlean grout plug which is 15' long. It tested out at 50 psi yesterday morning.

Normally, we would expect something between 100 and 200 psi for superlean. I went back and checked the 28 day result on that area, and at that time it tested at 35 psi. We don't consider this a significant problem since it is located outside of the MAC.

The reason we put superlean in there is to try to close the LOS pipe at that point. Therefore, weaker in this area is not necessarily bad. But it is a spurious point from what we had expected and should be noted.

Going down the by-pass drift - this is pretty much as presented to the CEP. I know of no changes, such as voids, as it is pretty well built as reported to the CEP.

Rock matching grout and superlean grout in the by-pass drift looked real fine this morning - around 1000 to 1050 and 100 to 200 psi. The high strength grout had some results that were a little confusing. We had 3 placements in the high strength grout plug which are delineated by these fancy marks here. In this plug, at seven days we had 2945 psi with Waterways Experiment Station and had 3000 psi with H&N in breaks. This morning early, by 6:30, we got 2900 with WES and 2627 with H&N for an average of 2869 psi.

In the middle pour we see a similar set of results. This being Waterways and this being H&N and again with the overall average.

The anchor plug was only 7 days old so this is the result this morning and this is the average. These are the kind of results we would expect in 7 days. They are not of concern. Our criteria is typically 2000 or 2500 psi for high strength grout. However, I always target for 3000. I would suspect we have 3000 psi.

EXHIBIT 4

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

September 3, 1982

NSP/TO
MS F670

Commander
Field Command DNA
Attn: FCTOU (Major Jerry D. Wilcox)
Kirtland AFB, NM 87115

Dear Major Wilcox:

Enclosed is the MIDAS MYTH/MILAGRO Memorandum of Agreement which I have reviewed and signed.

Sincerely,

Tom Scolman

T. T. Scolman
Deputy Associate Director
Test Operations

TTS:pw

Encl: a/s

cc: J. W. House, ESS/CPO, MS F659
D. C. Hoffman, INC, MS G760
L. A. Gritzo, M-DO, MS P915
D. S. Metzger, P-DO, MS D434
F. A. Morse, P-DO, MS D408
P. B. Lyons, P-14, MS D410
N. S. P. King, P-15, MS D406
L. F. Luehring, WX-DO, MS P945
E. J. Sowder, WX-6, MS F680
W. B. Dudgeon, WX-9, MS D411
F. J. Honey, WX-10, MS F678
R. E. Hunter, X-DO, MS B218
W. P. Wolff, NSP/TO, NTS/J900
W. P. Wolff, NSP/TO, MS F670
L. D. Tatro, NSP/TO, MS F670
J. H. Norman, NSP/TO, MS F670
L. M. Baggett, NSP/TO, MS F670
C. R. Robertson, NSP/TO, MS F670
CRM-4, MS A150
TO files
N. M. Hoffman, X-5, MS F669

EXHIBIT
4

DEFENSE NUCLEAR AGENCY
FIELD COMMAND
KIRTLAND AIR FORCE BASE, NEW MEXICO 87115

FCTOU

27 AUG 1982

SUBJECT: Memorandum of Agreement between FCDNA and LANL, MIDAS MYTH/MILAGRO

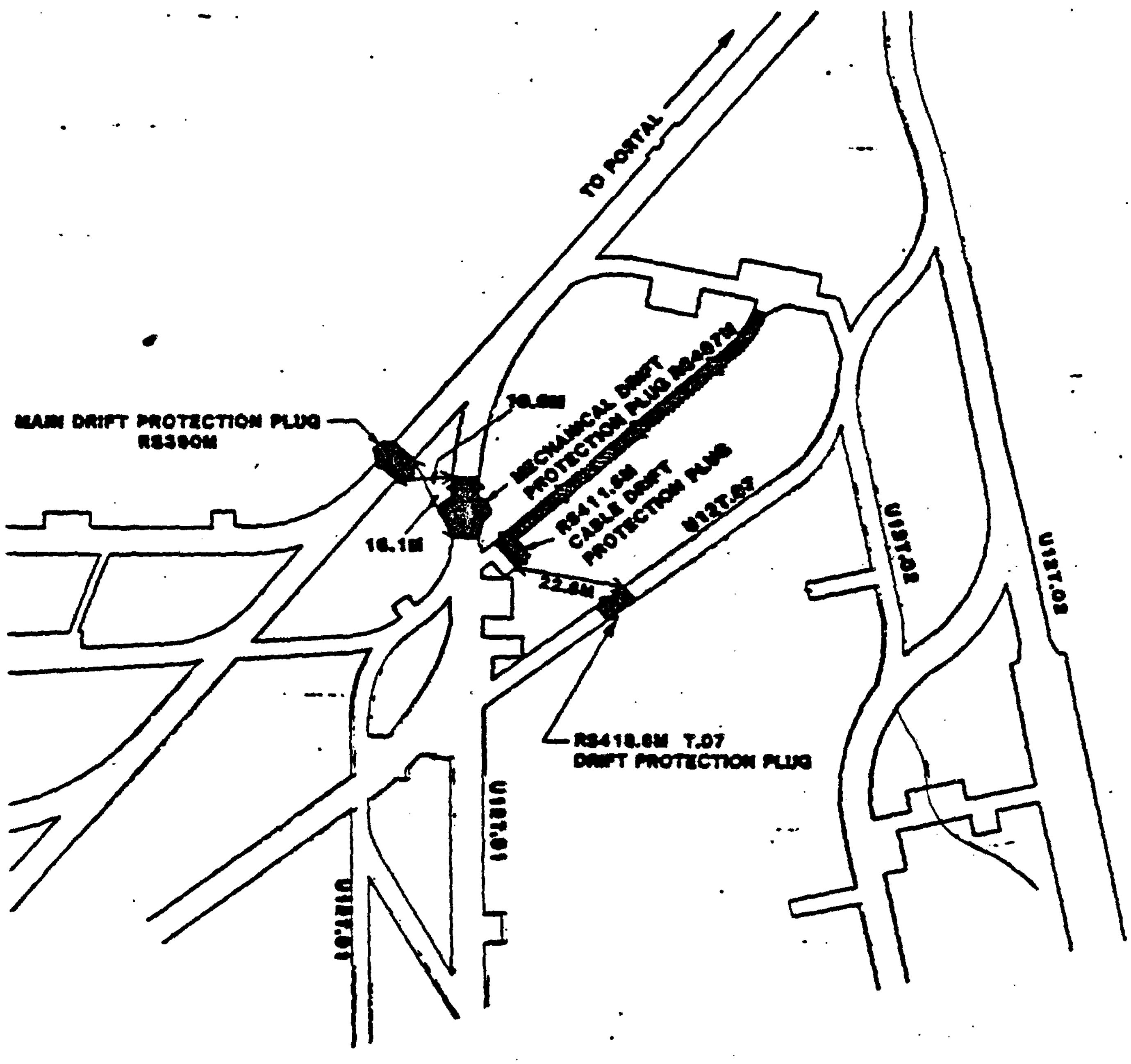
Tom Scolman
Deputy Associate Director
for Test Operations
Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, NM 87545

Here is the MIDAS MYTH/MILAGRO Memorandum of Agreement for your review and signature.

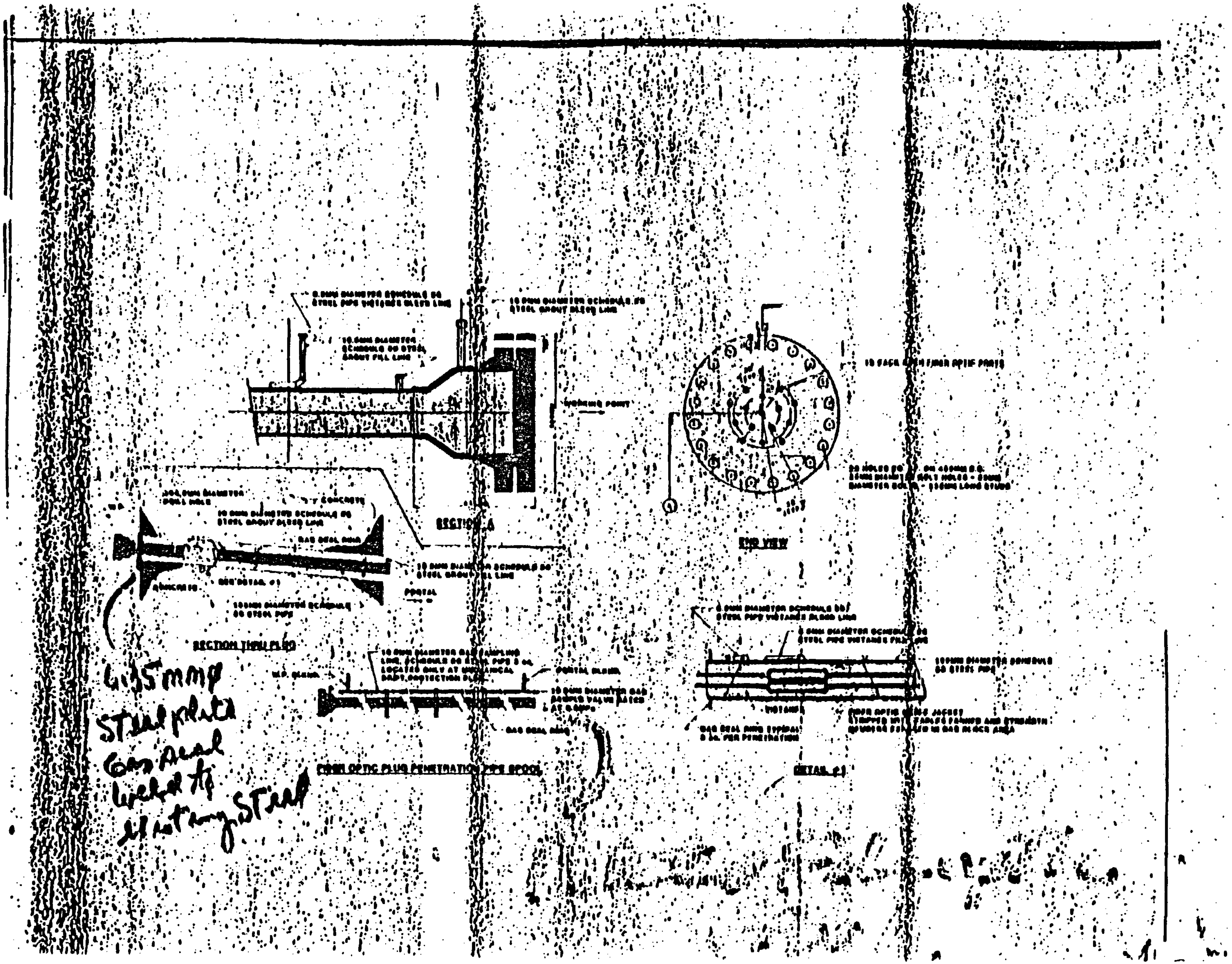
Jerry D Wilcox

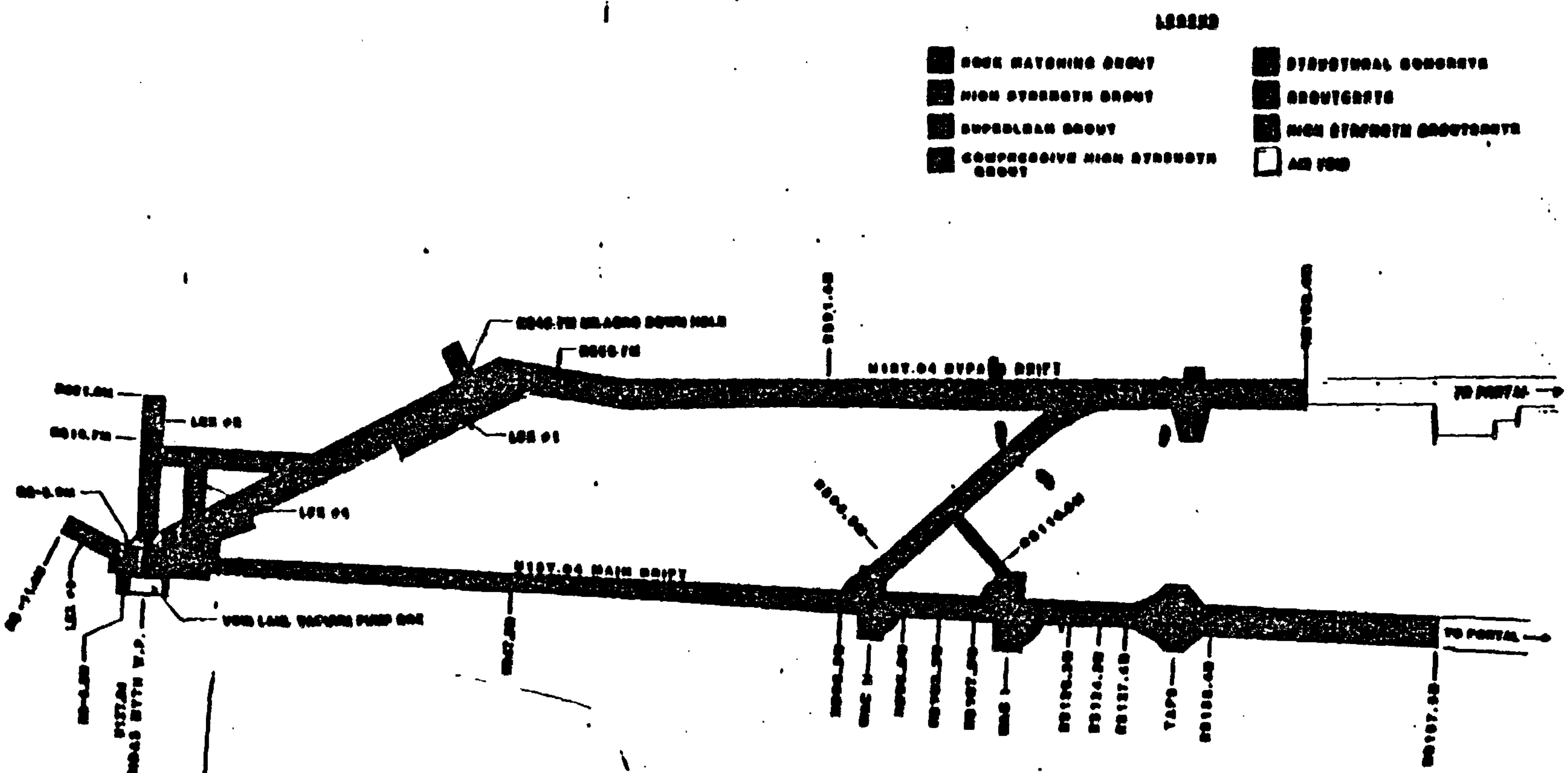
JERRY D. WILCOX
Major, USAF
Test Group Director, MIDAS MYTH

1 Incl
as



U12T.04 MIDAS MYTH


SECTION A
END VIEW
SECTION THRU PLUG
FIBER OPTIC PLUG PENETRATION PIPE SPOOL
DETAIL #1
6.35 mm Ø
Steel plate
Gas seal
welded to
all rotating steel



U12T.04 MIDAS MYTH STEMMING PLAN

~~2890~~
2945 3007
2900 2623

2869

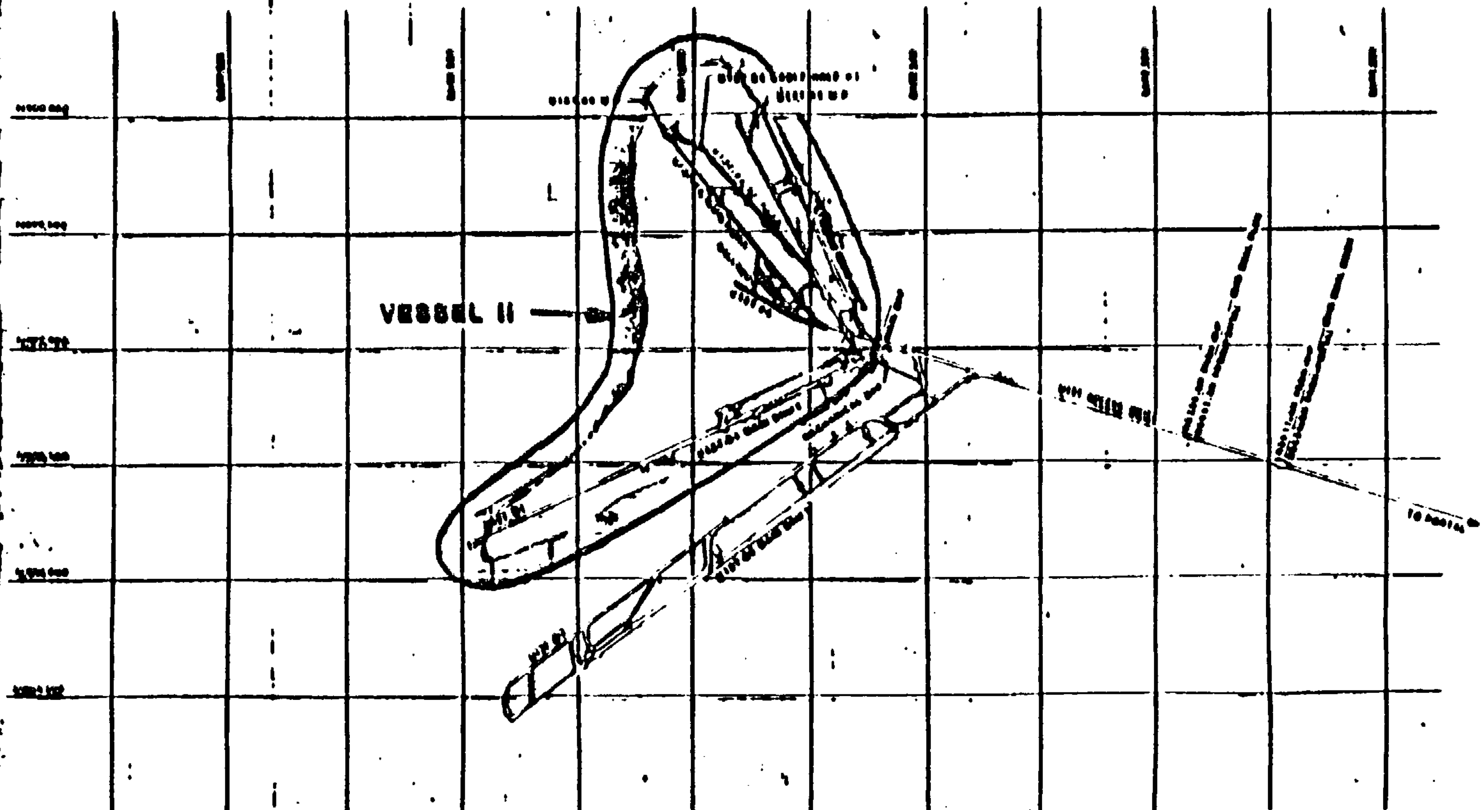
3230 2978
2990 2623

2955

3385 3455
~~28~~

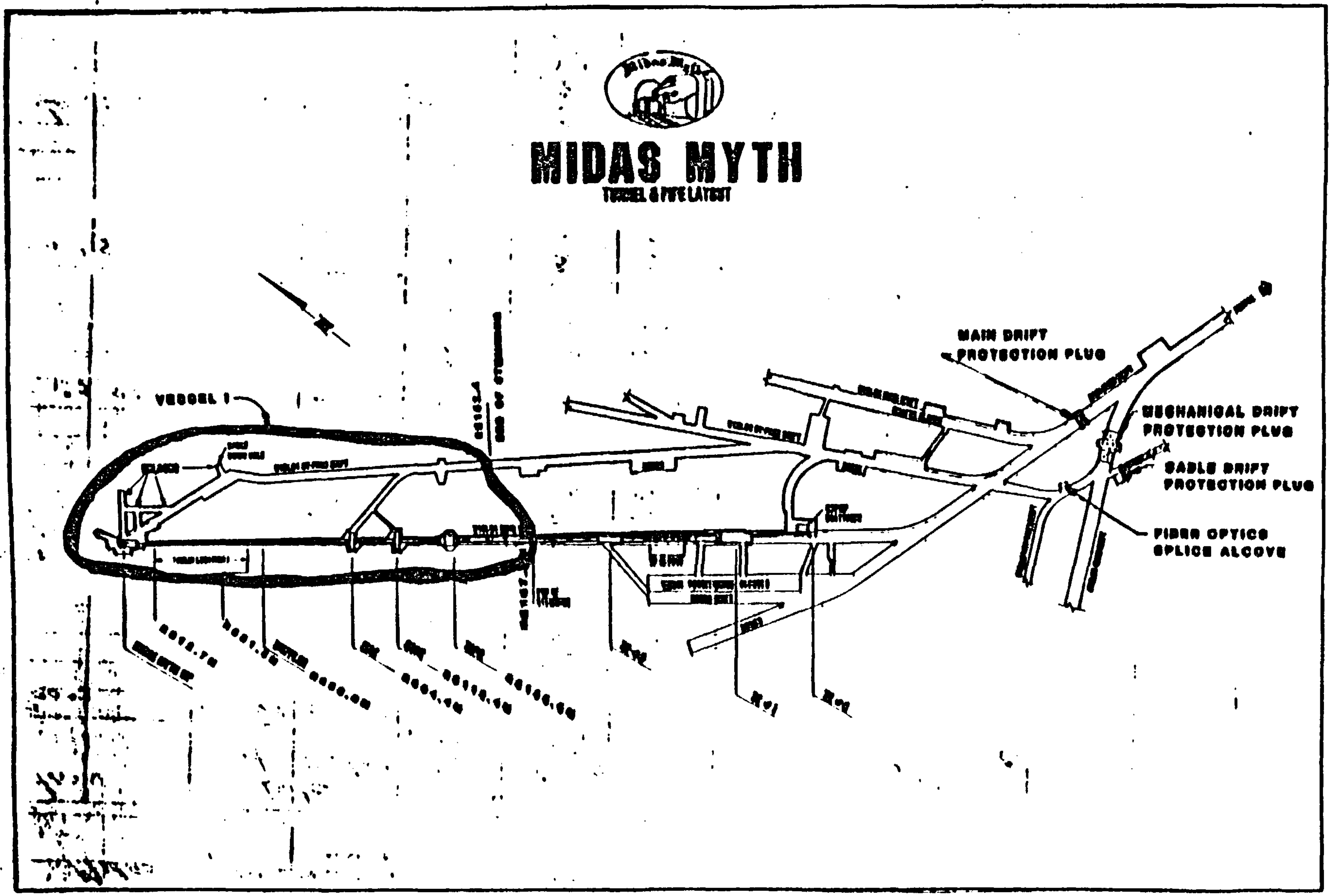
3405

Midas Myth



U12N TUNNEL LAYOUT

Mida


MIDAS MYTH
VESSEL 1
MAIN DRIFT PROTECTION PLUG
MECHANICAL DRIFT PROTECTION PLUG
CABLE DRIFT PROTECTION PLUG
FIBER OPTICS SPLICE ALCOVE

Midas Myth

Two aspects of the stemming and containment plan have not been presented to the CEP. These are: 1) four additional cables pass through the gas seal plug - these are treated in the same manner as the additional cables that pass through the drift protection plug and that have been approved by the CEP. 2) for operational reasons, plastic steel has been used for a small portion of the gas tight weld on plates on the gas seal plug and in the drift protection plug. Neither of these perturbations causes me concern for the containment of Midas Myth and I see no reason to refer Midas Myth back to the CEP.

Vern Wheeler (LLNL): Midas Myth has been emplaced and stemmed as presented to the CEP.

Strength tests on some of the grout pours are somewhat ambiguous but the grout pours meet criteria.

The minor change from a gas weld to a cold weld on a short section of weld is acceptable and the addition of four electrical cables is not a problem.

The addition of a protective box around the firing set is of no consequence.

None of these discrepancies degrade the containment of Midas Myth and I see no reason to refer any of these back to the CEP.

Dr. Broyles: Any questions from the Panel?

None.

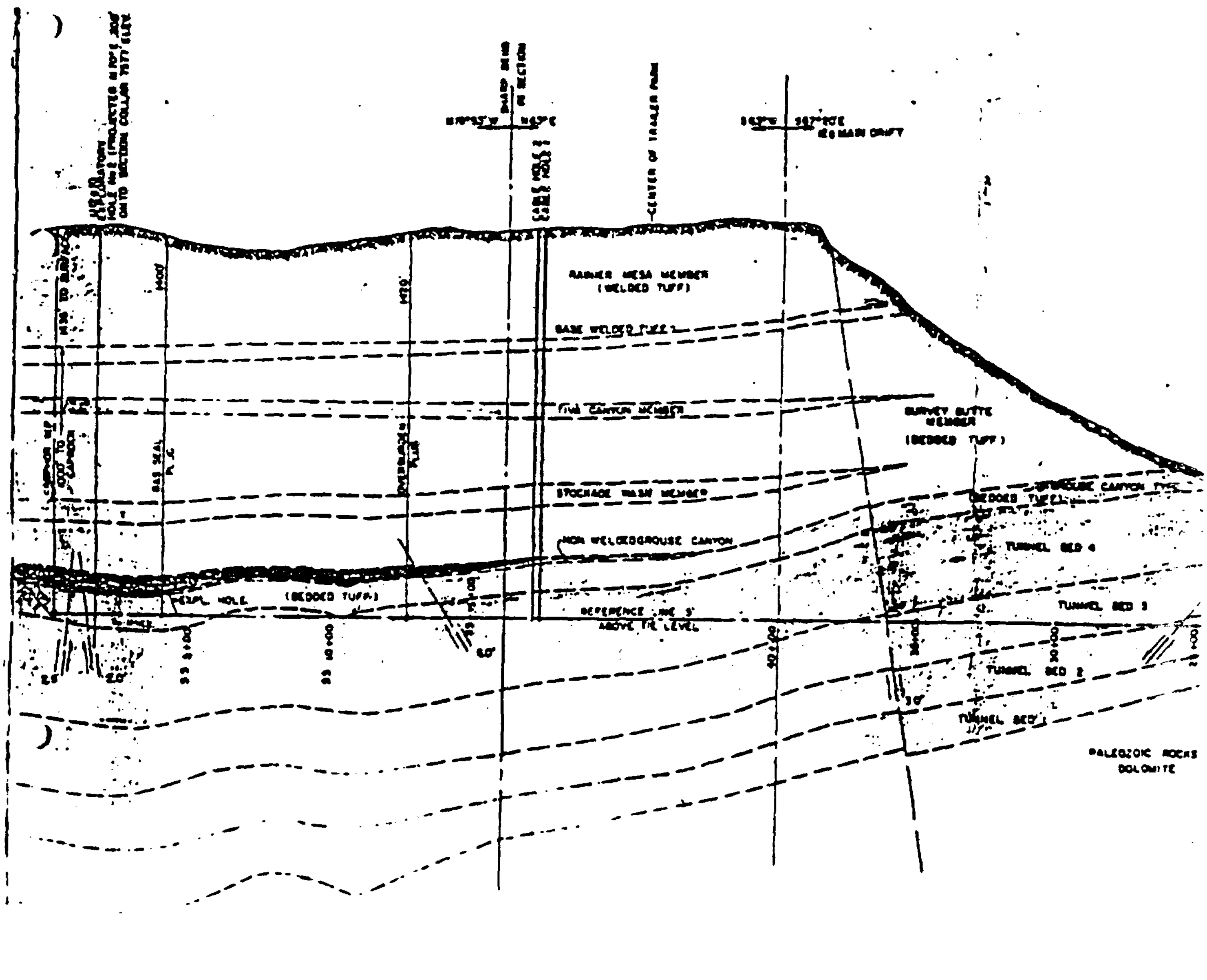
Dr. Broyles: We have heard the presentations and the panel is satisfied that Midas Myth and Milagro as-builts are as specified to the CEP and there is no need to refer the minor variations back to the CEP. We recommend proceeding.

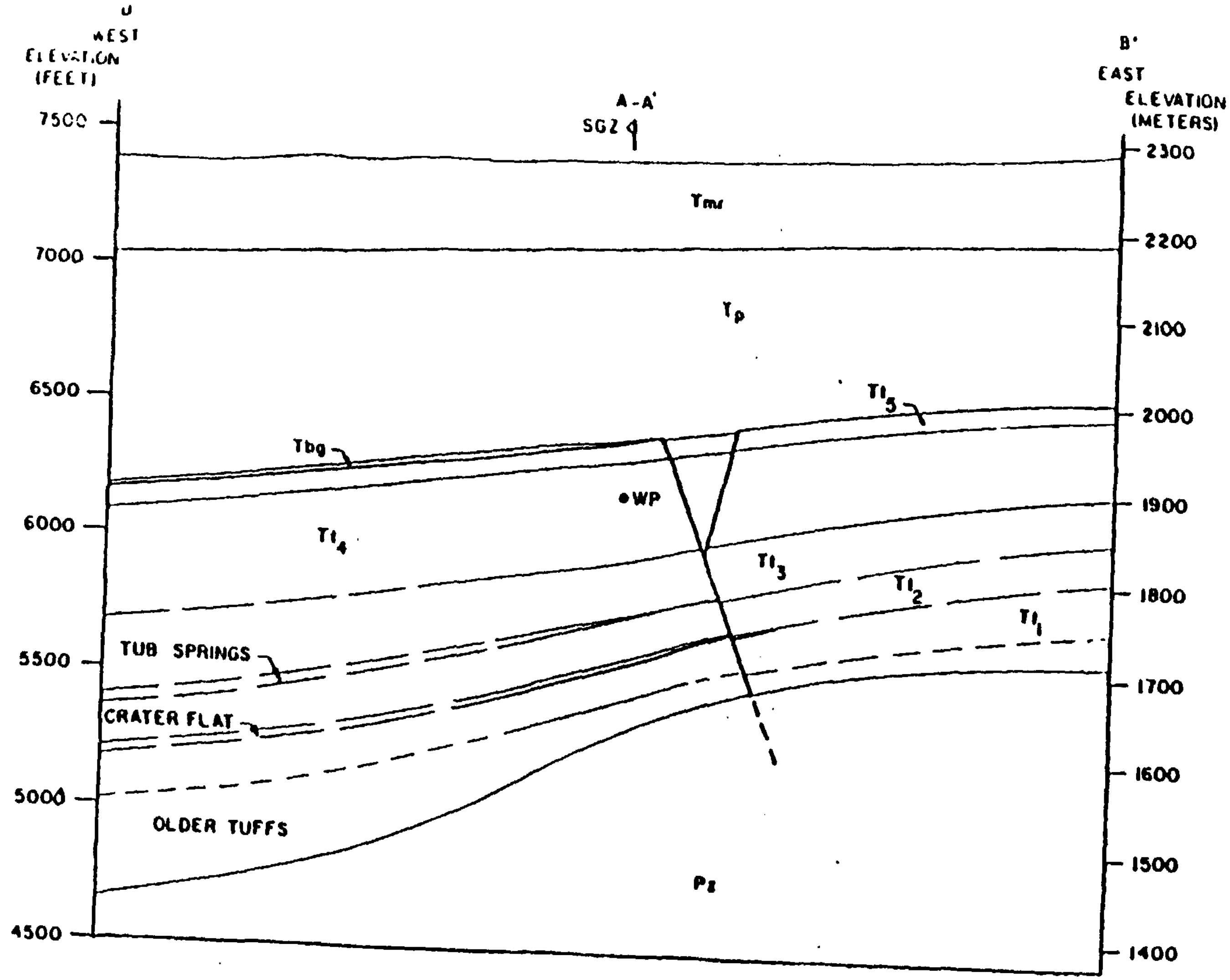
Nelson: I agree with your recommendation and do not intend to refer this back to the CEP. We will proceed with briefings as scheduled.

Meeting adjourned.

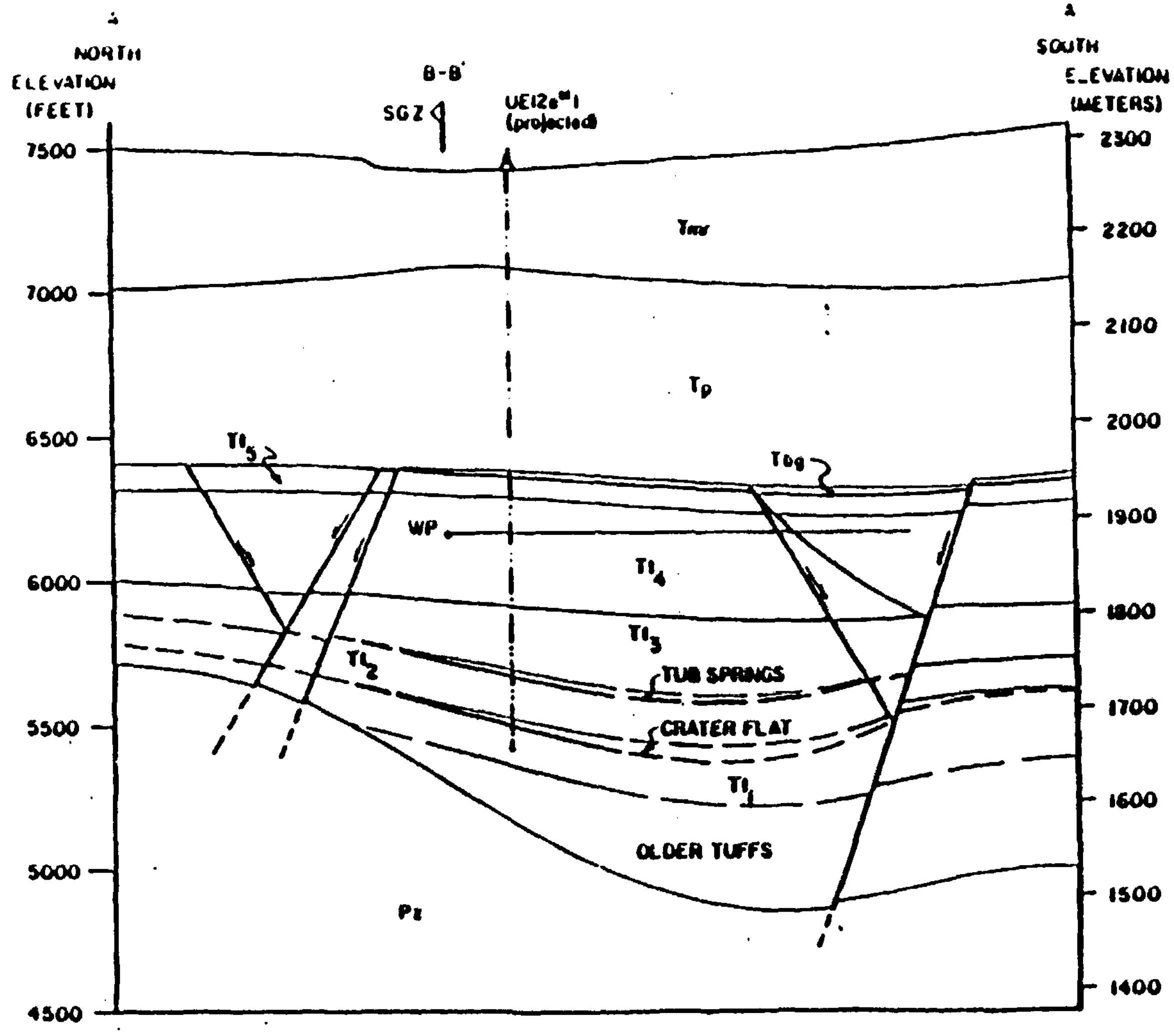
Approved by: Joseph V. LaCarl
for Test Director

Geologic cross section through G-tunnel and the Camphor WP (after Sandia)

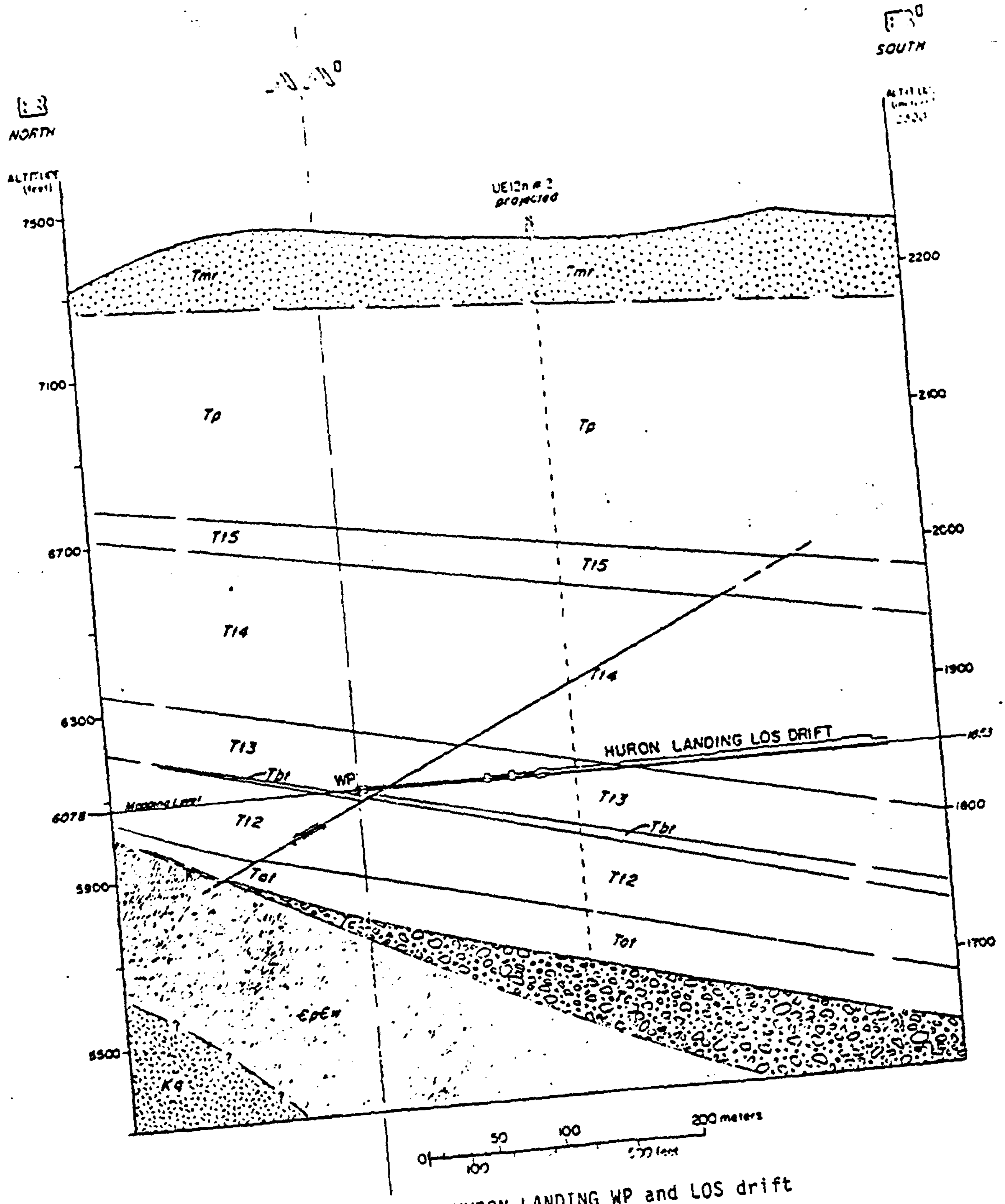




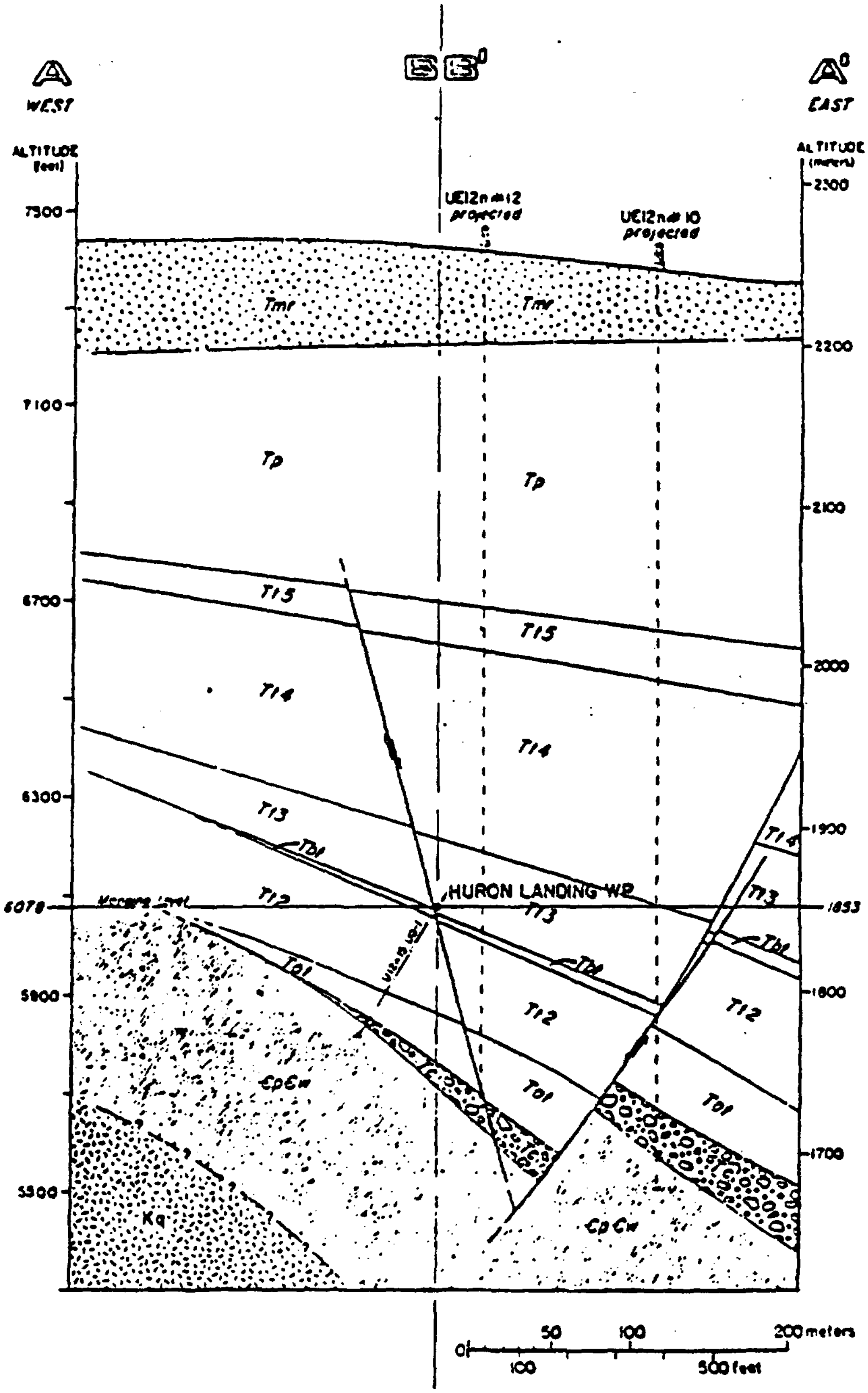
Cross section B-B' through the DINING CAR WP (this section normal to A-A')



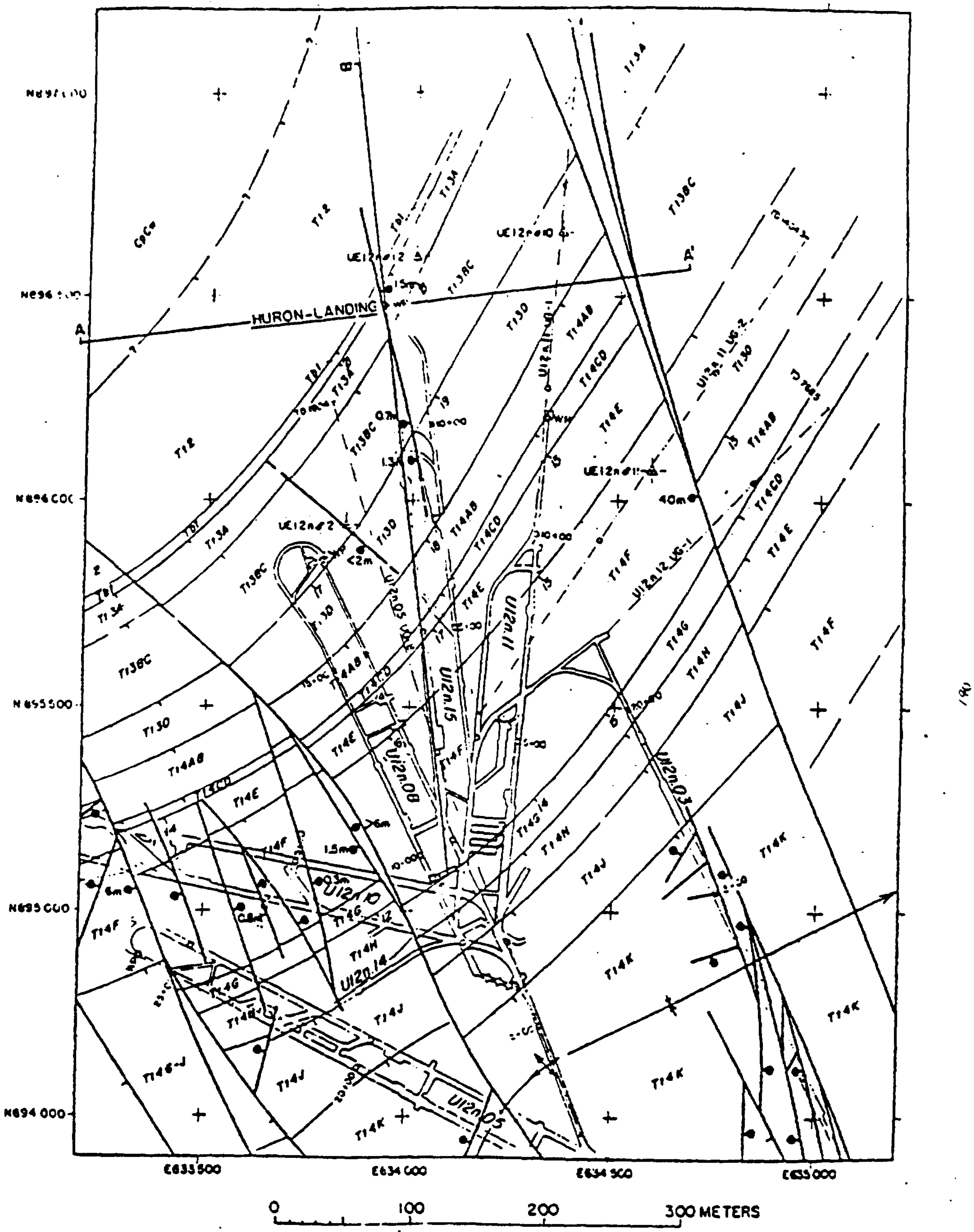
Cross section A-A' through the DINING CAR (U12e.18) WP and LOS drift



Cross section B-B' through the HURON LANDING WP and LOS drift

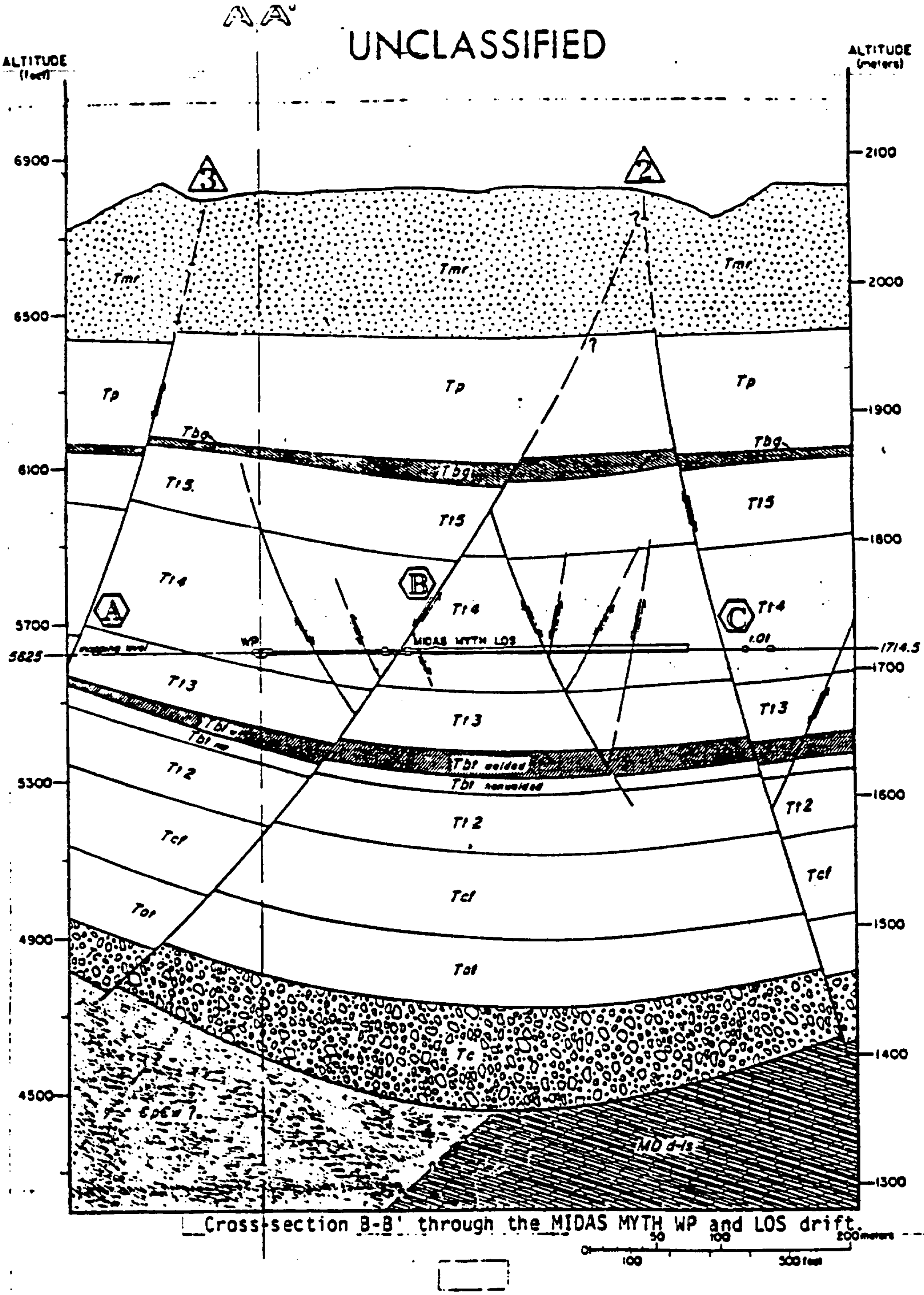


Cross section A-A' through the HURON LANDING WP



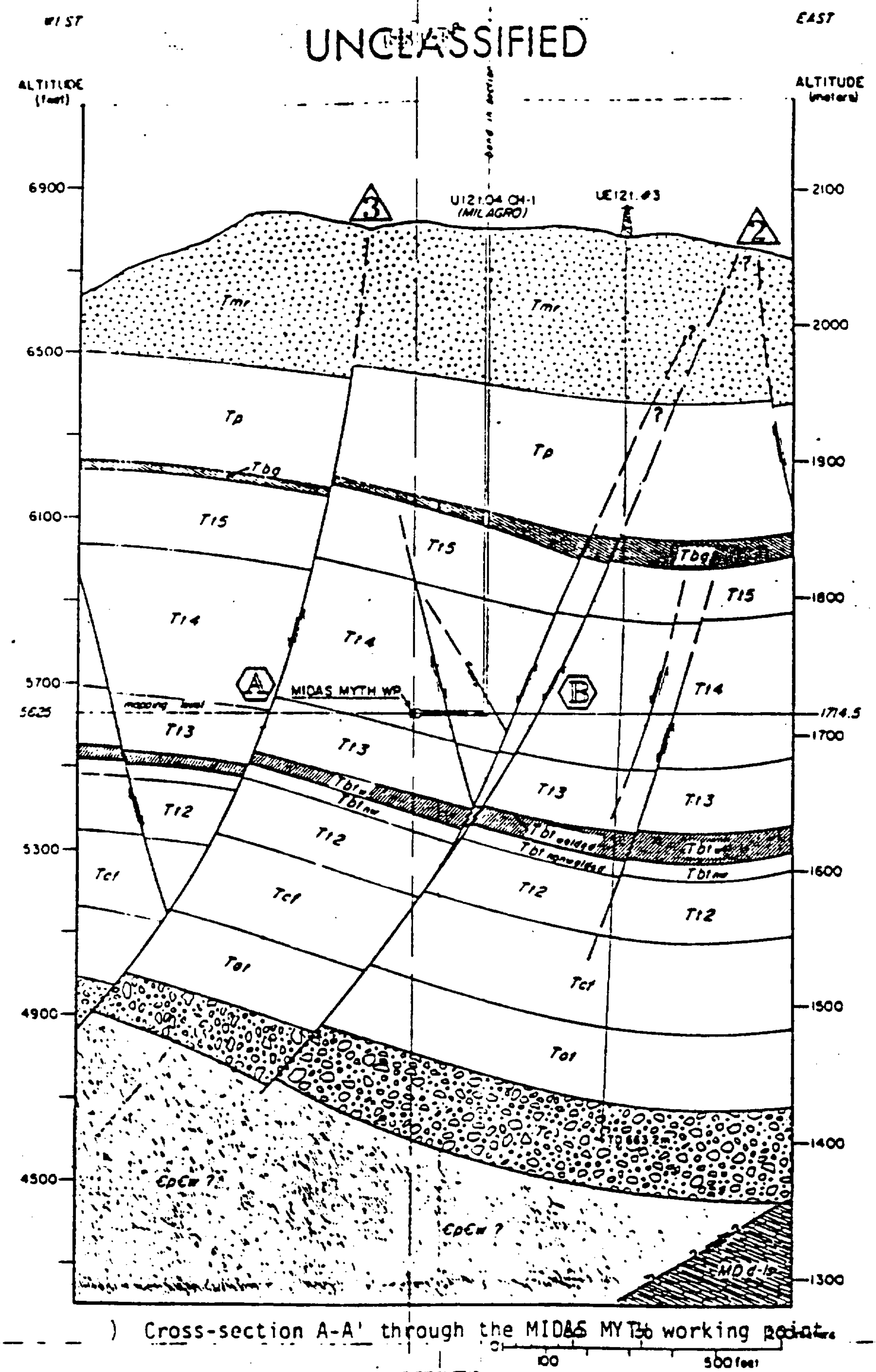
Northern N-tunnel complex showing locations of HURON LANDING/DIAMOND ACE cross sections

UNCLASSIFIED

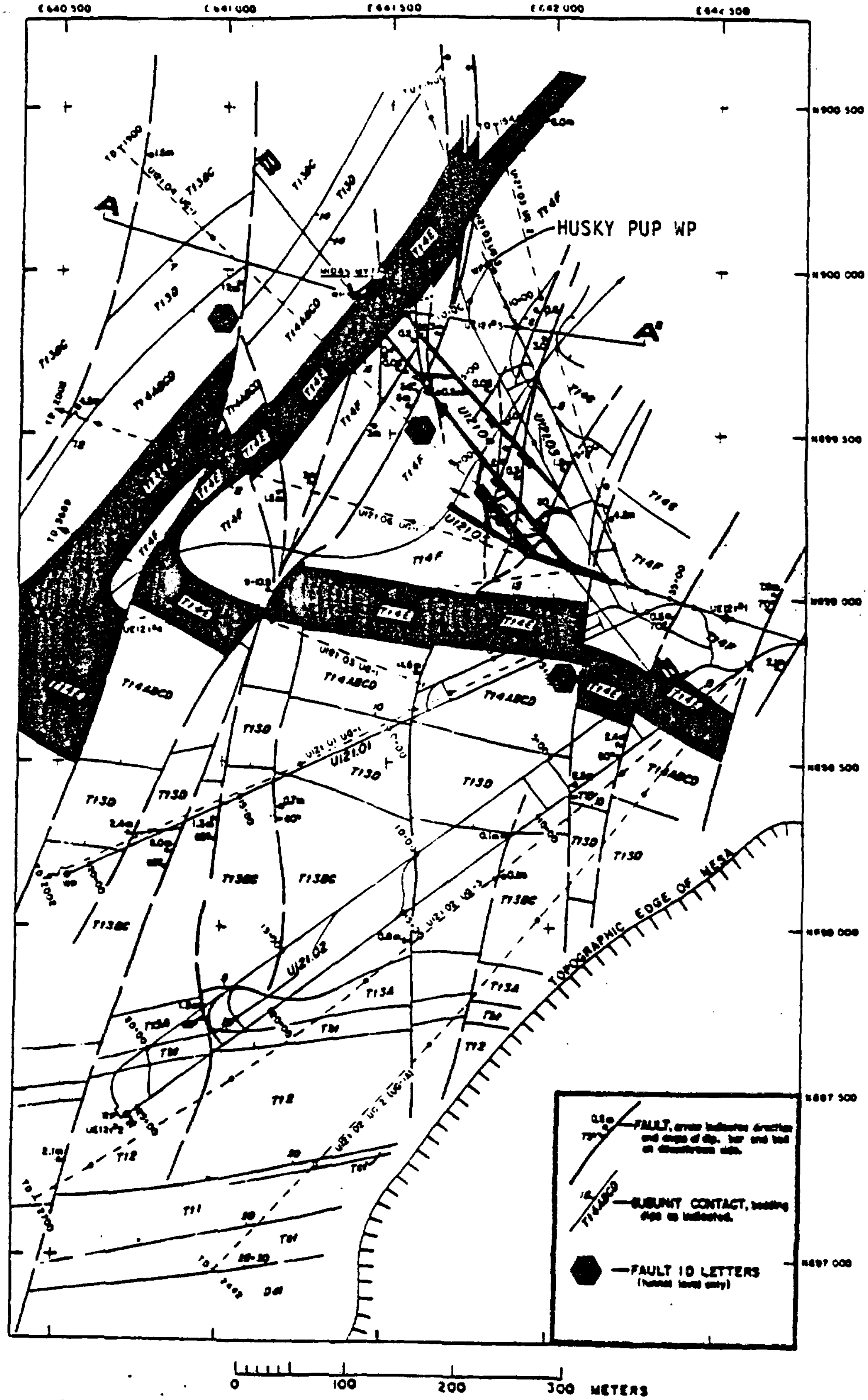


Cross-section B-B' through the MIDAS MYTH WP and LOS drift.

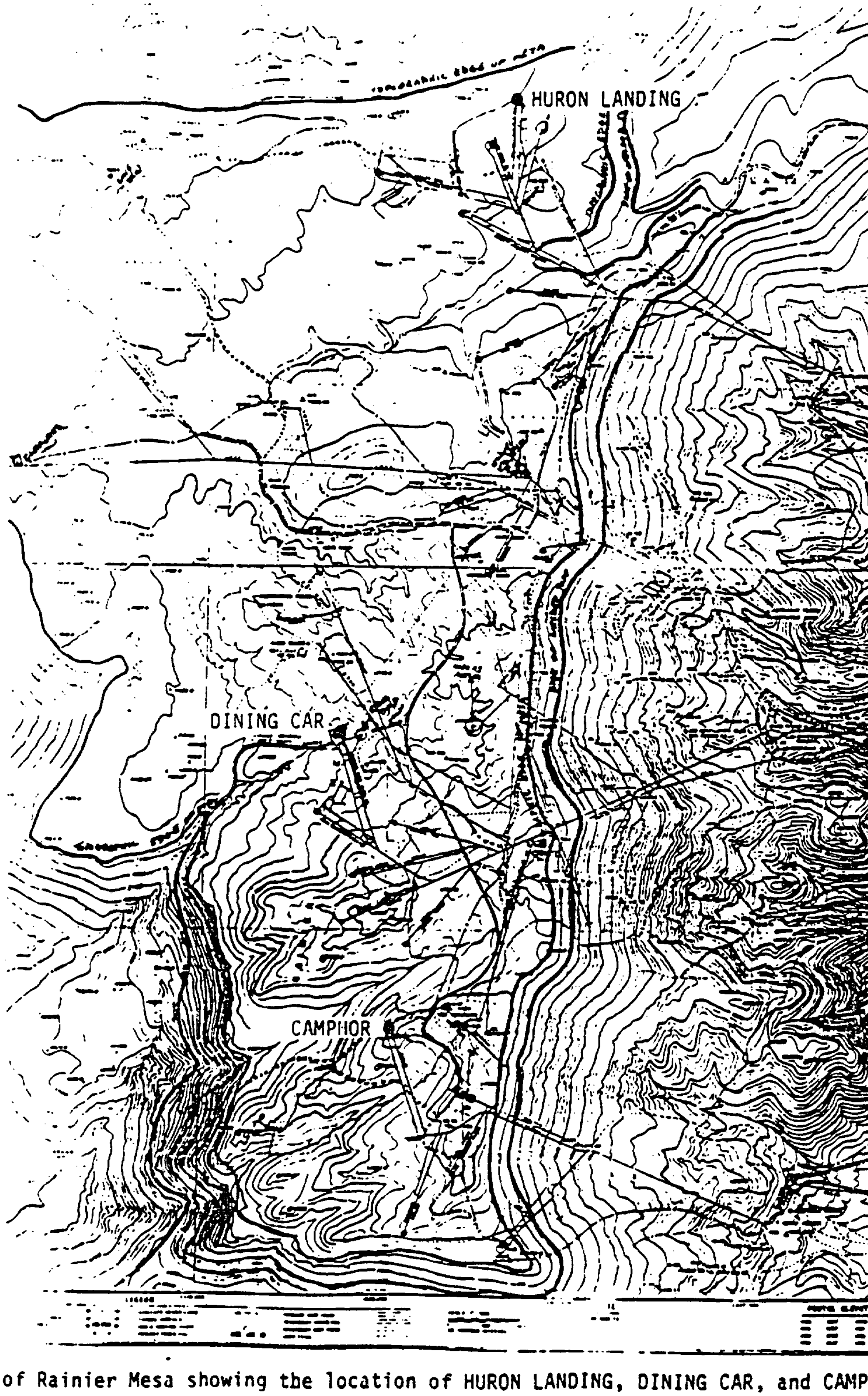
UNCLASSIFIED



) Cross-section A-A' through the MIDAS MYTH working point



T-tunnel complex map showing locations of MIDAS MITH cross sections,(HUSKY PUP)



Map of Rainier Mesa showing the location of HURON LANDING, DINING CAR, and CAMPHOR.

[illegible] showing the location of MIDAS MYTH and HUSKY PUP.

Eon/Era	System	Series	Formation	Member or unit and symbol
Cenozoic Era	Tertiary	Miocene	Timber Mountain Tuff	Rainier Mesa Member Tmr
			Paintbrush Tuff	Tiva Canyon Member Tpc; Tp
			Stockade Wash Tuff	Tsw; Trab
			Bedded and ash-flow tuffs of Area 20	Trab
			Bedded tuff of Dead Horse Flat Tdhb	
			Belted Range Tuff	Grouse Canyon Member Tbg
			Tunnel beds	Unit 5 Tt5
				Unit 4 Tt4 Subunits AB, CD, E, F, G, H, J, K[1]
				Unit 3 Tt3 Subunits A, BC, D[2]
			Belted Range Tuff	Tub Spring Member Tbt
			Tunnel beds	Unit 2; Tt2
			Crater Flat Tuff	Tcf; Tt2
			Tunnel beds	Unit 1 Tt1
			Redrock Valley Tuff	Trv
			Older tuffs	Tot
			Paleocolluvium	Tc
Mesozoic Era	Cretaceous		Quartz monzonite of Gold Meadows stock	Kqm
Paleozoic Era	Devonian Silurian Ordovician Cambrian		Paleozoic rocks, undivided	Pz[3]
			Wood Canyon Formation	€Zw
Proterozoic Eon			Stirling Quartzite	Z; Z[3]

[1]K is the youngest.
[2]D is the youngest.
[3]In some drill holes, paleocolluvium of Tertiary age (Tc) rests on Paleozoic or Precambrian rocks

Table 1.--General stratigraphy of Rainier Mesa area, Nevada Test Site.

DINING CAR (U12e.18)

DEPTH OF WP BELOW SURFACE	DISTANCE OF WP TO PRE-TERTIARY SURFACE	NEAREST EXPENDED WP
383 m	>260 m	336 m to e.14
>383 m	>229 m	

STRATIGRAPHIC UNIT	THICKNESS (approximate, in meters)
Tmr	99
Tp	218
Tbg	5 (partially welded)
Tt5	21
Tt4	88 (WP in Tt4H) 38 m above WP 50 m below WP
Tt3	69
Tbt	6 (non-welded)
Tt2	39
Tot	>37

CAMPHOR (U12g.10)

DEPTH OF WP BELOW SURFACE	DISTANCE OF WP TO PRE-TERTIARY SURFACE	NEAREST EXPENDED WP
437 m (vert)	331 m (vert)	244 m to g.07
427 m (slant)		

STRATIGRAPHIC UNIT	THICKNESS (approximate, in meters)
Tmr	153
Tp	33
Tpt	12 (non- to densely welded)
Tp	113 (partially zeo-litized)
Tpsw	96 (non-welded)
Tbg	21 (welded)
Tt5	36 (WP in Tt5) 30 m above WP 6 m below WP
Tt4	114
Tt3	81
Tt2	58
Tot	>76

HUSKY PUP (U12t.03)

DEPTH OF WP BELOW SURFACE	DISTANCE OF WP TO PRE-TERTIARY SURFACE	NEAREST EXPENDED WP
348 m (vert) 328 m (slant)	260 (vert) 255 (slant)	686 m to t.01

STRATIGRAPHIC UNIT	THICKNESS (approximate, in meters)
Tmr	123
Tp	98
Tbg	20
Tt5	41
Tt4	108 (WP in Tt4F)
Tt3	44
Tbt	34 (welded)
Tt2	46
Tcf	67 (non-welded)
Tot	55
Tc	62

HURON LANDING/DIAMOND ACE (U12n.15)

DEPTH OF WP BELOW SURFACE	DISTANCE OF WP TO PRE-TERTIARY SURFACE	NEAREST EXPENDED WP
407.8 m (vert) 402.0 m (slant)	111.3 m (vert) 82.0 m (slant)	149.6 m to n.11 195.2 m to n.08

STRATIGRAPHIC UNIT	THICKNESS (meters)
Tmr	60.4
Tp	160.0
Tt5	26.0
Tt4	120.4
Tt3	45.6 (WP in Tt3A) 41.1 m above WP 4.6 m below WP
Tbt	4.3 (non-welded)
Tt2	56.7
Tot	31.1
Tc	14.6

Paleocolluvium	Tc	Consolidated colluvium consisting of pre-Tertiary gravel and boulders in a zeolitized tuff matrix

MIDAS MYTH/MILAGRO (U12t.04)

DEPTH OF WP BELOW SURFACE	DISTANCE OF WP TO PRE-TERTIARY SURFACE	NEAREST EXPENDED WP
361 m (vert) 356 m (slant)	314 m (vert) 282 m (slant)	129 m to t.03

STRATIGRAPHIC UNIT	THICKNESS (meters)
Tmr	113.1
Tp	89.3
Tbg	8.8 (densely-welded)
Tt5	52.8
Tt4	109.7 (WP in Tt4ABCD) 96.9 m above WP 12.8 m below WP
Tt3	46.0
Tbt	27.7 (welded)
Tt2	47.2
Tcf	62.2 (non-welded)
Tot	54.9
Tc	63.4

STRATIGRAPHIC UNIT	ABREVIATION	LITHOLOGIC DESCRIPTION
Rainier Mesa Member of the Timber Mt. Tuffs	Tmr	Upper portion, densely- to moderately-welded ash-flow tuff. Basal Portion, partially to non-welded ash-flow tuff
Paintbrush Tuff	Tp	Vitric, bedded ash-fall tuff, reworked ash-fall tuff, and tuffaceous sandstone
Tiva Canyon Member of the Paintbrush Tuff	Tpt	Non-welded to densely-welded ash-flow tuff
Stockade Wash Member of the Paintbrush Tuff	Tpsw	Non-welded ash-flow tuff and bedded ash-fall tuff
Grouse Canyon Member of the Belted Range Tuff	Tbg	Non-welded to densely-welded ash-flow tuff
Tunnel beds unit 5	Tt5	Vitric, thick-bedded ash-fall tuff
Tunnel beds unit 4	Tt4	Zeolitized, bedded ash-fall and reworked ash-fall tuffs
Tunnel beds unit 3	Tt3	Zeolitized, bedded ash-fall and reworked ash-fall tuffs
Tub Spring Member of the Belted Range Tuffs	Tbg	Upper portion, densely- to moderately-welded ash-flow tuff. Lower portion, partially to non-welded ash-flow tuff
Tunnel beds unit 2	Tt2	Zeolitized, bedded ash-fall tuffs, and reworked ash-fall tuffs
Tuffs of Crater Flat	Tcf	Zeolitized, non-welded ash-flow tuff, and zeolitized, bedded ash-fall tuffs
Older Tuffs (undivided)	Tot	Zeolitized, non- to partially welded ash-flow tuffs, zeolitized, bedded and reworked ash-fall tuffs

Continued

welding and can be different colors, though their chemical compositions may be identical.

A few thin, welded, ash-flow tuff units are present beneath the caprock, interfingered with the Tunnel beds. The most commonly observed (in drill holes) are the Tub Springs Member of the Belted Range Tuff, between Tunnel beds units 2 and 3; and the Grouse Canyon Member of the Belted Range Tuff, between Tunnel beds unit 5 and the Paintbrush Tuff. The thickness of these units varies dramatically from place to place, and in some parts of the mesa one or both units may be absent. The degree of welding of these units is also quite variable, and is mainly dependent on the thickness of the units. The units may be as thick as 30 m.

The following section summarizes the geologic features of several HLOS test sites constructed in Rainier/Aqueduct Mesa. MIDAS MYTH/MILAGRO and HUSKY PUP were conducted in Aqueduct Mesa. HURON LANDING/DIAMOND ACE, DINING CAR, and CAMPHOR were conducted in Rainier Mesa.

The following table summarizes the major stratigraphic units of Rainier Mesa, gives a brief lithologic description of each unit, and provides an abreviation which will be used throughout the rest of this report. These abreviations are also used on maps and cross sections provided for each event.

Paleozoic rocks, at an elevation of approximately 1280 m. However, the tuffs are generally saturated interstitially hundreds of meters above the regional water table. This perched water does not move, appreciably, through the tuffs interstially, due to the low permeability of the tuff. The only freely moving water in the tunnels is present along fracture and fault zones.

The vitric tuffs overlying Tunnel beds 1 through 4 include Tunnel beds unit 5 and the Paintbrush Tuff. Tunnel bed 5 is a thick-bedded ash-fall tuff, and its base is zeolitized in some localities ("G" Tunnel). The Paintbrush Tuff consists of vitric bedded and reworked ash-fall tuffs 200 to 220 m thick. This unit may be only semi-consolidated, and can resemble a friable sand.

The caprock at Rainier Mesa is a welded ash-flow tuff, the Rainier Mesa Member of the Timber Mountain Tuffs. Ash-flow tuff, or ignimbrite, is deposited from a gaseous flow of ash, pumice, crystals and lithic fragments from a volcano. As the ash-flow cools and degasses, it is compressed and hardens during a process known as welding. The quick-cooling upper and lower surfaces of the flow are less welded, while the slow-cooling center becomes densely welded. The nonwelded base of the Rainier Mesa Member is approximately 10 m thick and grades upward into partially-, and finally, densely-welded tuff. The welded tuff on Rainier Mesa ranges in thickness from 45 to 90 m. Welded tuffs usually display no bedding, but they may be separated into recognizeable cooling units. These units may display different degrees of subdivided into five units. Each of the five has been further subdivided into mappable subunits. These subunits are defined on the basis of lithologic characteristics such as distinctive beds and sequences of beds. The Tunnel beds subunits are bedded peralkaline and calcalkalic ash-fall tuffs and reworked ash-fall tuffs. These tuffs are deposits of wind and water-borne ash, pumice (volcanic glass), crystals, and lithic fragments that have been consolidated and compacted into beds varying in thickness from a centimeter to as much as three to five meters.

The volcanic glass making up pumice is chemically unstable, and in the presence of ground water it is commonly altered to various clays and zeolite minerals. Where zeolities are formed, the resulting altered tuff is referred to as a zeolitized tuff. Throughout Rainier Mesa the Tunnel beds tuffs and Older Tuffs have undergone such alteration, so that the lower bedded ash-fall tuffs, usually up through Tunnel beds unit 4, are zeolitized. The overlying bedded tuffs, usually Tunnels beds unit 5 and the Paintbrush tuff, have not been altered: the pumice of these tuffs remains in its unaltered vitric state. Tunnels in the mesa are situated, for the most part, within the zeolitized bedded tuff section, which is 200 to 350 m thick.

The crystals of most zeolite minerals are submicroscopic. The process of zeolitization of an ash-fall tuff serves to decrease it porosity and increase its strength. The water table in Rainier Mesa lies approximately 550 m below tunnel level, in

EXHIBIT 5

FENIX & SCISSON, INC.
P. O. BOX 498
MERCURY, NEVADA 89023

ADDRESS REPLY TO: TES-3335 15 March 1984

MEMORANDUM

TO: R. T. Stearns

FROM: M. J. Baldwin MJB

SUBJECT: GENERALIZED GEOLOGY OF RAINIER AND AQUEDUCT MESAS AND OF SELECTED HLOS SITES

Rainier and Aqueduct Mesas are part of the topographically high area in the northwest corner of the NTS (Nevada Test Site) known as the Belted Range. "T" Tunnel has been driven into Aqueduct Mesa. "G", "E", and "N" Tunnels have been constructed in Rainier Mesa. The mesas are separated geographically from each other by Aqueduct Canyon, and Rainier Mesa lies southwest of Aqueduct Mesa. However, the two mesas can be considered as one when discussing the geology of the area. The remainder of this section will refer to Rainier Mesa, but all such references should be understood to include Aqueduct Mesa.

Rainier Mesa is an elongate, north-south-trending topographic feature, that encompasses approximately 11 square km in area. The top of the mesa at "N" Tunnel is at an average elevation of 2285 m above sea level. The average "N" Tunnel elevation is 1850 m, approximately 435 m below the mesa surface. At "T" Tunnel, the average mesa elevation is 2100 m, and the average tunnel elevation is 1716 m, approximately 384 m below the mesa surface.

EXHIBIT

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The mesa is made up of a series of volcanic units deposited on an irregular, eroded surface of Upper pre-Cambrian and Paleozoic sedimentary rocks. Table 1 is a generalized listing of the stratigraphic units that make up Rainier Mesa.

The pre-Tertiary rocks, 400 to 600 million years old, are structurally complex, that is, intricately folded and faulted. Vertical drill holes in the area have penetrated the Stirling Quartzite, quartzites and schists of the Wood Canyon Formation, and various Paleozoic dolomites. Granitic rock of the Gold Meadows Stock, (Mesozoic-age, approximately 100 million years old) has been encountered in drill holes in some parts of the mesa, where the stock has intruded the older sedimentary rocks.

Miocene-age ash-fall and ash-flow tuffs (26 to 7 million years old), were deposited by many eruptions from several different volcanic centers in southern Nevada. The tuffs have been draped over the irregular pre-Tertiary surface, but are structurally simple. The older tuffs thicken and thin dramatically, reflecting the underlying surface, and may have depositional synclines and anticlines. Higher in the section, however, the Tunnel beds rarely exhibit dips greater than 25°, and faulting is minimal. Where faults have occurred, they are generally the result of compaction of the tuffs over the pre-Tertiary topography, and displacements are on the order of 1 cm to 10 m.

As can be seen on Table 1, the Tunnel beds Formation has been

PHOTO C. Fracture 45m northeast of SGZ across UE12n.12 drillpad, showing 0.2m displace
View looking northeast.

PHOTO D. Fracturing across road 200m southeast of SGZ. View looking south.

FIGURE 4.--*Surface effects from the HURON LANDING/DIAMOND ACE event, faulting east of SGZ.*

PHOTO E. Fracture 177m east of SGZ, showing 0.15m displacement. View looking east.

PHOTO F. Disturbed ground 122m east of SGZ. View looking east.

FIGURE 5.—*Surface effects from the HURON LANDING/DIAMOND ACE event.*

PHOTO G. Fracture 450m southeast of SGZ, Fracture open up to 0.5m. View looking nort

FIGURE 6.--*Surface effects from the HURON LANDING/DIAMOND ACE event, "30m fault".*

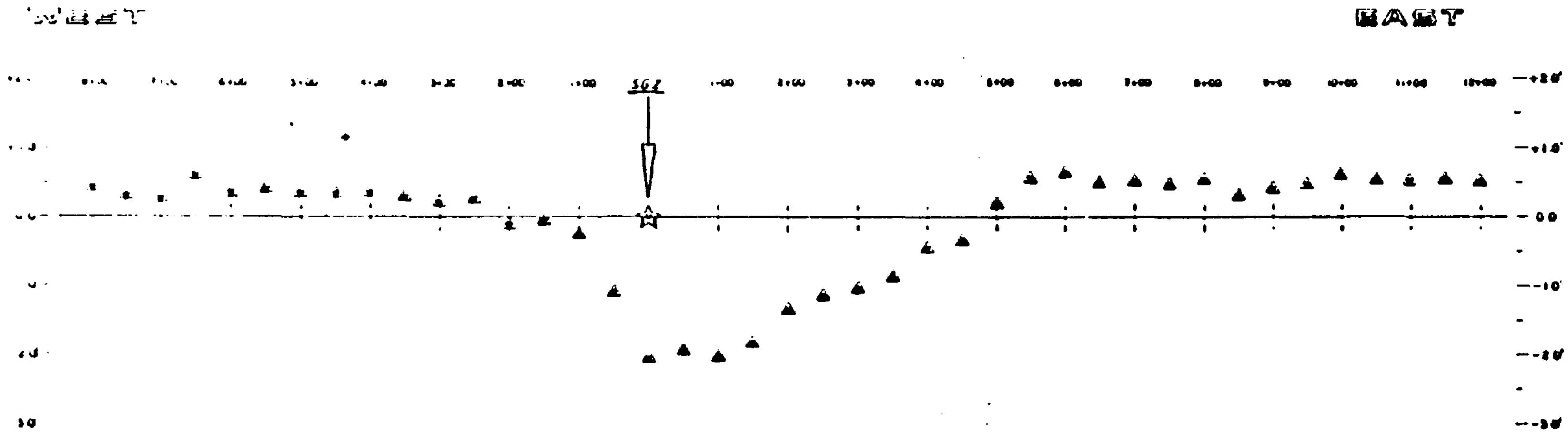

FIGURE 7 -- *Cross section showing differences in elevation (pre- vs. post-event) measured along a N75°E line through HURON LANDING SGZ.*

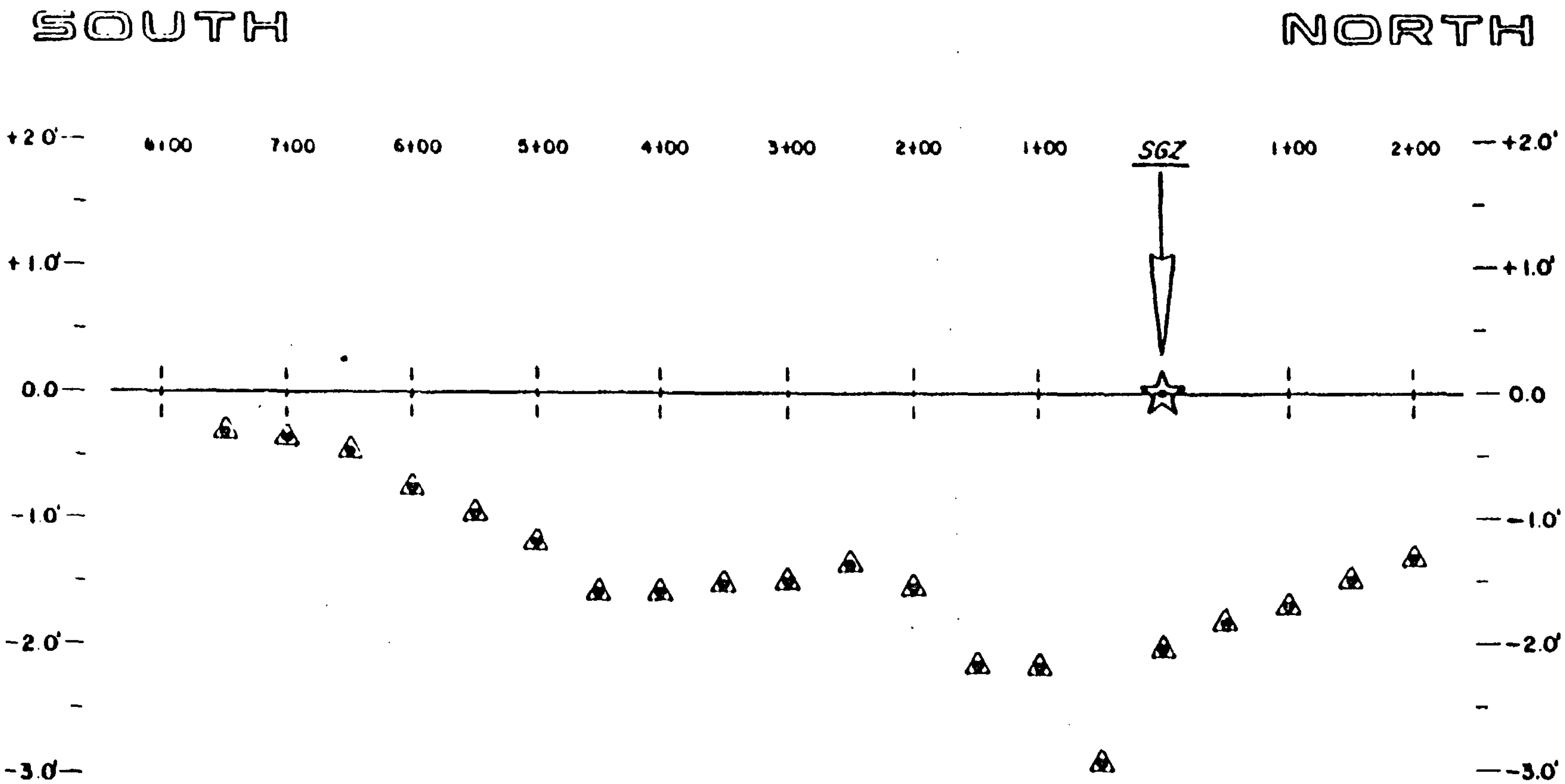

FIGURE 8.--*Cross section showing differences in elevation (pre-vs. post-event) measured along a N15°W line through HURON LANDING SGZ.*

note the apparent reversal of the true surface displacement versus the measured relative displacement along Fault #1.

Figure 8 shows the changes in elevation measured along the N15°W line. This line is subparallel to Fault #1, and is somewhat more symmetrical about SGZ than the N75°E line.

As mentioned above, several post-event faults and fractures southeast of SGZ seemed to be concentric about the U12n.11 SGZ, and the entire area was somewhat disturbed. In an attempt to assess the changes, it was requested that the N75°E survey line established prior to the MINORS IRON event, through the U12n.11 SGZ, be resurveyed. The cross section shown on figure 9 compares the elevations measured along the line immediately after the MINERS IRON event with the elevations measured after the HURON LANDING/DIAMOND ACE event, approximately two years later. Additional surface subsidence of the MINERS IRON chimney, due to the HURON LANDING/DIAMOND ACE event, is easily seen. An additional 1.2 m of subsidence was measured at SGZ, which is twice the initial collapse measured on several other events in the same yield range. Fracture "B", first measured after the MINERS IRON event, was reactivated as shown on figure 9, and Fault #1 can be seen at 4+60 on the west end of the line.

During reduction of the survey data, a major problem was encountered. The actual elevations at the point where the N15°W (HURON LANDING) line crosses the N75°E (MINERS IRON) line could not be correlated. The data were checked by Holmes & Narver, and it was decided to rerun the surveys. Due to the aforementioned weather conditions, the second survey was not completed until the spring of 1983. Data from the second survey solved some minor errors, but the differences in elevations at the crossing point were still unresolved. The only other possible source for the error was the original MINORS IRON survey. The field books were checked and it was found that the benchmark "Doll" had been utilized for the MINERS IRON surveys, but not for the HURON LANDING surveys. The benchmark was then field-checked and found to be 0.46 m low. This difference in benchmark elevation is probably due to the surface effects from the nearby DIABLO HAWK (U12n.10A) event. Recalculation of the elevations on the MINERS IRON surveys resolved the problem.

The subsidence interpretation presented in the MINERS IRON surface effects memo (Townsend to Ristvet, 6 April, 1981) is still valid, but the actual elevations are 0.46 m too low.

As previously noted, the surface effects from the HURON LANDING/DIAMOND ACE event are somewhat more severe than those caused by other nearby tests within the same yield range. A possible explanation for the apparent increase in severity could be the dislocating effect of nearby nuclear detonations upon natural discontinuities. MINC BLADE (U12n.08), detonated in June 1974, was the first event in this area. The surface effects from MING BLADE were essentially confined to one fracture/fault system (Fault #1) 290 m in length, with a maximum displacement of 0.1 m; and slump cracks subparallel to the edge of the mesa. The MINERS IRON event, executed six years later, produced surface effects over a large area, up to 2 km from SGZ, and three faults with displacements of up to 0.5 m. The HURON LANDING/DIAMOND ACE event produced mappable effects over an area comparable to that of MINERS IRON, however, faults with vertical displacements were widespread out to 250 m from SGZ. Fault #1 was reactivated over a length of 470 m, with displacements of up to 0.6 m. In addition, the proximity of the HURON LANDING/DIAMOND ACE event to the topographic edge of the mesa could also be a contributing factor to the increased severity of surface effects from the HURON LANDING/DIAMOND ACE detonation.

cc: C. E. Keller, FCTK
DNA Geology File, FCTK
R. D. Carroll, USGS

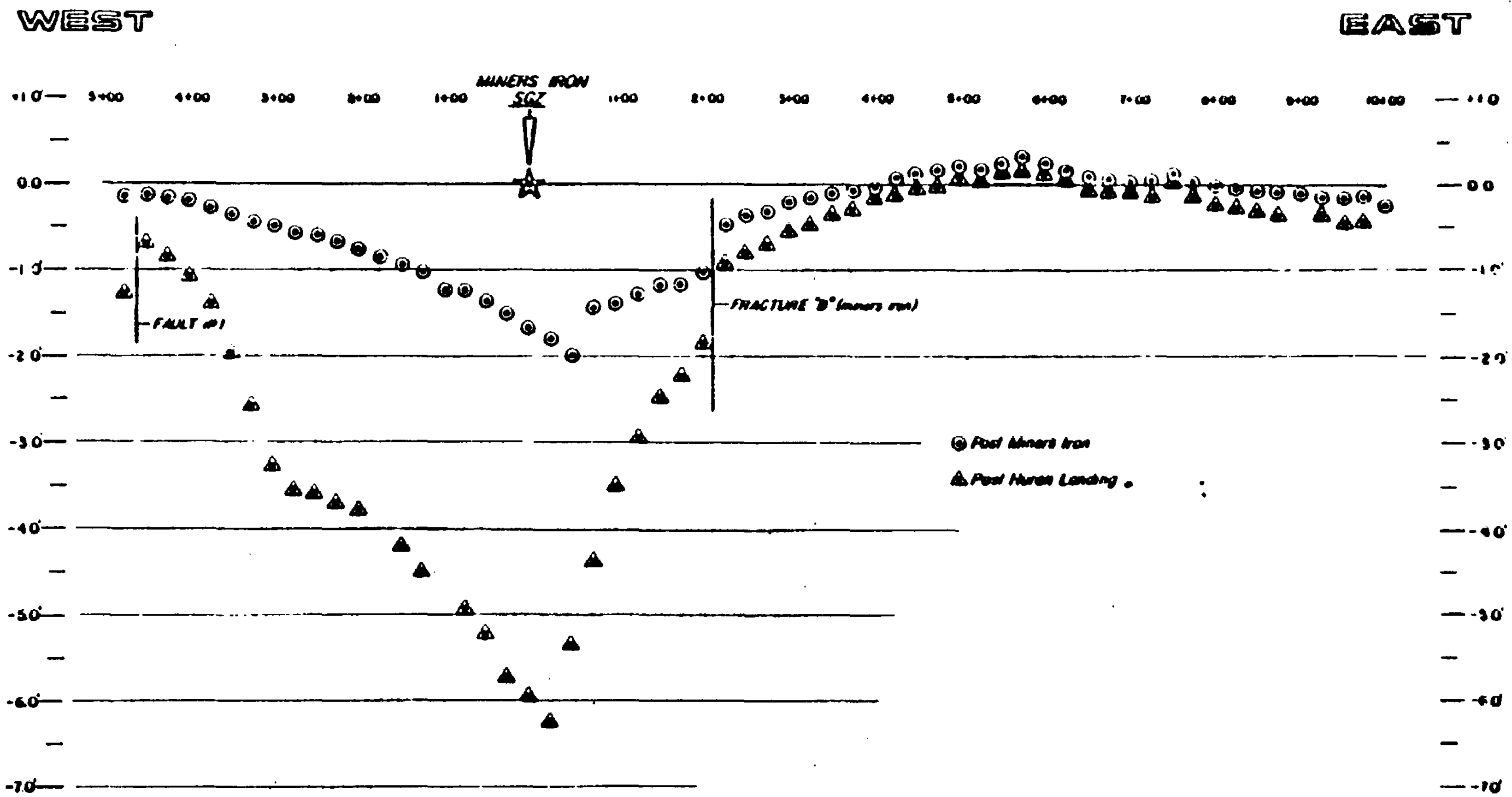

FIGURE 9.--*Cross section showing differences in elevation (post MINERS IRON vs. post HURON LANDING) measured along a N75°E line through MINERS IRON SGZ.*

EXHIBIT 6

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FEN!

MERCURY, [illegible]

ADDRESS REPLY TO TES-4021 23 September, 1983

MEMORANDUM

TO: J. W. LaComb

FROM: D. R. Townsend DRT

SUBJECT: SURFACE EFFECTS OF THE HURON LANDING/DIAMOND ACE (U12n.15) EVENT

The HURON LANDING/DIAMOND ACE event was detonated Thursday morning, 23 September, 1982, 408 m beneath the surface of Rainier Mesa. The test was constructed in the U12n.15 drifts, located in the northern part of the U12N Tunnel Complex (fig. 1).

Surface effects from the low-yield nuclear test were initially examined Thursday afternoon, but underground reentry priorities precluded further investigations of the surface effects until the following week. Unfortunately, during the interim, Rainier Mesa was subjected to an early winter storm which left 75-150 mm of snow on the mesa surface. Final mapping and documentation were completed as soon as possible; however, an unusually heavy snow cover on the north slope of the mesa forestalled final mapping of that area until early spring.

The surface effects from the HURON LANDING/DIAMOND ACE detonation were similar in total extent, but somewhat greater in severity, than those observed following the nearby MINERS IRON (U12n.11) event (fig. 2, folded). Discontinuous fractures 1 to 5 mm wide, with no vertical displacement, make up the majority of surface effects. This type of fracture is usually observed on prepared dirt surfaces such as drill pads and roads. Cracks of this type were mapped at several locations along the North Rainier Mesa Road, up to 2 km east of SGZ (surface ground zero). A hairline fracture with no vertical displacement was again mapped along the surface projection of Fault #3, 380 m southwest of SGZ (a similar feature was observed after the MINERS IRON event) (figs. 1 and 2).

Fractures with vertical displacements were observed throughout the area of investigation. The most prominent of these features is a northwest-southeast-trending fault/crack system, that is located approximately 30 m west of SGZ (Fault #1). This system extends approximately 225 m to the north, and 245 m to the south of SGZ (fig. 2). Approximately 150 m of this system lies below the topographic edge of the mesa. The system is composed of several en echelon fractures and faults spanning a zone up to 30 m in width, with vertical displacements of up to 0.6 m, down to the west (fig. 3, photos A and B). Cracking along this alignment was first seen following the MING BLADE (U12n.08) event (see memo, Townsend to Ristvet, 10 June,

EXHIBIT

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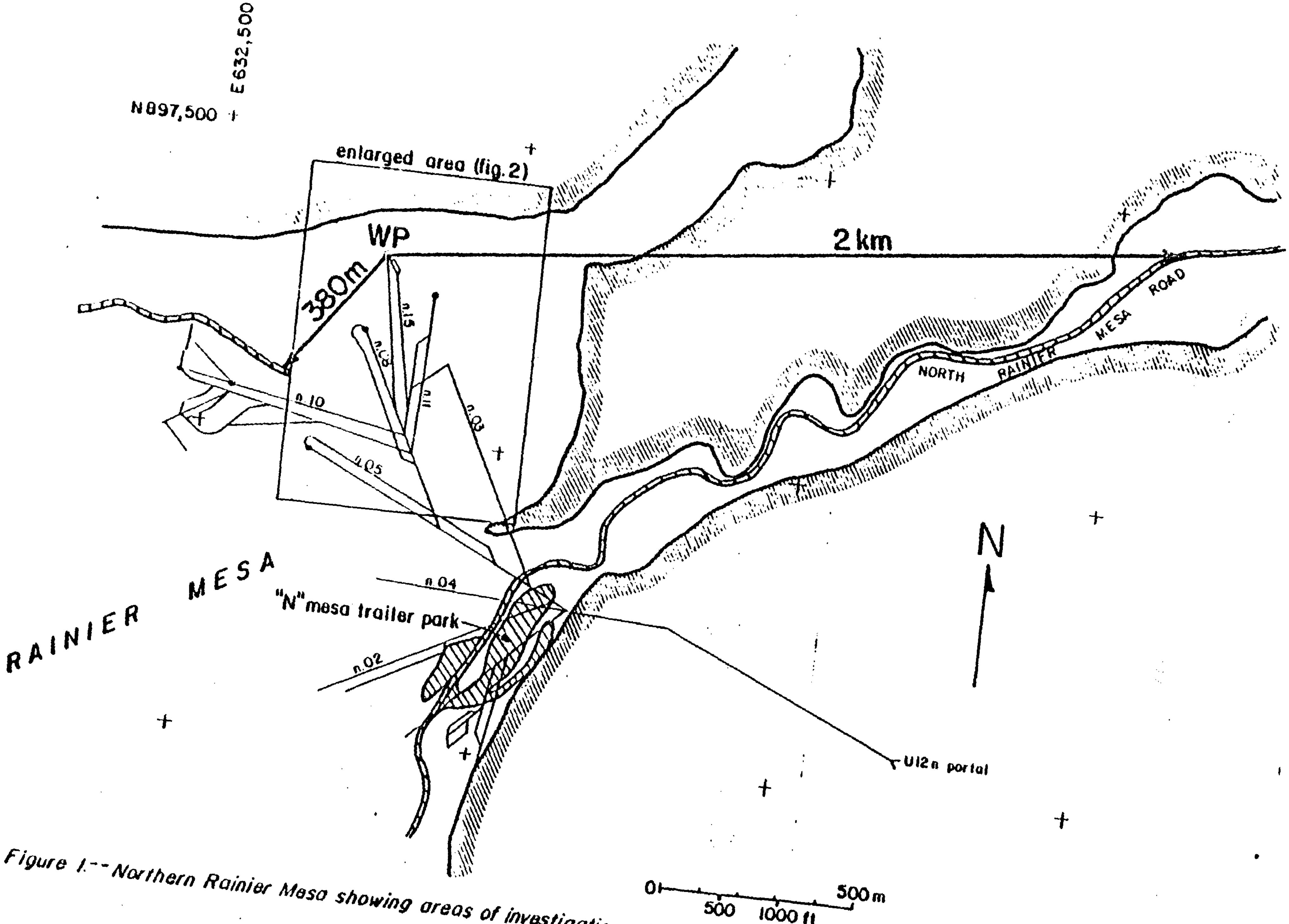


Figure 1.--Northern Rainier Mesa showing areas of investigation of HURON LANDING/DIAMOND ACE surface effects.

PHOTO A. Fracture zone 60m southwest of SGZ, showing 0.6m of displacement (down to the we
View looking north.

PHOTO B. Fracturing 150m southwest of SGZ along same zone shown on PHOTO A. View looking northeast at northeast corner of drillpad.

FIGURE 3.--*Surface effects from the HURON LANDING/DIAMOND ACE event, fault #1.*

1982: Reevaluation of Surface Effects over the U12n.15 (HURON LANDING] Drift Complex).

Additional fracturing and faulting, with displacements of up to 0.3 m, down to the north and west, occurred out to a distance of 250 m from SGZ (fig. 2). A fracture with 0.2 m displacement, down to the west, crosses the UE12n#12 drill pad, and extends 104 m in a northwest-southeastly direction (fig. 4, photo C). The road west of the UE12n#11 drill pad was again severely fractured and faulted (fig. 4, photo D). The orientations and locations of these faults and fractures were, in some cases, different from those mapped in this area following the MINERS IRON event. The initial examination of these features and others southeast of SGZ indicated that a concentric pattern had developed, which was centered on the MINERS IRON SGZ. Another fracture/fault system was mapped 183 m east of SGZ (fig. 2). This system trends north-south and is approximately 200 m in length. Displacements of up to 0.2 m (down to the west) were measured along this system (fig. 5, photo E).

Hairline cracking occurred along the base of the "6-m Fault" scarp, as was mapped following the MINERS IRON event (fig. 2). A large area of "disturbed ground" was mapped along the northward projection of the "6-m Fault", 122 m north of the measureable scarp. Two other large areas of "disturbed ground" were mapped at distances of 137 m and 200 m east of SGZ (fig. 2; fig. 5, photo F). These areas are associated with surface lineations, but their relationship to actual faulting is unknown.

Major fracturing again occurred along the trace of the "30-m Fault" 335 to 350 m east of SGZ. Discontinuous fractures were mapped along the north-south trace over a distance of 250 m. Many fractures were open up to 1.0 m in width, and several showed displacements of 0.1 m down to the west (fig. 6, photo G).

A series of large slump cracks was formed below the northern topographic edge of Rainier Mesa, subparallel to the mesa's edge (fig. 2). This type of slump feature is commonly observed on steep slopes, when the face of the slope is covered with colluvium.

Two survey lines were established across SGZ prior to the HURON LANDING/DIAMOND ACE event: A N75°E line 2000 ft in length (800 ft west, and 1200 ft east of SGZ); and a N15°W line 1000 ft in length (800 ft south, and 200 ft north of SGZ) (fig. 2). Elevations were measured along the lines at 50-ft intervals. After the event the lines were resurveyed to measure changes in the surface elevation. The differences in elevation (pre- versus post-event) measured along the N75°E line are shown in cross section on figure 7. The 1.5- to 2.5-ft (0.46- to 0.76-m) differences, seen near SGZ, are similar to those measured for previous events in this area. It is interesting to

DEFENSE NUCLEAR AGENCY
FIELD COMMAND
KIRTLAND AIR FORCE BASE, NEW MEXICO 87115

MEMORANDUM OF AGREEMENT
BETWEEN
FIELD COMMAND DNA AND LOS ALAMOS NATIONAL LABORATORY

SUBJECT: MIDAS MYTH Front End Experiment (MILAGRO) Interface Document

1. REFERENCES:

a. Letter, LANL, ADNSP MSF 670, (Dr. Robinson) to ADDST(T), 6 Jul 82.

b. Letter, ADDST(T), (Dr. Knowles) to LANL, 15 Jul 82.

2. The magnitude of the approved MILAGRO experiment being fielded on MIDAS MYTH necessitates the need for an Interface Document that specifies areas of responsibility between LANL and FCDNA. In view of the above, the following outlines the major areas of agreement.

a. CONTAINMENT: In accordance with discussions between the FCDNA Containment Scientist and the LANL Containment Project Manager, FCDNA will be responsible for containment design of the underground construction area and cable hole.

b. DESIGN AND CONSTRUCTION:

(1) Cable hole, pad, roads and other mesa efforts will be designed by LANL with the design reviewed and approved by FCDNA.

(2) FCDNA (FCTC) will monitor all drilling and stemming of the cable hole.

(3) FCDNA will be responsible for design and construction of the underground area (i.e., mining, tunnel prep, pipe stub installation, stemming, etc.).

(4) LANL will be responsible for mesa construction (i.e., road, pad, utilities, etc.). All work requests (criteria letters) for these efforts will be coordinated with FCDNA (FCTC). Assume all recording will occur on mesa, except for 2 each ROSES for CORRTEX and Special Reaction History experiments.

(5) FCDNA will be responsible for integration of experiment hardware into the vacuum system.

(6) FCDNA will design and fabricate required testbed/experiment interfaces.

(7) LANL will provide detailed hardware design in a timely manner to allow for design of interfaces.

(8) LANL will provide front-end vacuum hardware, and is responsible for pumpdowns of the A-box and the front-end experiment stubs. FCDNA will develop a schedule of front-end activity to avoid interference between pumpdowns and experiment alignment events.

(9) All post shot reentry and recovery effort will be approved by the test controller and be conducted under the control of FCDNA.

c. SAFETY:

(1) REECo is responsible for mesa and tunnel safety coordination until fielding starts.

(2) About mid-Mar 83 (when fielding commences), LANL will accept responsibility for mesa safety coordination and FCDNA will accept responsibility for underground and portal safety coordination.

d. SECURITY: All activities associated with this effort must conform to DoD Classification Guide CG-WT-5.

e. SCHEDULING:

(1) FCDNA is responsible for the overall scheduling effort.

(2) LANL will be responsible for mesa construction scheduling. All scheduling will be coordinated with FCDNA (FCTC).

(3) FCDNA will be responsible for underground and portal scheduling. All scheduling impacting MILAGRO will be coordinated with LANL.

f. FUNDING: LANL will coordinate work requests with FCDNA (FCTC) for mesa construction effort as follows:

(1) Road and mesa pad construction. (FCDNA work orders, FY82 dollars; LANL will reimburse FCDNA in FY83).

(2) Drilling downhole cable hole.

(3) Power installation.

(4) Placing downhole cables/terminate at the mesa.

(5) Stemming cable downhole (includes grout contractor, if needed).

(6) Installing recording/other equipment on mesa.

(7) Recovering recording/other equipment on mesa.

(8) Other mesa support as required (i.e., shockmounting, security fences, etc.).

NOTE: LANL work orders will be used for all FY83 effort.

g. FCDNA will submit work requests for all underground and portal construction associated with MILAGRO support as follows:

(1) Mining bypass and all pipe stub access drifts.

(2) Tunnel preparation for pipe stub installation.

(3) Mining and construction of alcoves.

(4) Installing pipe stubs, experiment housing, and vacuum system (includes chilled water and power).

(5) Installing dewatering system.

(6) Stemming bypass and pipe stub access drift (includes grout contractor).

(7) Pulling cable from bottom of downhole and terminate at the experiment housing. (This may be accomplished by LANL).

(8) Pulling and terminating instrumentation cables to the ROSES at the 750ft location.

(9) Installation of 2 each ROSES.

(10) Other tunnel/portal support as required.

NOTE: Actual costs for the above will be charged to a FCDNA work order. If FCDNA is unable to fund this effort, LANL will provide necessary funding.

h. OTHER:

(1) All downhole and special underground cabling and associated connectors will be provided by LANL. All other cabling and connectors will be provided by FCDNA.

(2) All pipe stubs, experiment housing and front end vacuum systems will be provided by LANL.

(3) All recording instrumentation will be provided by LANL.

(4) Shielding materials will be provided by FCDNA.

(5) One regular ROSES and one large ROSES will be provided by FCDNA.

(6) LANL will configure the two ROSES.

(7) LANL will provide and configure all mesa vans, motor generator sets, and all transformers, etc.

PHILLIP E. OPPEDAHL
Captain, USN
Director, Test Directorate
FCDNA

26 August 1982
DATE

TOM SCOLMAN
Deputy Associate Director
for Test Operations
LANL

9/3/82
DATE

EXHIBIT 7

Ok. JoS

FENIX & SCISSON, INC.
P. O. BOX 498
MERCURY, NEVADA 89023

ADDRESS REPLY TO:

TES-4166

13 December, 1983

MEMORANDUM

TO: J. W. LaComb JoS

FROM: D. R. Townsend DRT

SUBJECT: PROPOSED SURFACE INVESTIGATIONS FOR THE MIDAS MYTH (U12T.04) EVENT

The opportunity to continue our investigations of post-event surface effects will again be available in conjunction with the MIDAS MYTH event. The differences in geology and phenomenology between "T" Tunnel and "N" Tunnel will make the MIDAS MYTH surface survey a valuable addition to our data base. The relatively thick "caprock" over the "T" Tunnel complex and the apparent high level of coupling such as that experienced during the HUSKY PUP event could influence the surface effects from the MIDAS MYTH event.

Two surface survey lines through SGZ, with elevations measured at 25 ft intervals, would provide data on surface subsidence and check surface displacements along lineations and suspected surface faults.

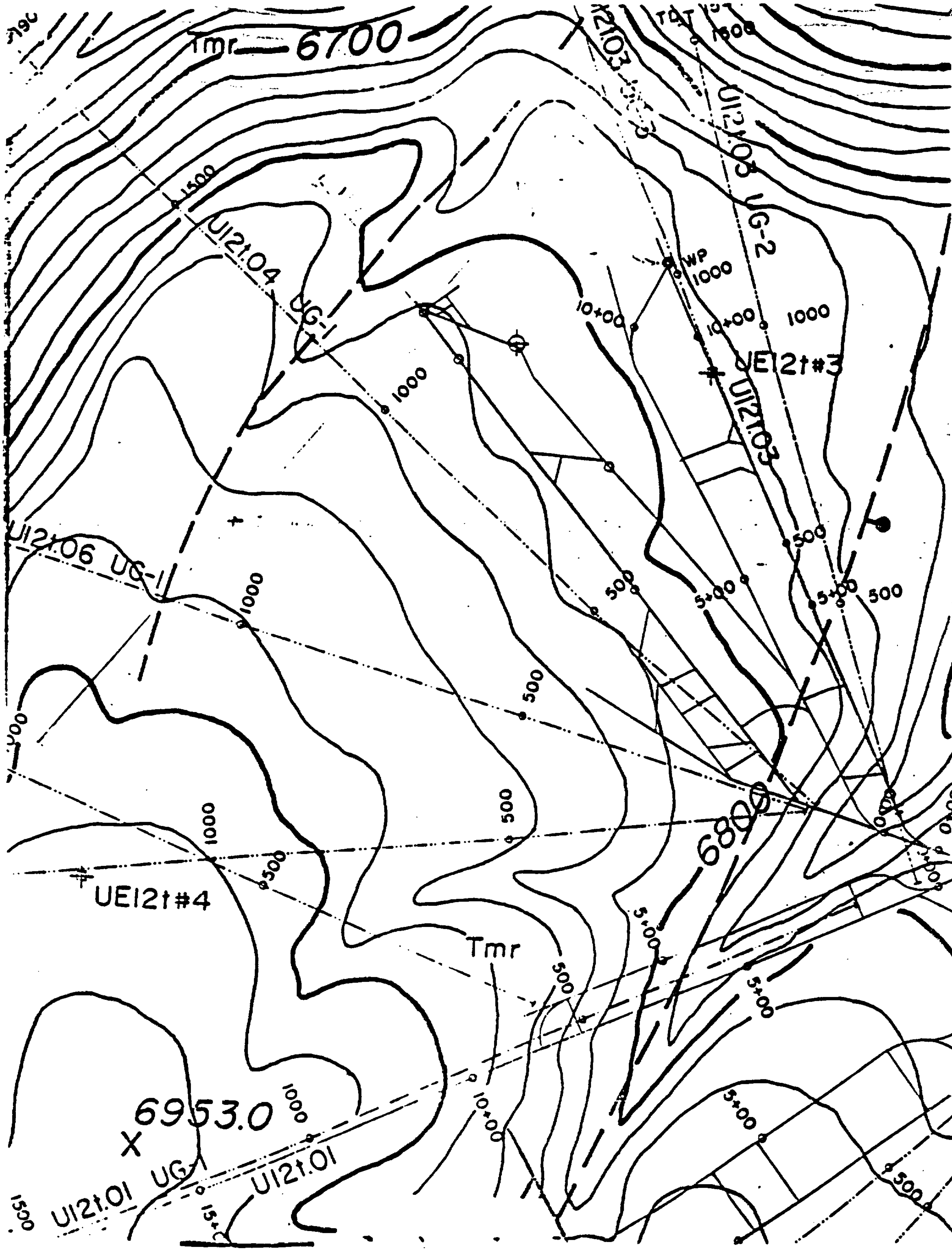
To maximize the utility of the data, the lines should be layed out as shown on the enclosed diagram. A line through the MIDAS MYTH SGZ along a bearing of approximately N40°E will also pass through the proposed SGZ for the MIGHTY OAK (T.07) event, and the line can be utilized for both events. This line should extend 1000 ft southwest of the MIDAS MYTH SGZ and 400 ft northeast (to edge of Aqueduct Canyon).

A second line bearing approximately N40°W will give a third dimension to the surface subsidence data and will cross suspected surface fault #3. This line should extend 300 ft northwest of SGZ (near the edge of the canyon) and approximately 500 ft southeast along the LOS Drift alignment.

In addition, a resurvey of the HUSKY PUP SGZ elevation would be beneficial to compare the secondary collapse, if any, as measured at the MINERS IRON SGZ, following the HURON LANDING event.

cc: C. E. Keller, FCTK
DNA Geology File, FCTK
R. D. Carroll, USGS

EXHIBIT
7



Tmr
6700
U12t.04 UG-1
1500
1000
WP
10+00
UE12t#3
U12t.03
U12t.03 UG-2
U12t.06 UG-1
500
5+00
6800
UE12t#4
Tmr
6953.0
U12t.01 UG-1
U12t.01

EXHIBIT 8

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
FCTOU	MIDAS MYTH Portal and Mesa Reentry/Recovery Plan

TO SEE DISTRIBUTION FROM FCTOU DATE 31 Jan 84 CMT 1

MAJ Hendrickson/dbb/6-7766

1. Attached is the MIDAS MYTH Portal and Mesa Reentry/Recovery Plan.

2. This plan will be briefed by LCDR Kovachat ~~1345~~ 1500 hours, D-7. at the T-Portal DNA Confere Room. All team chiefs will provide LCDR Kovach vehicle numbers to be used on reentry and t personnel assigned to those vehicles. Individuals will familiarize themselves with the specifics of the plan prior to the briefing. Team chiefs will ensure that appropriate memb of their reentry teams are present at the briefing.

Thomas F. Hendrickson

1 Incl
as

THOMAS F. HENDRICKSON
MAJ, USA
Program Director,
MIDAS MYTH

DISTRIBUTION:

DNA	LaComb	Taylor
	Ashbaugh	Hezlep
	Shirky	Dow
	Green	Kovach
	Wilcox	Koepp
	Miles	
REECo	Shackelton	
PAN AM	Reed	
BFE	Hassell	
LANL	Givens	
SAI (LV)	Sites	
[illegible]	Smith	
LPARL	Fisher	
SNLA	[illegible]more	
	Metcalf	
HS	[illegible]enwell M/S 239	
[illegible]	Hoskin	
EG&G	Leu	
	Adams	
[illegible]	Hoover	AREA 6 M/S 210

EXHIBIT
8

DA FORM 2496

MIDAS MYTH

PORTAL AND MESA REENTRY/RECOVERY PLAN

1. Objectives:

a. Reenter the U12t portal area for safety inspection, experimental data recovery, and preparation for tunnel reentry.

b. Reenter the Rainier Mesa for geographic survey, safety inspection and experimental data recovery.

Patient safety

2. General:

a. As soon as possible after event execution and upon direction of the Test Group Director (TGD), the mesa and portal areas will be reentered.

b. No attempt will be made to rush any part of the reentry/recovery sequence. The objectives of this plan will be accomplished with a maximum regard for personnel safety. Radiation exposures, if any, will be maintained as low as is reasonably achievable.

c. Under normal conditions, these activities are expected to be completed on D-Day.

3. Operational Control:

a. Operational control of reentry/recovery operations will come from the TGD thru the appropriate reentry/recovery officer to the reentry participants (See Inclosure 1).

b. At the discretion of the TGD and with the approval of the Test Controller, operational control of reentry operations will be released to the Reentry Coordinator, located in CP-1 Operations Control Center (OCC).

4. Reentry Stations/Control Points:

a. The Primary Reentry Station will be located at Gate 300, which is at the intersection of the Mercury Highway and Tippipah Highway.

b. A primary portal control point will be established at the T-Tunnel portal in the Health Physics Building.

c. A forward reentry station may be established at the 12-01 Road approximately one mile from Rainier Mesa Road at the 12-01 Closure Gate. An alternate forward reentry station may be activated on Rainer Mesa Road (Incl 2).

d. Reentry stations and control points are depicted at Inclosure 2.

5. Reentry Routes:

a. Mesa Reentry:

(1) Reentry route A will be via Mercury Highway, Rainier Mesa Road and 12-01 Road, as shown at Inclosure 2.

(2) Reentry route B will be via Mercury Highway, Rainier Mesa Road, Stockade Wash Road, Holmes Road, and East Mesa Road as shown at Inclosure 2.

(3) The mesa reentry route will be selected post-shot after helicopter surveillance of routes A and B.

b. The portal area reentry route will be via the Mercury Highway, Rainier Mesa Road, and 12-01 access road as shown on Inclosure 2.

6. Reentry Route Blockage:

a. An initial survey of the reentry routes will be made by helicopter.

b. Based upon the helicopter survey, the TGD will designate a reentry route and/or initiate action to clear the designated route.

c. If the Forward Reentry Station is utilized, all routes to enter area 12 can be opened at the discretion of the test controllers.

7. Communications:

a. The Reentry Communications network is presented at Inclosure 3.

b. All vehicles used on reentry/recovery will be equipped with Net 1 radios (available for issue at Building 726, REECo Communications), except the following:

(1) RADSAFE teams (Net 3).

(2) REECo electrical disconnect teams (Net 7).

c. All reentry and recovery officers will be equipped with a Net 3 radio in addition to Net 1.

8. Reentry Preparation (Pass Gate 200 before 0830 hours):

a. Reentry and emergency evacuation procedures will be briefed on or about D-7. A representative of each agency on each reentry party will be present at this briefing. Inclosure 4 lists members of each reentry/ recovery team. All team members must have a DOE "Q" clearance or a DOD SECRET or TOP SECRET clearance with sigmas 3 or 4 or 3.1 MiM or 4.1 MiM.

b. All reentry/recovery personnel will assemble at the Primary Reentry Station (Gate 300) at 1000 hours on D-Day. This will include:

(1) Environmental Sciences monitor teams.

(2) Mesa survey and recovery teams.

(3) Electrical disconnect team.

(4) Operators of prepositioned equipment.

(5) Pan Am photographers.

(6) Emergency medical team.

(7) Portal survey and reentry teams.

(8) Others to be designated.

c. There will be a minimum of two people in each vehicle. Reentry vehicles will be numbered with yellow tape on the left front fender and parked by backing into assigned numbered slots in the parking area at the Primary Reentry Station. Each recovery officer will verify that all designated personnel are present and in their specified convoy order. The assembly order and assignment of personnel to vehicles will be published and distributed at the D-7 meeting. The Primary Reentry Station will be managed by the Assistant Reentry Coordinator.

d. Environmental Sciences monitor teams will be dressed in full RADEX clothing and will have full face respirators with appropriate cannisters available. Portal and mesa reentry/recovery personnel will be prepared to dress out in a similar fashion when and if directed by the Reentry Coordinator. All reentry/recovery personnel will have accomplished face mask fitting prior to D-Day (contact Carl Soong (hygiene, Mercury) extension 986-0030).

9. Reentry Sequence:

a. General:

(1) The mesa and the portal will be swept by WSI personnel during morning of D-Day and will become part of the closed area NLT 0330 hours. These areas will not be reentered without the permission of the Test Group Director (subject to the approval of the Test Controller) until the area restrictions are removed.

(2) When directed by the TGD, the initial monitor teams will reenter the mesa and the portal areas along the designated routes and make radiation surveys. If necessary, operators of prepositioned equipment will be moved forward to remove any obstacles. When areas are judged safe for reentry, the mesa and portal reentry teams will be moved forward as appropriate under the direction of the Mesa and Portal Reentry Officers along the designated routes. If an emergency arises enroute, the situation will be reported by radio to the Reentry Coordinator.

b. Portal Reentry:

(1) When released by the TGD, portal reentry teams will proceed to the portal over the designated route under the direction of the Portal Reentry Officer.

(2) The Portal Reentry Officer will observe the status of the reentry lights located at the microwave tower near tunnels I, J, K. These lights are controlled from the DOD monitor room. If any reentry light is not on, the reentry will be halted until the Reentry Coordinator is notified and directs that reentry should proceed. If radio communications cannot be established in this situation, the portal reentry team will be withdrawn to a point where communications can be established.

(3) Upon arrival at the portal, the Portal Reentry Officer will establish communications, telephonic as well as radio, with the Reentry Coordinator and then begin safety inspection and general damage inspection.

(4) The portal reentry teams will insure that the HP Building is powered post shot, so that gas sampling can be accomplished. Documentary photography will be accomplished under the direction of the Portal Reentry Officer as required.

(5) When advised by the Reentry Coordinator, the portal recovery teams will recover data from B-70, B-72, B-79 (SNLA), the microwave timing station (LANL), and the Portal Recording Station (FCTEI).

(6) Upon the completion of these activities, the Portal Reentry Officer will advise the Reentry Coordinator of the situation and request permission to withdraw his reentry teams. Upon receipt of such permission, the portal reentry teams will withdraw through Gate 300.

(7) Personnel in the RAMS readout room will be kept continually informed on the results of gas sampling within the tunnel and the Reentry Coordinator will be updated periodically on the status.

(8) As soon as possible, an Environmental Sciences Base Station will be moved into the portal area and preparations for tunnel reentry begun.

(9) With the recommendations of the Sandia Environmental Health Advisor and the approval of the Test Controller, the TGD will direct ventilation of the tunnel to begin.

(10) Tunnel reentry most likely will [redacted] begin before D+1.

c. Mesa Reentry Survey/Recovery: The Mesa Survey Officer will conduct a geological survey of effects of the test on the mesa. Following the survey experiment recovery will be directed by the DNA representative in charge. Upon completion of this survey and experiment recovery, the DNA representative in charge will notify the Reentry Coordinator and withdraw his teams retracing the designated route back to Gate 300. When all the Reentry Survey/Recovery Teams have departed the mesa, the Environmental Sciences Monitor Team will be released from the mesa. The Mesa Survey Officer will ensure that the barricades are emplaced and the mesa is secured and report those facts to the Reentry Coordinator.

10. Special Instructions:

a. Should a limited reentry condition exist due to venting, reentry/ recovery teams will be formed into small groups. Each group will be accompanied by an ES monitor and will be controlled by the Reentry Coordinator from the OCC Operations Room. Specific instructions will define the work to be accomplished by each group and the maximum length of time permitted at the portal. No group will be dispatched for limited reentry unless the entire group can be safely evacuated in one less than their original number of vehicles.

b. In the extreme case that normal vehicular traffic into the portal or mesa areas is precluded, reentry will be delayed until the road can be adequately cleared.

c. Emergency Evacuation: In the event that an evacuation becomes necessary after reentry/recovery operations have begun, three blasts will be sounded on portable sirens at the portal and an announcement made on all nets to evacuate. The route for evacuation will be directed by the appropriate Recovery/Reentry Officers. The monitor teams will not leave the mesa or portal area until all teams have departed their areas. The monitor teams will trail behind their convoys to insure complete evacuation.

d. Cable Hole or Drill Hole Leakage:

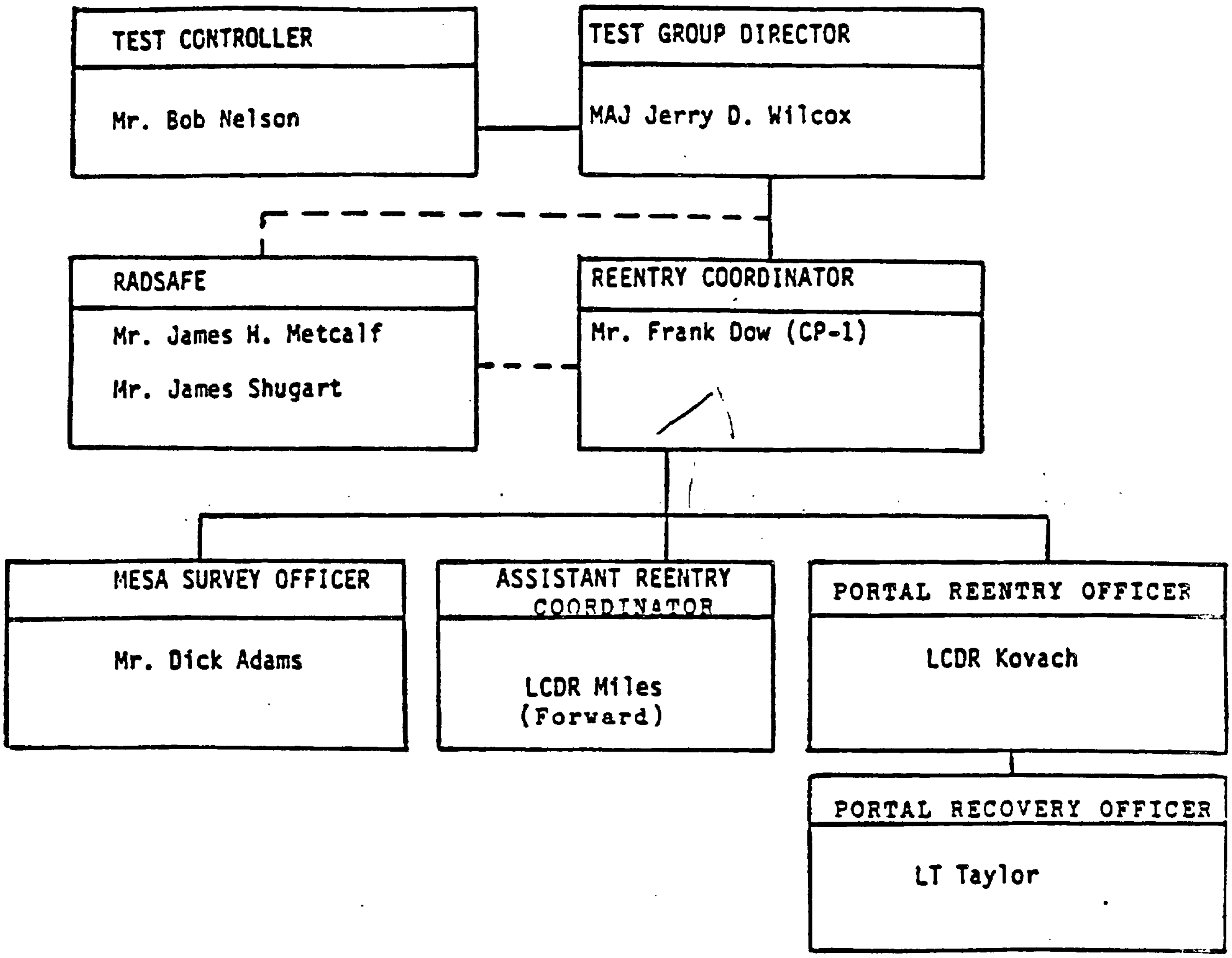
(1) If RAMS readings or a survey by ES personnel indicates that radioactive materials are escaping to the atmosphere from either a cable hole or a drill hole, positive action will be taken to stop the leak. The exact action will depend on the situation. All downhole cables will be cut.

(2) To facilitate actions in case of leakage, the following equipment will be prepositioned in the vicinity of the T-Tunnel mesa trailer park: one grouting pump truck with a full load of calseal and one full water truck. These trucks will be released by the mesa survey officer following the RADSAFE survey if no leakage is discovered.

ORIGINAL SIGNED BY
JERRY D. WILCOX
Major, USAF
Test Group Director,
MIDAS MYTH

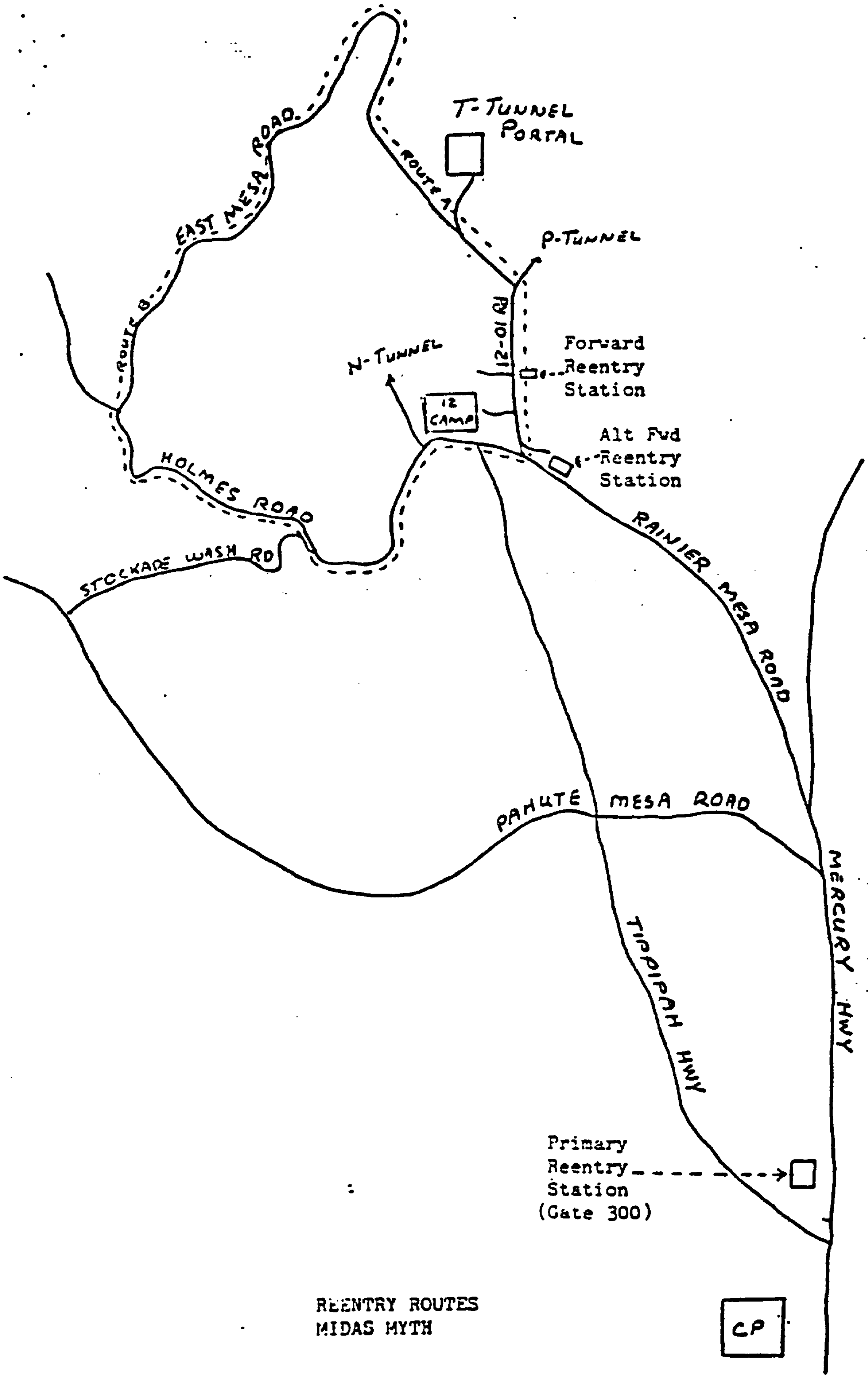
4 Incl
as

REENTRY ORGANIZATION CHART



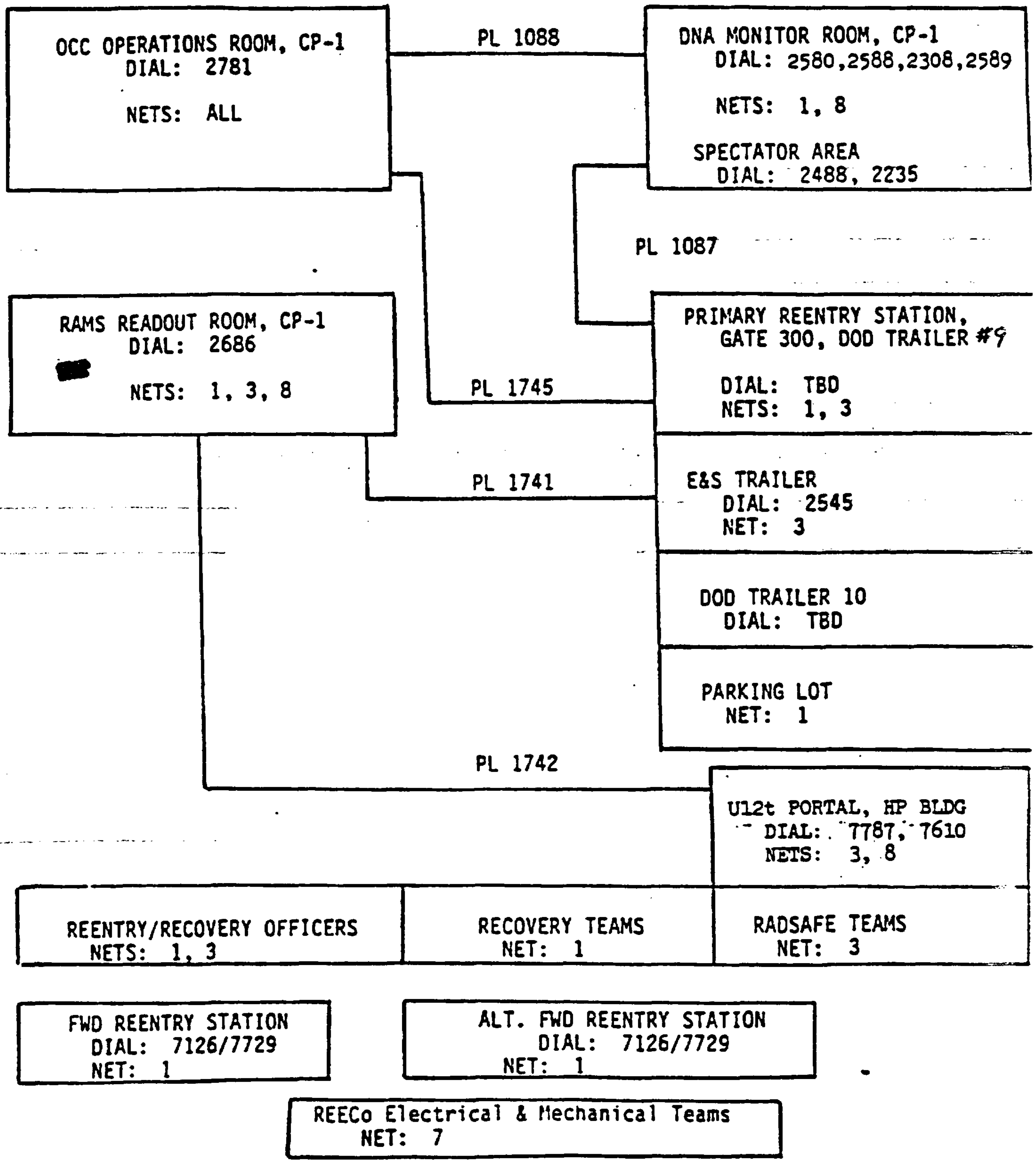
NOTE: Solid line indicates primary control channel.
Dashed line indicates advisory channel.

Incl 1



REENTRY ROUTES
MIDAS MYTH

REENTRY COMMUNICATIONS PLAN
MIDAS MYTH



Incl 3

MIDAS MYTH REENTRY/RECOVERY TEAMS

PORTAL REENTRY TEAMS

AGENCY	NAME	PURPOSE
DNA	Kovach, Richard O.	Portal Reentry Officer
	Green, Ira P.	Deputy Portal Reentry Officer
EG&G	Leu, Vernon	Construction Engineer
REECo	Van Cleave, K.	Damage Assessment Team
	Cook, J. K.	" " "
	Parish, H. B.	" " "
	Kelley, C. W.	" " "
	Matthews, L. W.	" " "
	Smith, C. W.	" " "
	Blichfoldt, J. E.	Electrical Disconnect Team
	Contrell, A. V.	" " "
	Chapman, D.	" " "
	Hayes, George R.	Equipment Operator
	Sawyers, B. R.	" "
	Jackson, Edward F.	" "
	Virgil, W. L.	ES Monitor Team #1
	Fanning, T. R.	" " " "
	Webb, William R.	Paramedic
	Calvird, Gregg A.	Industrial Hygiene
	Soong, Carlton S.	" "
	Straight, Robert J.	Gas Sampling
	Lyons, C. L.	" "
	Ward, V. L.	ES Mobil Check Team
	McDowell, E. M.	" " " "
PAN AM	Lovett, Mark E.	Documentary Photography
LANL	Eilers, Donald D.	Microwave Station/CORTEX
	Schmitt, Gerald G.	" " "
EG&G	Oconner, Michael X.	Microwave Station/CORTEX
	Whann, Dennis A.	" " "

Incl 4

MIDAS MYTH REENTRY/RECOVERY TEAMS (CONT'D)

PORTAL RECOVERY TEAMS

DNA	Taylor, Allen D.	In Charge/PRS Recovery
SNLA	Passmore, Henry J.	Data Recovery Team Chief
	Bradshaw, Joseph J.	B-72 Recovery
	Gilmer, Maurice	" "
	Miller, Gary O.	" "
	Worthon, Gordon S.	" "
EG&G	Crowe, Carlyle, S.	B-79 Recovery
	Kluesner, William J.	" "
	Ellis, James E.	B-70 Recovery
REECo	Jarred, Wilfred G.	B-70, 72, 79 Elec/Mech Disconnect
	Villaverde, Timothy	" "
	Rhinehart, Arvil	" "
	Douglas, Nora	" "
	Garrett, Wilfred R.	" "
BFE	Hassell, Harold H.	PRS Data Recovery Team
	Toepfert, Donald G.	" " " "
	Stepaniak, Francis J.	" " " "
	Gozikowski, Eugene J.	" " " "
SAI	Woodward, Doyle E.	" " " "
	Tate Jr., James B.	" " " "
	Sites, Kennety R.	" " " "
KSC	Westlund, Dick	" " " "
EG&G	Mikulis, Michael	" " " "
	Green, Lewis F.	" " " "
	Finney, Jeff	" " " "
	Harkcom, John K.	" " " "
	Hess, John T. Jr.	" " " "
LPARL	Schallan, J. S.	" " " "
	Fisher, T. R.	" " " "
FCTC-TEMS	Patton, Arthur D.	" " " "
GRC	Steele, Robert E.	" " " "

MIDAS MYTH REENTRY/RECOVERY TEAMS (CONT'D)

MESA SURVEY/RECOVERY TEAMS

DNA	Adams, Dick P.	In Charge
	Harris-West, Barbara L.	Survey Officer
F&S	Townsend, Dean R.	Geological Survey Team
	Baldwin, Margaret J.	" " "
	Brandt, Judith M.	" " "
	Castellanos, Mayra R.	" " "
REECo	Lencioni, Nathan	ES Monitor Team #2
	Solzano, R.	" " "
	~~Anderson, E. M.~~	" " "
	~~Fanning, Genery S.~~	ES Support LANL Recovery
	Pena, Juan R.	" " " "
	Dotson, Thomas A.	Elec Disconnect
	Ellis, Jeff	Paramedic
LANL	Gerke, David	P14-101 (Alpha)/Anchor Station
	Young, Carlton S.	" " " "
	Allen, Jerry E.	" " " "
	Day, Robert	" " " "
	Perea, Jake	WX 10-9 Trailer
	Odom, Conin	" "
	Christensen, Robert	" "
	Alrick, Keith	P15 Trailers
	Hughes, Williams	" "
	Galbraith, John	" "
	Buchanan, Russel B.	Health Physicist
	Mayer, William J.	Transformer/Instrumentation
EG&G	Gatling, James	P14-101 (Alpha)
	Farwell, Richard	" "
	Clark	" "
	Jacobs, Richard	" "
	Smith, T.	" "
	Netolicky, K.	" "
	Goplin, Richard	WX 10-9 Trailer
	Coleman, R.	" " "
	Hawkins, Bonard	" " "
	Kelley, L.	" " "
	Carlson, C.	P15 Trailers
	Mitchell, D.	" "
	Heisler, D.	" "
	Riesen, R.	" "
	Kingery, D.	" "
	Wiems, Clete	" "
	Martinson, D.	" "
	Peterson, K.	" "
	Allred, George	Anchor Station
	Jennings, Richard	" "
	Selbeck, Ed	" "
PAN AM	Foster, Steven	Documentary Photography

EXHIBIT 9

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
FCTCU	MIDAS MYTH TUNNEL Reentry/Recovery Plan

TO	FROM	DATE	CMT 1
SEE DISTRIBUTION	FCTCU (CDR Hezlep)	27 Jan 84 CDR Hezlep/dbb/6-7767	

1. Attached as Inclosure 1 is the MIDAS MYTH tunnel reentry plan.

2. For Reentry Teams: This plan will be briefed on D-3 at 1300 in the DOD/DNA T-Tunnel bldg. Individuals should make every attempt to familiarize themselves with the specifics of the plan prior to the briefing. Team chiefs will ensure that appropriate members of their reentry team are present at the briefing.

3. For Data Recovery Teams: The Data Recovery Team briefing is tentatively scheduled at 1-00 on D-1 in the DOD DNA T-Tunnel office bldg. with data recovery commencing an hour later.

L M Hezlep
LYNN M. HEZLEP
CDR, USN
Program Director,
MIDAS MYTH

1 Incl
as

DISTRIBUTION:

DNA
Mr. LaComb
Mr. Shirky
Mr. Ashbaugh
CDR Hezlep
Maj Wilcox
LCDR Miles
Mr. Dow
MAJ Hendrickson
Maj Naegeli
LCDR Kovach
LCDR Koepp
Capt Martin
Lt Taylor
Mr. Gantick

LPARL
Mr. Fisher

AFWL
Mr. Marshall (2)

REECo
Mr. Shackelton (5)
Mr. Penwell (ES)
Mr. Hoskins (IM)

Pan Am
Mr. Reed

LANL
Mr. Norman (2)

SAI (LV)
Mr. Sites (2)

SAI (A)
Mr. Miller

[illegible]
Mr. Metcalf
Mr. Keck (5)

KSC
Mr. Smith (2)

GRC
Mr. McCorkle

H&N
Mr. Richey

JAYCOR
Mr. Nunan

MDL
Mr. Gilbert

DOE/[illegible]
Mr. Nelson
Mr. Hoover

LMSC
Mr. Kissinger (2)
Mr. Pacheco

EG&G
Mr. Kitchen
Mr. Whipple

EXHIBIT
9

DA FORM 2496, AUG 80

[illegible] 1982-386[illegible]

MIDAS MYTH TUNNEL REENTRY PLAN

1. Objectives:

a. Reestablish the U12t tunnel complex to operational status.

b. Recover degradable data from the U12t.04, Ball-hall, t.05, t.03 bypass, and t.04 bypass ROSES/Alcoves.

2. General:

a. This plan assumes successful stemming and covers the initial entry into the tunnel until all degradable data has been removed.

b. Reentry operations will be conducted in compliance with applicable portions of "General Tunnel Reentry Procedures for Defense Nuclear Agency and Sandia Laboratories Nuclear Tests" (SLA-74--0199, May 1974), and standard NTS safety and security procedures.

c. No attempt will be made to rush any part of the reentry/recovery sequence. The reentry schedule is conservative, flexible, and will be advanced or delayed as conditions dictate.

d. All radiation exposures, if any, will be maintained as low as is reasonably achievable.

e. Major modifications of this plan must be approved by the Test Controller based upon the recommendations of the DNA Test Group Director (TGD) or his designated representative. Daily progress reports will be forwarded to the Operations Control Center (OCC).

f. Mr. Shirky will be the FCDNA Reentry Coordinator. Mr. Shirky, Mr. Metcalf, Mr. Penwell, and Mr. Shugart constitute the Reentry Control Group (RCG). REECo Reentry Team members, portal coordinators, and primary personnel are listed in Inclosure 1.

3. General Safety Notes:

a. All personnel on the Reentry and Rescue teams will be certified in the use of self-contained breathing apparatus and will have demonstrated proper use of the Draeger or McCaa apparatus to the satisfaction of REECo Industrial Safety (IS) personnel.

b. All personnel on the Rescue Team will be required to wear the McCaa self-contained breathing apparatus.

c. The Rescue Team will remain in an area designated by the REECo Portal Coordinator until moved underground to the fresh air station.

d. If the Rescue Team is required to move into the tunnel to aid a member of another team, it will do so only at the direction of the Reentry Control Group (RCG). The REECo Portal Coordinator will confer with the RCG, to insure that the Rescue Team can safely conduct its mission.

e. A REECo Portal Coordinator will be available at all times when crews are underground.

f. Reentry teams will be briefed by the Team Chief on potential hazards of experimenter's equipment (gas bottles, pressure lines, squibs, batteries) and what action should be taken to render safe any hazard observed. Inclosure 2 itemizes and locates known potential post-execution hazards.

g. All hazards will be corrected as teams advance on various phases of reentry. If hazardous conditions are encountered that cannot be corrected by a team, that team will return to the portal for further instructions.

h. Any mission will be aborted if remote Environmental Health Department (EHD) or REECo Environmental Sciences (ES) monitoring equipment detects extraordinary hazards within the tunnel or if communications are lost with the Reentry Control Group.

4. Team Designations:

a. Work Team. A work force not required to be qualified on the self-contained breathing apparatus.

b. Initial Reentry Team. (Reentry Team #1)

c. Backup Reentry Team (Reentry Team #2)

d. Rescue Team.

e. Data Recovery Team.

NOTE: The Rescue Team will not be used for any general reentry work. It will be maintained on a standby basis for emergency requirements only. The standby diesel locomotive will be readily available with adequate air pressure.

5. Sequence of Operations Prior to Tunnel Reentry:

a. D-Day:

(1) Using the remote gas sampling system, obtain gas samples for analysis by gas chromatography from the following locations as appropriate:

(a) Portal side of Gas Seal Door (GSD).

(b) WP side of GSD.

(c) WP side of Gas Seal Plug (GSP).

(d) Portal side of Mechanical Drift Protection Plug (MDPP).

(e) WP side of MDPP.

(f) Outside LOS pipe on top of TC #2

(g) Inside LOS pipe on top of TC #2

(2) After sampling, with the approval of the Test Controller, activate the ventilation system. If approval is not received, request this permission on D+1.

(3) Using the remote system:

(a) Establish ventilation at portal side of GSD (valve left open).

(b) Establish ventilation through the GSD and to the GSP.

(c) Remotely open the drain lines at the GSP and MDPP. (The drain valve at the GSD must be manually opened).

NOTE: Items (1) and (2) above may be intermixed and are contingent on Test Controller's approval, based upon existing conditions. In no case will personnel or equipment be within line-of-sight of the portal when initial ventilation is established.

b. D+1:

(1) Confirm that the Mobile Environmental Sciences Base Station is in position and conduct the following checks:

(a) Gas sample and confirm results per items 5a(1) above.

(b) Confirm that the T-Tunnel mesa trailer park is evacuated and all downhole cables are disconnected.

(c) Confirm that all power to the mesa trailer park is OFF. Confirm 110 Volt halon fire suppression has been activated.

(d) Obtain Remote Area Monitoring System (RAMS) Room verification that there have been no significant changes in the RAMS readings.

(e) Confirm that the reentry control system items listed, located in the Reentry Control/Monitor Control Building (RC/MC), are locked out. Con[illegible] that the LOS of the tunnel is clear. Then lockout CP-1 control of the follow[illegible] reentry items:

[illegible]	RECLOSURE NUMBER	SWITCH No.
(1) Reentry Power	1	
(2) Compressors		1
(3) Tunnel Utility Power	3	
(4) Instrument Power	4	
(5) Portal Utility	2	

ITEM	RECLOSURE NUMBER	SWITCH No.
(6) Section #3 Power		2
(7) Section #2A Power		3
(8) Section 2 Power		4
(9) Section #1 Power		5

Secure the reentry panel and give the key to the Portal Coordinator.

(f) If cavity collapse was not recorded on D-Day, check to see if it was recorded during the night.

(g) Confirm that all underground telephones are OFF or confirmed disconnected.

(h) Confirm that the tunnel public address system is disconnected and secure.

(i) Confirm that all underground utility power, underground instrument power, section 2A, and section 3 reentry power, and portal utility power is OFF.

NOTE: Portal power may be reset if all underground systems are adequate.

(j) Confirm that all underground cables to the portal which are not used for RAMS and reentry functions are disconnected. (See Portal Reentry Check List).

(k) Confirm that an ambulance is located at the portal.

(l) Confirm that an air compressor is operating at the portal.

(m) Confirm that a back-up diesel locomotive is readily available with adequate air pressure.

(n) Confirm Vent Pad dampers are set for reentry.

(2) Advise OCC that tunnel checks have been completed and request permission to proceed with tunnel reentry.

6. Sequence of Operations for Tunnel Reentry:

NOTE: Items a (1) through a (17) may be completed on D-Day with the approval of the Test Controller.

a. Initial Reentry by Work Teams on D+1:

(1) Establish communications with Reentry Control Group.

(2) Check with Reentry Control Group to insure that all tunnel conditions are acceptable.

(3) Team Chief, while in communication with Reentry Control Group, brief team on tunnel conditions, mission of the team, and general procedures.

(4) Recheck communications with Reentry Control Group.

(5) Enter the tunnel using a diesel locomotive and proceed to the GSD while reporting progress, radiation readings, gas readings, and tunnel conditions.

(6) Check portal side of the GSD for damage. Report radiation, gas, and damage conditions.

(7) Confirm positive air flow through the makeup ventilation line to the WP side of the GSD.

(8) Confirm positive air flow through ventilation line to the portal.

(9) Request permission to gas sample manually from the WP side of the GSD. When directed, ES and Industrial Hygiene (IH) personnel take samples and report results.

(10) If permission to open GSD water drain line was not granted on D-Day, request permission to open the GSD water drain line. When directed, open the drain line only so far as to not overflow the tunnel drain.

(11) Request permission to open man-way door in the GSD.

(12) When directed, open man-way door with ES and IH personnel sampling continuously.

(13) Check the tunnel on the WP side of the GSD.

(14) Chain man-way door open.

NOTE: Some water may be standing behind the GSD. Team members will be advised not to get wet. One team member should have safety approved hip boots or waders available.

(15) ES and IH personnel sample on the WP side of the door.

(16) If required, place the diaphragm water pump on the WP side of the GSD.

(17) Open and secure the gas seal door and install track section.

(18) Request permission to proceed toward the GSP.

(19) When directed, proceed to the GSP, taking readings and reporting conditions.

(20) Check the portal side of the GSP for damage. Report radiation, gas, and damage conditions. Check for water running through the drain line.

(21) Request permission to gas sample manually from the WP side of the GSP. When directed by Reentry Control, ES and IH personnel take samples and report results.

(22) Request permission to open the 26" and 38" turn tubes.

(23) Slide the ventilation "Dutchman" from the end of the vent line to the 26" turn tube flange and tape the connection. Check for positive air flow through the 38" line.

(24) Request permission to inspect WP side of the GSP.

(25) The Team Chief will crawl through the 38" line and note condition of the WP side of the GSP. If required, activate the diaphragm water pump on the WP side of the GSP.

(26) Work Team returns to the portal on the train.

b. Initial Reentry by Reentry Teams on D+1.

Note: Reentry teams will be briefed by the Team Chief on potential hazards of experimenter's equipment (gas bottles, pressure lines, squibs, batteries) and what action should be taken to render safe any hazard observed. Inclosure 2 itemizes and locates known potential post-execution hazards.

The initial reentry approach to the MDPP (Mechanical Drift Protection Plug) is written with the assumption that remote sampling has indicated that there is fresh air on the portal side of the MDPP. If sampling shows otherwise, the reentry teams must don breathing apparatus when they go through the GSP.

NOTE: If cavity collapse has not been confirmed, reentry through the MDPP will be delayed 24 hours. Consideration will be given to reestablishing ventilation through the MDPP. The rest of the reentry will not be affected by this change.

(1) Reentry Team and Rescue Team prepare to move into the tunnel.

(2) Reentry Team and Rescue Team, with the communications reel, proceed to the portal side of the GSP, monitoring radiation and gas levels. Rescue Team will remain at portal side of GSP.

(3) Reentry Team Chief check communications with Reentry Control Group.

(4) Reentry Team Chief, while in contact with Reentry Control Group, brief team on tunnel condition, mission of the team, and general procedures.

(5) Reentry Team Chief crawl through the GSP. If water is present on the WP side of the GSP, report to the Reentry Control Group. If required, establish pumps. Reentry Team proceed through the GSP, uncover locomotive and proceed to pick up communications reel from the Red Shack located in the ASR Access Drift, checking side drifts, vent lines, and tunnel superstructure enroute. Continue down the U12t Main Drift to its intersection with the t.0' Drift.

(6) Look down the main drift to the DPP and note condition. Then proceed down the t.01 drift to the MDPP.

(7) Check for damage to the portal side of the MDPP and make radiation and gas level surveys.

(a) Confirm positive air flow into portal left rib vent line.

(b) Confirm open position of drain valve on portal side of MDPP. Report flow or no-flow condition from drain line.

(c) Obtain water sample if flow exists.

(8) Request permission to manually gas sample from the WP side of the MDPP.

(9) ES and IH obtain samples and report readings.

(10) Request permission to open the 24" and 36" turn tubes on portal side of the MDPP. Open the 24" turn tube first. ES and IH personnel take readings as door is opened. Slide the ventilation "Dutchman" from the end of the vent line to within 6" to 12" of the 24" turn tube. Open 36" turn tube and confirm positive air-flow through the 36" turn tube.

(11) Slide ventilation "Dutchman" to mate with 24" turn tube flange and tape the connection. Reconfirm positive air-flow through the 36" turn tube.

(12) Request permission to visually inspect WP side of the MDPP. Team Chief dons breathing apparatus and crawls through 36" penetration.

(13) Team Chief reports visual conditions on WP side of MDPP and returns to the portal side of the MDPP. If water is present on the WP side of the MDPP, report to the Reentry Control Group. Install diaphragm pump on the WP side if necessary.

(14) Move Rescue Team and communications reel to the portal side of the MDPP. Reentry Team dons breathing apparatus and is checked by auxiliary personnel using standard Mine Rescue Team check. Reentry Team Chief checks communications with RCG and briefs the Reentry Team on the mission of the team and general procedures. Request permission for the team to proceed through the 36" crawl tube.

(15) When directed, proceed through the 36" line and assess tunnel damage on the WP side of the MDPP. ES and IH personnel will make the required checks.

(16) Confirm vent lines on the WP side of the MDPP are in place and verify position of dampers in vent lines leading to t.03/t.04 bypass, t.04, the Ball-hall, and t.05 drifts.

NOTE: The term "Walk-Out means a check of alcove and drift conditions with continuous gas and radiation monitoring by ES and IH personnel.

(17) Request permission to continue with the walk-out. When directed, proceed down the Cable Access x-cut to the U12t Main Drift to its intersection with the t.04 drift. Check the condition of the diagnostic stubs, and the LPARL Alcove #1-26. 20 NiCd batteries are located in a container adjacent to a diagnostic stub in this area.

(18) Check the condition of the Shield Wall next to the LPARL Alcove. Manually open the 3 drain valves for the Shield Wall Vent System located on the shield wall.

(19) ES and IH personnel take manual gas sample through shield wall.

(20) Drain and remove bolts holding 48" door on crawl tube through shield wall. Remove door and check conditions in the Sandia diagnostics area.

(21) Exit the LPARL diagnostics area, continue down the U12t Main and t.05 drifts until intersecting the Ball Hall/t.05 x-cut. Close 6 freon bottle valves, located on the left rib of the x-cut, which supply ROSES R100, R101, 102, 103, 104, and 106.

(22) Proceed down t.05 to FCTC ROSES 106.

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. Then open the top port. DO NOT SHINE LIGHT INSIDE ROSES

(c) ROSES 106 has 2 UPS battery systems on invert. Report condition.

(23) Return to AFWL ROSES 102 and 103. Starting with the WP side ROSES 102:

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. DO NOT SHINE LIGHT INSIDE ROSES.

(c) Open top port. Repeat ventilation operation for ROSES 103.

(d) ROSES 102 and 103 each contain film pack memory batteries.

(24) Return to LPARL ROSES 002 and 003, and the SNLA DAASY ROSES. Beginning with WP ROSES 002:

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. DO NOT SHINE LIGHT INSIDE ROSES.

(c) Reach inside door and shut off the freon. Close door. Open top port. Repeat ventilation operation for ROSES 003 and DAASY.

NOTE: DAASY freon bottle is 4 ft. inside of door on right wall.

(d) ROSES 002, 003, and DAASY contain UPS battery systems. The DAASY also has 7 lead acid batteries located outside and adjacent to the ROSES. Report condition.

(25) Proceed toward WP down the Ball-hall walkway to AFWL Alcove #1-3. Perform damage assessment of alcove and enter into x-cut 1A. Alcove #1-3 contains UPS battery systems and DES batteries.

NOTE: Continuously check integrity of the communications line as Reentry Team continues walk-out.

(26) Commence gas sampling through x-cut 1A shield wall gas sampling line. Drain water and remove doors. Assure air flow into LOS drift and request permission to proceed through x-cut penetration to the TC #1 area. Note conditions and report.

(27) Request permission to open LOS vent port. Open port by moving the vent port pull wire located on the left rib near the TC #1 door. ES and IH personnel make checks and report vent flex contents.

(28) Request permission to crack TC#1 door.

(29) Crack the TC #1 door and confirm air flow. Obtain swipe samples and evaluate conditions. Leave the TC #1 door cracked.

(30) Visually look down the left rib of the HLOS pipe. If conditions permit proceed down the left rib of the HLOS pipe past the TC #2 access hatch to SS 6+25. Insure that the flex exhaust duct is securely attached to the LOS vent port. Open the port by moving the vent port pull wire located on the left rib of the HLOS pipe. ES and IH personnel make checks and report vent flex contents.

NOTE: Continuously check integrity of the communications line as Reentry Team continues walkout.

(31) Return down the left rib of the HLOS pipe to TC #1.

(32) Exit through x-cut 1A and the AFWL Alcove #1-3 and proceed via the Ball-Hall center walkway to the intersection of the x-cut between t.05 and the Ball-hall. Note condition.

(33) Continue toward WP down the center walk-way to the LANL Well Head Alcove. Note conditions.

(34) Proceed to the Red Shack ROSES R100.

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. Then open the top port. <u>DO NOT SHINE LIGHT INSIDE ROSES.</u>

(c) ROSES R100 contains 3 carbon batteries.

(35) Proceed to KSC Alcove #1-6. Enter alcove and note conditions. Alcove #1-6 contains 4 UPS battery systems and DES batteries.

(36) Continue to timing and firing ROSES R101.

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. Then open the top port. DO NOT SHINE LIGHT INSIDE ROSES.

(c) ROSES R101 contains 1 UPS battery system.

(37) Proceed to FICU ROSES 011.

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. DO NOT SHINE LIGHT INSIDE ROSES

(c) Reach inside door and shut off freon. Close door. Open top port.

(38) Continue to EG&G Alcove #1-5 located in x-cut 1F. Enter alcove and note conditions.

(39) Continue to SNLA Alcove #1-4 also located in x-cut 1F. Enter alcove and note conditions. Alcove #1-4 contains 1 UPS battery system and DES batteries.

NOTE: Continuously check integrity of the communications line as Reentry Team continues walk-out.

(40) Exit x-cut 1F and proceed to SMO ROSES 104.

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. Then open the top port. DO NOT SHINE LIGHT INSIDE ROSES

(41) Proceed to KSC ROSES 004 and 005. Starting with the WP side ROSES 004:

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. DO NOT SHINE LIGHT INSIDE ROSES.

(c) Reach inside door and shut off freon. Close door. Open top port. Repeat ventilation operation for ROSES 005.

(d) ROSES 004 and 005 contain film pack batteries.

(42) Continue to KSC alcove #1-2. Enter alcove and note conditions.

(43) Proceed to SNLA Alcove #1-1. Enter alcove and note conditions. Alcove #1-1 contains 5 UPS battery systems.

(44) Proceed to SNLA ROSES 022 and KSC ROSES 010. Starting with ROSES 022:

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. DO NOT SHINE LIGHT INSIDE ROSES.

(c) Reach inside door and shut off the freon. Close door. Open top port. Repeat ventilation operation for ROSES 010.

(d) ROSES 022 contains 5 NiCd batteries in racks. ROSES 010 contains film pack batteries.

(45) Proceed to SNLA ROSES 027, S101, and S102. Starting with ROSES 027:

(a) Close ground switch and turn off lights.

(b) Open bottom port at lower left of the door. DO NOT SHINE LIGHT INSIDE ROSES.

(c) Reach inside door and shut off the freon. Close door. Open top port. Repeat ventilation operation for ROSES S101 and S102.

(d) ROSES 027 contains 5 NiCd batteries in racks. ROSES S101 and S102 each have lead acid memory batteries in racks.

(46) Proceed to SNLA ROSES R001 and 026. Starting with ROSES R001.

(a) Close the ground switch and turn off the lights.

(b) Open the bottom port at the lower left of the door. DO NOT SHINE LIGHT INSIDE ROSES.

(c) Reach inside door and shut off the freon. Close door. Open top port. Repeat ventilation operation for ROSES 026.

(d) ROSES R001 and 026 each contain 5 NiCd batteries in racks.

(47) Proceed up the U12t Main Drift to the intersection with the t.03 B.P. drift. Continue up the t.03 B.P. (towards the W.P.) noting ground and safety conditions.

(48) Stop at SAI Alcove #1-28. DO NOT ENTER ALCOVE. DO NOT SHINE LIGHT INTO ALCOVE. Note conditions. ES and IH personnel make required checks.

(49) Continue up the t.03 B.P. until it intersects with the t.04 B.P. Look up t.03 B.P. and note condition of area around scrub generators. Batteries are located inside scrub generators.

(50) Continue up the t.04 B.P. drift to the freon bottle rack located on the right rib of the t.04 B.P. drift opposite LANL ROSES 105. Close the valve on the freon bottle supplying LANL ROSES 105.

(51) Proceed up the t.04 B.P. drift to the convection wall located at CS2+50. Note conditions.

(52) Reverse direction and continue walk-out down the t.04 B.P. to LANL ROSES 105.

(a) Close the ground switch and turn off lights.

(b) Open the bottom port at the lower left of the door. <u>DO NOT SHINE LIGHT INSIDE ROSES</u>.

(c) Open top port.

(53) Proceed to LANL ROSES 007.

(a) Close the ground switch and turn out lights.

(b) Open the bottom port at the lower left of the door. <u>DO NOT SHINE LIGHT INSIDE ROSES.</u>

(c) Reach inside door and shut off the freon. Close door. Open top port.

(d) LANL ROSES 007 has 2 lead acid batteries on invert.

(54) Advance to LANL Alcove #1-9. Note conditions. Alcove #1-9 contains 7 UPS battery systems.

(55) Proceed up the t.04 B.P. and t.03 B.P. to the SGEMP x-cut. Continue down the x-cut to the SGEMP shield wall. Note conditions.

(56) Reverse direction and proceed to JAYCOR Alcove #1-8; enter alcove and note conditions. Perform same assessment on alcove #1-3C.

(57) Proceed to SAI ROSES 008, 009, and 018. Starting with ROSES 008:

(a) Close the ground switch and turn out lights.

(b) Open the bottom port at the lower left of the door. <u>DO NOT SHINE LIGHT IN ROSES</u>.

(c) Reach inside door and shut off the freon. Close door. Open top port. Repeat ventilation operation for ROSES 009 and 018.

(d) ROSES 008, 009, and 018 contain film pack batteries.

(58) Proceed down the t.03 B.P. and into the cable access x-cut.

(59) Reentry Team returns to the portal side of the MDPP.

c. Reentry by Data Recovery Team on D+1 (D+2 if initial reentry is delayed).

The Data Recovery Team (Inclosure 3) is composed of three separate recovery teams which will recover degradable data from ROSES, diagnostic stubs, camera boxes, etc. Members of the team are to recover data by the most direct route and in the most expeditious manner consistent with safe practices.

(1) The Data Recovery Team Chief checks with the Reentry Control Group to insure all tunnel conditions are acceptable.

(2) The Data Recovery Team proceeds to the portal side of the MDPP.

(3) Establish telephone communications with the portal.

(4) The Team Chief will brief the team on tunnel conditions, mission of the team, and general procedures to be followed. A DNA Representative will accompany each sub-team on recovery mission. Requirements for respiratory protection and protective clothing will be determined by the Reentry Control Group based on the information available.

(5) When directed, Team A proceeds through the 36" turn tube and recovers data from the KSC ROSES 004, 005, and 010; AFWL ROSES 102 and 103; and BMO ROSES 104.

(6) When directed, Team B proceeds through the 36" turn tube and recovers data from the LPARL diagnostic stub area and ROSES 002 and 003. Additional data will be collected from SNLA ROSES 022, 027, R001, and 025. FCTC will recover data from cameras located in the Ball-hall.

NOTE: LPARL will recover time dependent experiments. These will be inventoried, double bagged, and brought to Area 12 SRD compound for shipment.

(7) When directed, Team C proceeds through the 36" turn tube and recovers data from SAI ROSES 008, 009, 018, and Alcove #1-28. Additional data will be collected from LANL ROSES 105 and 007.

(8) When all data is recovered, sub team leaders will direct their teams to return to the portal.

(9) FCTC will recover scratch gages from positions not yet determined. The FCTC representative will join Team A, B, or C as appropriate.

Jerry D. Wilcox
JERRY D. WILCOX
Major, USAF
Test Group Director
MIDAS MYTH/MILAGRO

3 Incl
1. Reentry Teams/Drawings
2. Potential Post Shot Hazards
3. Data Recovery Team

MIDAS MYTH-MILAGRO TUNNEL REENTRY ASSIGNMENTS DATE 1-27-84

THE FOLLOWING TEAM ASSIGNMENTS HAVE BEEN MADE FOR THE MIDAS MYTH - MILAGRO TUNNEL REENTRY TASK. D+1

PORTAL COORDINATION TEAM

MINE SAFETY	EDWARDS, HARVEY D.
PORTAL COORDINATOR	WILHELM, BRUCE L.
ALT. PRTL. COORDINATOR	VAN CLEAVE, KEVIN
REENTRY GROUP-INDUSTR. HYG.	
INDUSTRIAL HYGIENE	FRAZIER, AL
INDUSTRIAL HYGIENE	VILLAIRE, JAN
INDUSTRIAL HYGIENE	LENCIONE, NATE
RADIATION SAFETY	PENNELL, CLIFFORD R.
RADIATION SAFETY	SINGART, JAMES
RADIATION SAFETY	MOSKIN, DARWIN
REECO SAFETY	LORDS, ALVIN J.
REECO SAFETY	SEIRA, HANK
HEALTH PHYSICS	METCALF, JAMES
PARAMEDIC/AMBULANCE	WHITE, WILLIAM
RESPIRATORY EQUIP	TAYLOR, MIKE

WORK TEAM

TEAM CHIEF	SHENA, WILLIAM M.
MINER	MASCARENAS, APOLONIO
MINER	SCHUTT, RONALD R.
MINER	MONTOYA, TITO H.
ENVIRONMENTAL SCIENCES	FANNING, THEODORE R.
INDUSTRIAL HYGIENE	FOLEY, JAMES L.
OPERATOR (MOTORMAN)	SEVERSON, JACK H.
MINER (SHAFTER)	HAMRICK, GEORGE A.
BULL GANG	COOPER, JERRY

DATA RECOVERY D+1

MONTOYA, TITO
NOHRA, PAUL
ALT. WISENBERGER, PHILLIP

REENTRY TEAM #1

TEAM CHIEF	WOMACK, CHARLES
MINER	HOWELL, VIRGLE L.
MINER	NOHRA, PAUL T.
MINER	WEISENBERGER, PHILLIP A.
ENVIRONMENTAL SCIENCES	LYONS, CRAIG L.
INDUSTRIAL HYGIENE	CALVIRD, GREGG A.

SCIENTIFIC ASSESSMENT D+2

HOWELL, VIRGIL
SWEET, WILBUR
ALT. MONTOYA, TITO

REENTRY TEAM #2

TEAM CHIEF	TADLOCK, WAID
MINER	GREGORY, SCOTT K.
MINER	WELLMAN, JAMES G.
MINER	SWEET, WILBUR E.
ENVIRONMENTAL SCIENCES	MC DOWELL, ELIZABETH M.
INDUSTRIAL HYGIENE	HAWORTH, ORIN L.

RESCUE TEAM

TEAM CHIEF	ATKINSON, LAVELL
MINER	MORLEY, ROBERT G.
MINER	TRUJILLO, ACORCINIO
MINER	AEBISCHER, MICHAEL L.
ENVIRONMENTAL SCIENCES	SOLZANO, RICHARD
INDUSTRIAL HYGIENE	MC NEILL, BARRY
DATA RECOVERY-RADSAFE	ANDERSON, ELAINE M.
DATA RECOVERY-IH	LENCIONI, NATE
PARAMEDIC	ELLIS, JEFFREY

ADDITIONAL PERSONNEL IN SUPPORT OF TUNNEL REENTRY D+1

SUPERVISION

SHACKELTON, SEYMOUR T.
RUTH, A. W.
WILHELM, BRUCE L.
HARVEY, WILLIAM C.
LI, IGNATIUS W.
SHERA, WILLIAM M.

MINERS

HANSEN, MONTE (OUTSIDE)
ALA, LAWRENCE (EXPEDITER)
EUBANKS, ALBERT

OPERATORS

SAWYERS, B. R.
PULLINS, ELIJAH (COMPRESSOR)
JACKSON, EDWARD F.

LINEMEN

THOMPSON, VERNON
CONNOLLY, GEORGE

BULL GANG

SANDERS,JR. JAN
HANSON, JEFFREY M.
SWINSON, WILLIAM A.

WIREMEN

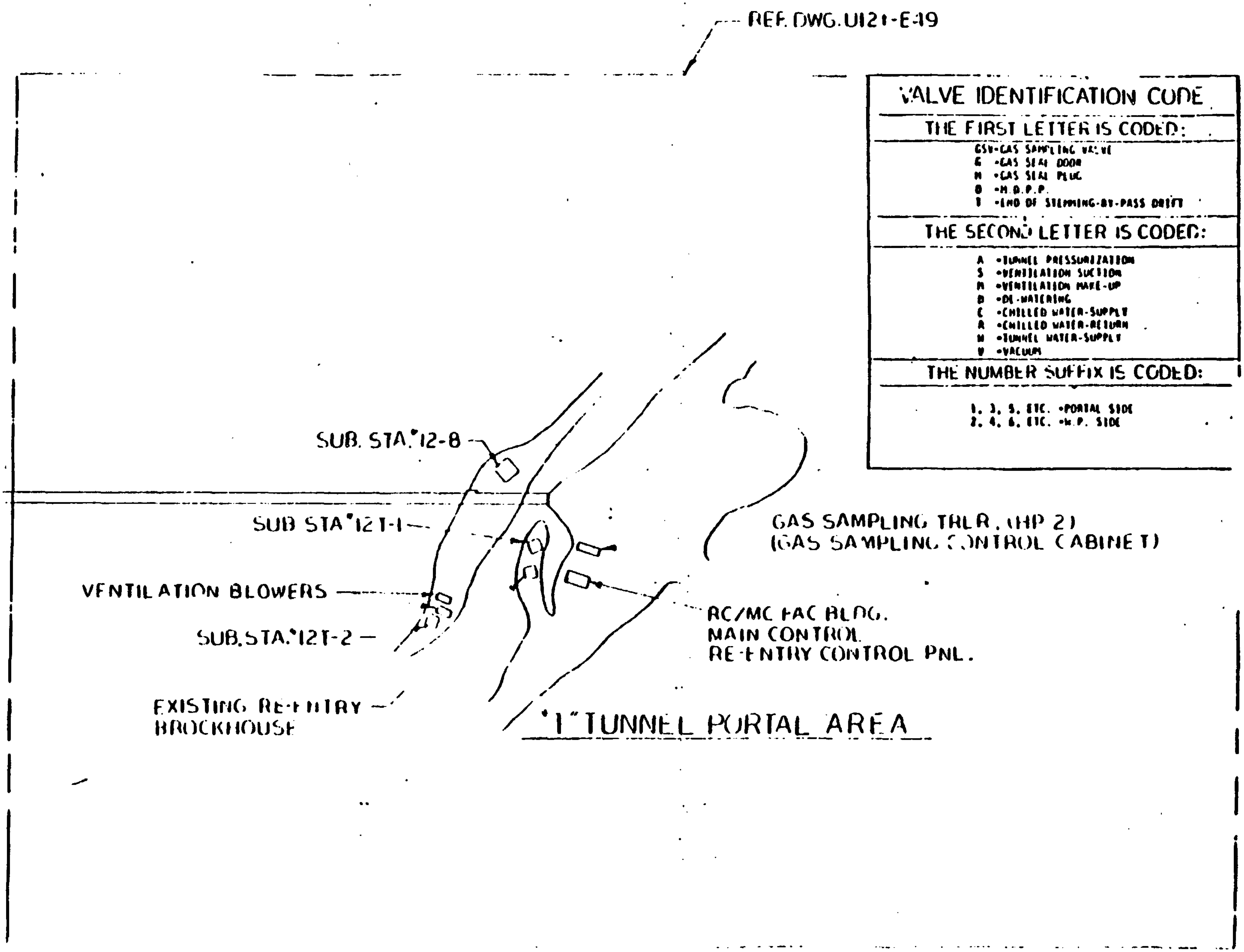
BROWN, DAVID M.
COOK, JAMES B.
PARISH, HAROLD B.
CHAPMAN,DENNIS
WOODWARD, FORREST J.
WESCOATT, EARL E.

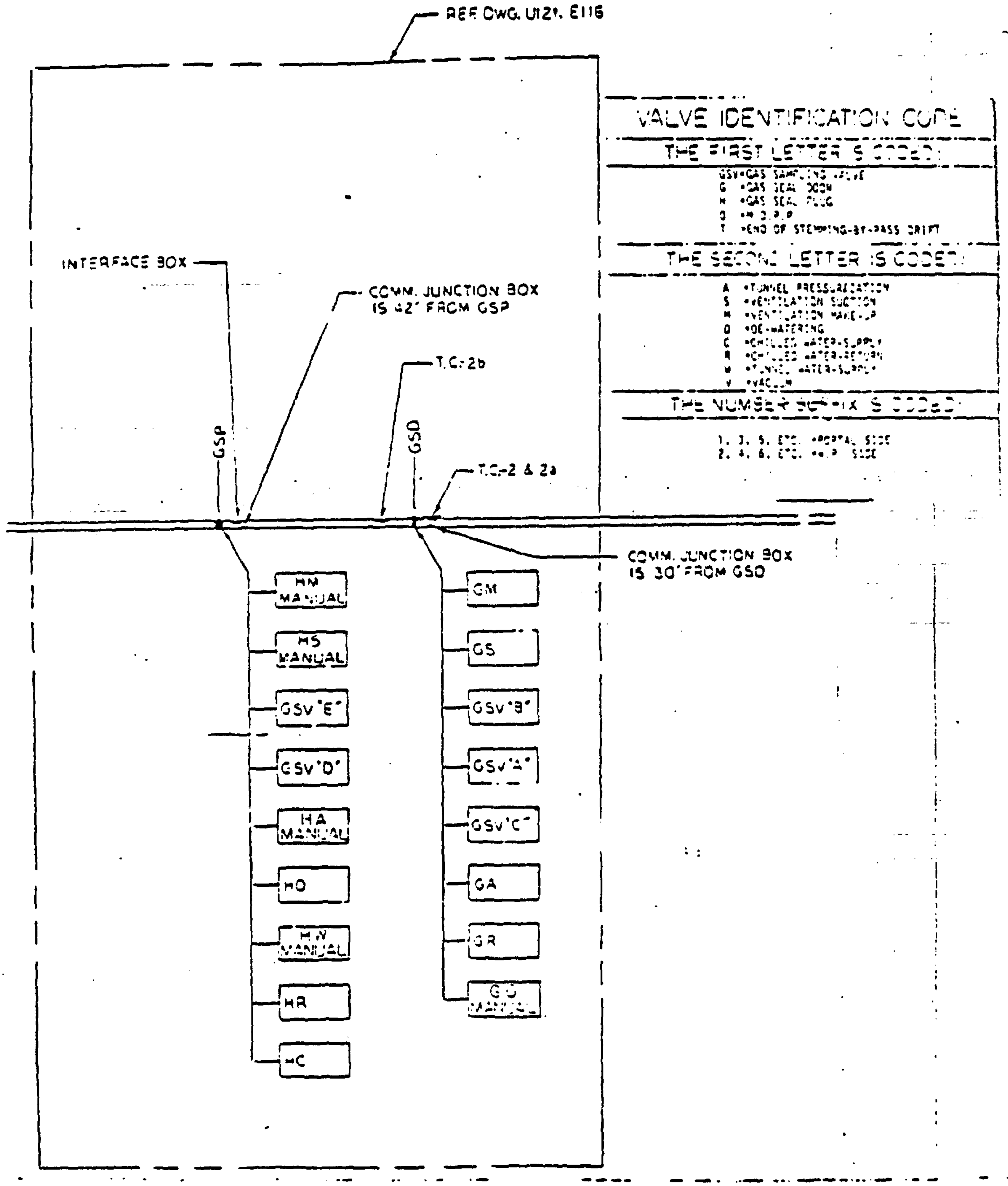
CARPENTERS
BAIN, R. C.
BUSHELL,B.B.
GIDDENS, CHARLES
FIELDS, ROBERT

FITTERS

DUENHOG, STEPHEN L.
AMIE, WILLIE H.
JARMALILLO, FRANK T.
VANCE, DEWEY C.
DILLWITH, ERNEST J.
PARRISH, SAM E.

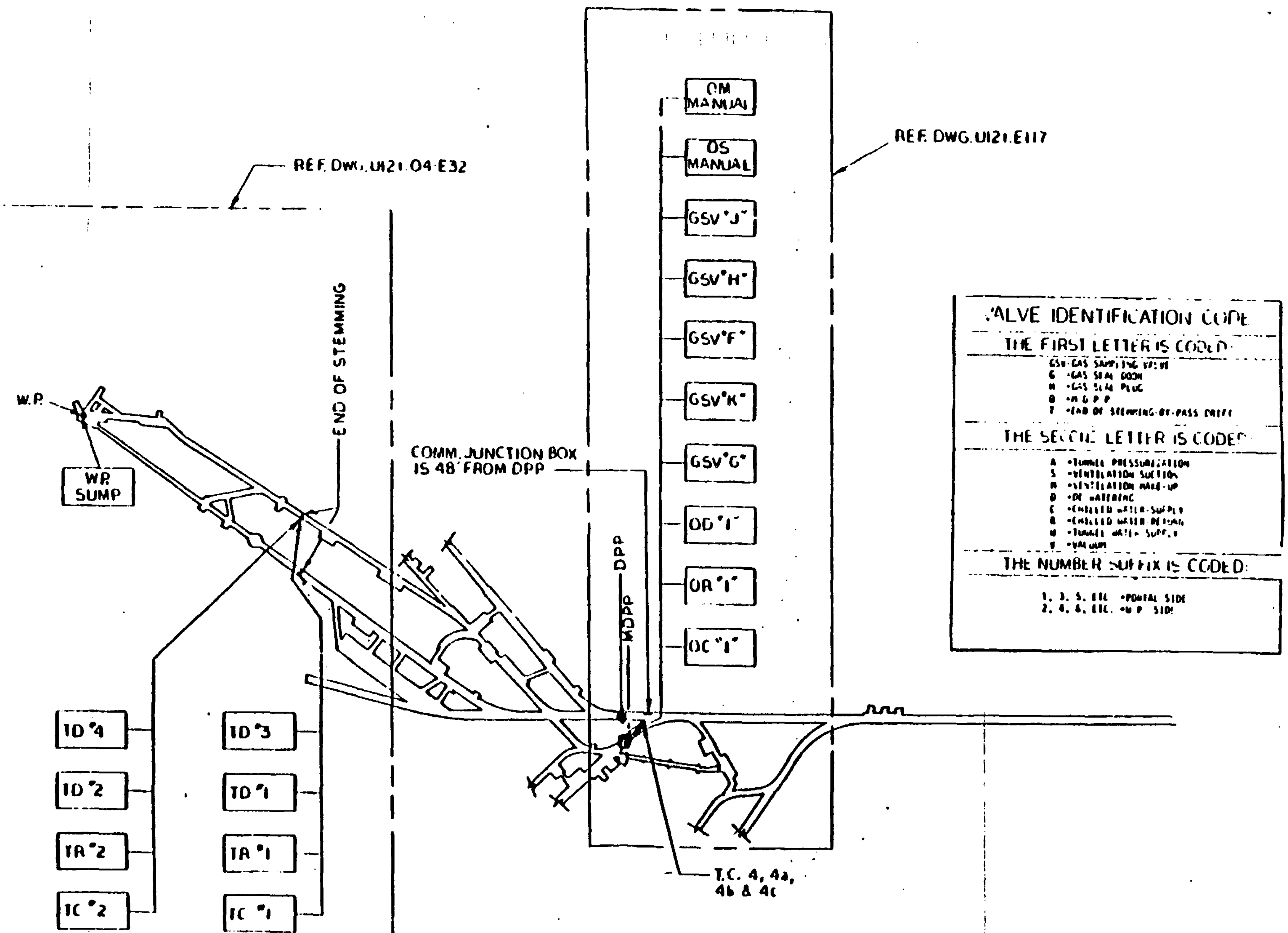
Incl 1


REF. DWG. U12t-E49
VALVE IDENTIFICATION CODE
THE FIRST LETTER IS CODED:
GSV-GAS SAMPLING VALVE
G -GAS SEAL DOOR
H -GAS SEAL PLUG
D -H.D.P.P.
T -END OF STEMMING-BY-PASS DRIFT
THE SECOND LETTER IS CODED:
A -TUNNEL PRESSURIZATION
S -VENTILATION SUCTION
M -VENTILATION MAKE-UP
D -DE-WATERING
C -CHILLED WATER-SUPPLY
R -CHILLED WATER-RETURN
W -TUNNEL WATER-SUPPLY
V -VACUUM
THE NUMBER SUFFIX IS CODED:
1, 3, 5, ETC. -PORTAL SIDE
2, 4, 6, ETC. -W.P. SIDE
SUB. STA. 12-8
SUB STA. 12T-1
VENTILATION BLOWERS
SUB. STA. 12T-2
EXISTING RE-ENTRY BROCKHOUSE
GAS SAMPLING TRLR. (HP 2)
(GAS SAMPLING CONTROL CABINET)
RC/MC FAC BLDG.
MAIN CONTROL
RE-ENTRY CONTROL PNL.
"T" TUNNEL PORTAL AREA



REF DWG. U129, E116
INTERFACE BOX
COMM. JUNCTION BOX IS 42' FROM GSP
T.C.-2b
GSP
GSD
T.C.-2 & 2a
COMM. JUNCTION BOX IS 30' FROM GSD
HM MANUAL
HS MANUAL
GSV "E"
GSV "D"
HA MANUAL
HD
HW MANUAL
HR
HC
GM
GS
GSV "B"
GSV "A"
GSV "C"
GA
GR
GD MANUAL
VALVE IDENTIFICATION CODE
THE FIRST LETTER IS CODED:
GSV=GAS SAMPLING VALVE
G =GAS SEAL DOOR
H =GAS SEAL PLUG
T =END OF STEMMING-BY-PASS DRIFT
THE SECOND LETTER IS CODED:
A =TUNNEL PRESSURIZATION
S =VENTILATION SUCTION
M =VENTILATION MAKE-UP
D =DE-WATERING
C =CHILLED WATER-SUPPLY
R =CHILLED WATER-RETURN
W =TUNNEL WATER-SUPPLY
V =VACUUM
THE NUMBER SUFFIX IS CODED:
1, 3, 5, ETC. =PORTAL SIDE
2, 4, 6, ETC.

Incl 1


REF. DWG. U121.04.E32
REF. DWG. U121.E117
CM MANUAL
OS MANUAL
GSV "J"
GSV "H"
GSV "F"
GSV "K"
GSV "G"
OD "1"
OR "1"
OC "1"
W.P.
W.P. SUMP
END OF STEMMING
COMM. JUNCTION BOX IS 48' FROM DPP
DPP
MDPP
TD #4
TD #2
TR #2
TC #2
TD #3
TD #1
TR #1
TC #1
T.C. 4, 4a, 4b & 4c
VALVE IDENTIFICATION CODE
THE FIRST LETTER IS CODED:
THE SECOND LETTER IS CODED:
THE NUMBER SUFFIX IS CODED:

INCL 1

HAZARDOUS MATERIAL QUANTITY SUMMARY

(Supplemental)

Contains revised totals as of 31 January 1984

Type of Hazard	TC #0	TC #1	TC #2	SGEMP SCT.	OUTSIDE HLOS Pipe
EXPLOSIVE:					
HNS		0.780g			
Holex #72					200.000mg
HNS & HNAB		21.600g			
Di-Nitrol-Phenol					120.000mg
TOXIC:					
Beryllium	0.075kg	0.991kg	24.400g		0.735kg
Teflon		2.936kg			
RADIOACTIVE:					
D38		69.520kg	6.416kg		3.000g
H3	Deleted	3Ci			
Th		1.000g			1.500g
U235					5.000mg
U238					2.000g
ELECTRICAL:					
Capacitors	6 @ 6.0kV	3 @ 6.0kV			
NC Timers	12 @ 2.5kV				
Sprytrons	36 @ 3.0kV				
Neutron Detectors		3 @ 2.5kV			
Power Supply					2000V
Filament				160V/60A	
Batteries				6 "D" $LiSO_2$	
MECHANICAL:		Spring Loaded Doors, STUs			
PRESSURE:					
N_2 Bottles					12 @ Hi Pressure Alcove 5 @ SGEMP Alcove 2 @ 20" Stub btw'n 1st @ 2nd shield walls 2 @ rt. rib adj. TC-1
Freon					Adjacent to chillers, inside or near most ROSES

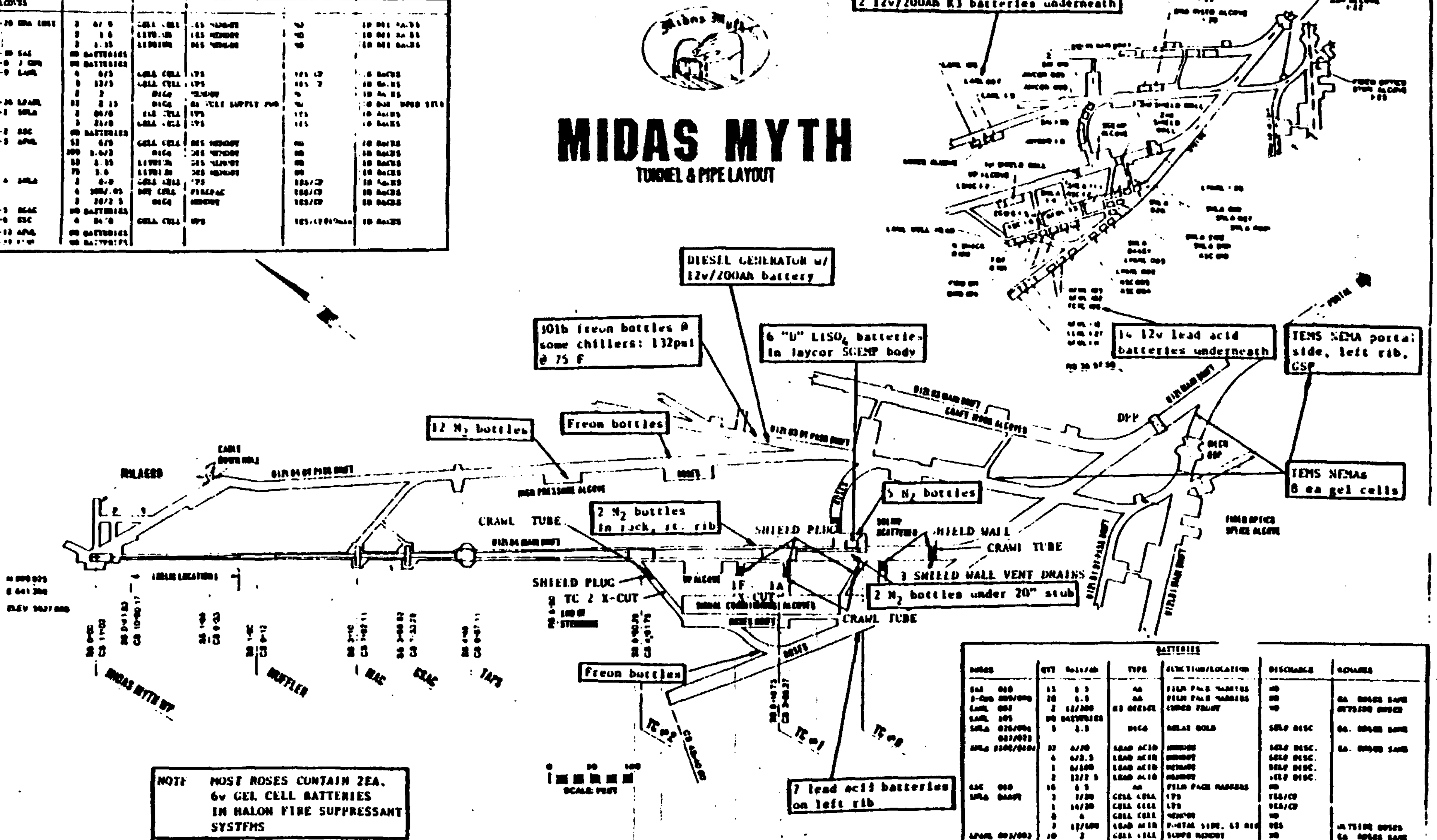
Incl 2

UNCLASSIFIED

ALCOVES	QTY Volts/ah	TYPE	FUNCTION	DISCHARGE	REMARKS
1-20 [illegible]	3 6/9	GELL CELL	[illegible] MEMORY	NO	10 [illegible]
	3 1.5	LITHIUM	[illegible] MEMORY	NO	10 [illegible]
	3 1.35	LITHIUM	[illegible] MEMORY	NO	10 [illegible]
1-[illegible] SAL	NO BATTERIES				
1-0 J CUB	NO BATTERIES				
1-0 LAML	6 6/3	GELL CELL	UPS	YES CP	10 [illegible]
	3 12/3	GELL CELL	UPS	YES [illegible]	10 [illegible]
	2 2	NICd	MEMORY	[illegible]	10 [illegible]
1-20 SPAML	83 2.15	NICd	[illegible] SUPPLY [illegible]	[illegible]	[illegible]
1-1 SPLA	3 [illegible]	GEL CELL	UPS	YES	10 [illegible]
	3 [illegible]	GELL CELL	UPS	YES	10 [illegible]
1-2 ESC	NO BATTERIES				
1-3 APML	53 6/9	GELL CELL	[illegible] MEMORY	NO	10 [illegible]
	100 [illegible]	NICd	[illegible] MEMORY	NO	10 [illegible]
	50 1.35	LITHIUM	[illegible] MEMORY	NO	10 [illegible]
	75 3.0	LITHIUM	[illegible] MEMORY	NO	10 [illegible]
1-4 SPLA	3 6/0	GELL CELL	UPS	YES/CP	10 [illegible]
	6 [illegible]	DRY CELL	FIREPAC	YES/CP	10 [illegible]
	3 [illegible]	NICd	MEMORY	YES/CP	10 [illegible]
1-5 GCAC	NO BATTERIES				
1-6 ESC	6 [illegible]	GELL CELL	UPS	YES/CP [illegible]	10 [illegible]
1-13 APML	NO BATTERIES				
[illegible]	NO BATTERIES				

MIDAS MYTH

TUNNEL & PIPE LAYOUT



NOTE MOST ROSES CONTAIN 2EA. 6v GEL CELL BATTERIES IN HALON FIRE SUPPRESSANT SYSTEMS

UNDERGROUND HAZARDS LOCATIONS

BATTERIES

ROSES	QTY Volts/ah	TYPE	FUNCTION/LOCATION	DISCHARGE	REMARKS
SAL 010	13 1.5	AA	FILM PACK MARKERS	NO	
J-CUB [illegible]	20 1.5	AA	FILM PACK MARKERS	NO	EA. ROSES SAME
LAML [illegible]	2 12/200	R3 DIESEL	UNDER TRAILER	NO	OUTSIDE ROSES
LAML 105	NO BATTERIES				
SPLA 026/006 017/022	5 1.5	NICd	RELAY HOLD	SELF DISC	EA. ROSES SAME
SPLA [illegible]	32 6/30	LEAD ACID	MEMORY	SELF DISC.	EA. ROSES SAME
	4 6/2.5	LEAD ACID	MEMORY	SELF DISC.	
	1 6/100	LEAD ACID	MEMORY	SELF DISC.	
	2 12/2.5	LEAD ACID	MEMORY	SELF DISC.	
ESC 010	16 1.5	AA	FILM PACK MARKERS	NO	
SPLA [illegible]	3 7/20	GELL CELL	UPS	YES/CP	
	1 14/20	GELL CELL	UPS	YES/CP	
	6 6	GELL CELL	MEMORY	NO	
	3 12/100	LEAD ACID	PORTAL SIDE, LT RIB	YES	OUTSIDE ROSES
APAML 001/002	20 2	GELL CELL	SCOPE MEMORY	NO	EA. ROSES SAME
	2 30	LEAD ACID	COMPUTER BACKUP	NO	
	1 1.5	DRY CELL	MEMORY	NO	
	1 12	LEAD ACID	RECOVERY SYSTEM	NO	
APML 101/102	27 1.5	AA	FILM PACK MARKERS	NO	EA. ROSES SAME
PETC 100	14 12	LEAD ACID	UPS	YES	OUTSIDE ROSES
ESC 005/006	18 1.5	AA	FILM PACK MARKERS	NO	EA. ROSES SAME
DNB/LLNL 104	NO BATTERIES				
[illegible] 011	NO BATTERIES				NO FIREPAC
TAF 104	1 6/0	GELL CELL	UPS, [illegible]	SELF DISC.	[illegible]
[illegible] 100	NO BATTERIES				

INCLOSURE 2

DATA RECOVERY TEAMS

TEAM A

HESSLER, Lynn [illegible] (1) (DNA)
(F) McDOWELL, Elizabeth (ES)
McNEILL, Berry (IH)
MONTOYA, T. (REECo Miner)

BMO ROSES 104
MAUS, Charles
NETOLICKY, Kenneth

KSC ROSES 004, 005, 010
PIXLER, Jerry
RAMOS, Thomas J.
SEDRIST, Dale A.

AFWL ROSES [illegible]
SLAUGHTER, Cecil
(F) MANTHEI, Debra
BRABHAM, Odis

TEAM B

HENDRICKSON, Thomas H. (1) (DNA)
[illegible], Craig (ES)
FOLEY, Jim (IH)
[illegible], P. (REECo Miner)

FCTC CAMERA
[illegible], Art

LPARL STUBS (2) and ROSES [illegible]
SALISBURY, Stan
PRONKO, John
FISHER, Robert
CHALMERS, Robert
SHEETS, Ray

SNLA ROSES F001, 022, 026, 027
YUKUBOUSKI, Albert F.
THOMAS, Kelly D.
MAGILL, Donald L.
KRAEMER, Kenneth L.
MILLER, Gary D.
LUCAS, Clifford D.

TEAM C

MARTIN, Charles R. (1) (DNA)
FANNING, Theodore (ES)
BOONE, Carl (IH)
WEISSENBERGER, P. A. (REECo Miner)

SAI ROSES 008, 009, 013, ALCOVE 1-26
MILLONES, Lawrence A.
WINN, Cleo G.
WOODWARD, Doyle E.
MIDDLETON, Gary T.
GOULDING, Luther J.
MUNIZ, Nelson J.
BORTH, Steven B.

LANL ROSES 105, 007
WHALEN, Dennis A.
O'CONNER, Michael
MERKEL, Edward

NOTES:

(1) Denotes team leader.

(2) LPARL will recover time dependent experiments. These will be inventoried, double bagged and brought to Area 12 SRC compound for shipment.

(3) FCTC ([illegible] Gabrial) will recover Scratch Gages from locations not yet determined. He will join Team A, B, or C as appropriate.

Incl. 3

EXHIBIT 10

EXHIBIT 11

STATE OF NEVADA — DEPARTMENT OF HUMAN RESOURCES
DIVISION OF HEALTH — SECTION OF VITAL STATISTICS
CERTIFICATE OF DEATH

Ex. 9

003681

[redacted] A. [redacted] Clark

Las Vegas | Southern Nevada Memorial Hospital | Yes | Inpatient

White | American [redacted] [redacted]

[redacted] U.S.A. [redacted] Yes

[redacted] Electrician | Electrical Co.

Nevada | Clark | Las Vegas [redacted] [redacted]

Charles A. Miesch Sr. [redacted]

[redacted] [redacted]

Removal | Sacred Heart Cemetery | Texarkana, Texas

[redacted] Palm Mortuary 1325 W. Main St. Las Vegas, Nevada 89101

[redacted]

3-7-84 | 2:30 A.M.

3-4-84 | 2:30 A.M.

Corrie L. May, M.D. - Deputy Med. Examiner - 1704 Pinto Lane, Las Vegas, Nev.

[redacted] MAR 7 1984

Complications of multiple injuries

Yes | Yes

Accident | Feb. 15, 1984 | Approx. 11:30 A. | Collapse of ground following explosion

Yes | Test Site | Area 12, Test Site, Nye County, Nev.

46585

VITAL RECORDS

"CERTIFIED TO BE A TRUE AND CORRECT COPY OF THE DOCUMENT ON FILE WITH THE REGISTRAR OF VITAL STATISTICS, STATE OF NEVADA." This copy was issued by the Clark County Health District from State certified documents as authorized by the State Board of Health pursuant to NRS 440.175.

NOT VALID WITHOUT THE RAISED SEAL OF THE CLARK COUNTY HEALTH DISTRICT

OTTO RAVENHOLT, M.D.
Registrar of Vital Statistics

MAR 8 1984

CLARK COUNTY HEALTH DISTRICT
625 Shadow Lane P.O. Box 4426
Las Vegas, Nevada 89127
702-383-1223

EXHIBIT

11

EXHIBIT 12

Control No. 83-18
Annex to
NTS-SOP-APPENDIX USOl
Part I-A

SAFETY AND HEALTH COORDINATION
(EXCEPT RADIOLOGICAL SAFETY)
TRANSFER OF RESPONSIBILITY

A. Pursuant to NTS-SOP-USOl, responsibility for safety and health coordination for the area, facility, site, or operation described as:
MIDAS MYTH - "T" tunnel

is assigned/~~returned~~

to: Major Jerry D. Wilcox USAF

from: REECo

effective (date): October 1, 1983 time 0800 a.m./~~p.m.~~

Date: 11-10-83 F. R. [signature]
NTS Support Office

Date: 15 Nov 83 Jerry D. Wilcox
Test Group Director

B. Occupational safety and health coordination responsibility for the above area is returned to: __________

effective (date): __________ time ______ a.m. p.m.

Date: __________ __________
NTS Support Office

Date: __________ __________
Test Group Director

NOTE: This form is to be completed in duplicate and sent to the organization accepting responsibility. One signed copy is to be returned to the Director, NTSSO. Copies should then be sent to other interested organizations.

Revised:
PO59A-1

EXHIBIT
12

EXHIBIT 13

Annex to
NTSO-SOP-APPEND 0501
Part I-8

DELEGATION OF RADIOLOGICAL SAFETY COORDINATION RESPONSIBILITY

DELEGATION TO TGD

Pursuant to Section 0524-012 of the NTSO-SOP, Radiological Safety Responsibility for the GZ Area is delegated to the LANL Test Group Director on 2/1/84.

Test Name MILAGRO/MIDAS MYTH Location U12t.04

Chief, Coordination Branch, NV 2/1/84 (Date)

Accepted By: Walter P. Wolff 2/1/84
Test Group Director (Date)

RETURN TO DOE

Radiological Safety Responsibility for the above area is requested to be returned to the Manager, NV, on 2/15/84

Test Group Director (Date)

Accepted By:
Chief, Coordination Branch, NV (Date)

EXHIBIT

13

Revised: February 5, 1982
P059A-10

Annex to
NTSO-SOP-APPENDIX 0501
Part I-8

DELEGATION OF RADIOLOGICAL SAFETY COORDINATION RESPONSIBILITY

DELEGATION TO TGD

Pursuant to Section 0524-012 of the NTSO-SOP, Radiological Safety Responsibility for the GZ Area is delegated to the D.N.A. Test Group Director on February 15, 1984.

Test Name MIDAS MYTH/MILAGRO Location U12t.04

Chief, Coordination Branch, NV 2/15/84 (Date)

Accepted By: Test Group Director 2/15/84 (Date)
Maj. J. D. Wilcox

RETURN TO DOE

Radiological Safety Responsibility for the above area is requested to be returned to the Manager, NV, on ______________________

Test Group Director (Date)

Accepted By: Chief, Coordination Branch, NV (Date)

EXHIBIT 14

EXHIBIT 14

MIDAS MYTH yield determined to be less than 20 kt by LLNL.

EXHIBIT 15

EXHIBIT 15

MIDAS MYTH yield determined to be less than 20 kt by Sandia Laboratories Seismic Net.

EXHIBIT 16

FENIX & SCISSON, INC.
P. O. BOX 498
MERCURY, NEVADA 89023

ADDRESS REPLY TO: TES-4333 14 March 1984

MEMORANDUM

TO: J. W. LaComb

FROM: D. R. Townsend

SUBJECT: PRELIMINARY DATA REPORT ON THE SURFACE EFFECTS OF THE MIDAS MYTH/MILAGRO (U12t.04) EVENT

INTRODUCTION

The MIDAS MYTH/MILAGRO event was detonated at 0900 hours Wednesday, 15 February 1984. The WP (Working Point) of the low-yield nuclear test was located 361 m beneath the surface of Aqueduct Mesa in the U12t.04 tunnel complex (fig. 1). The surface effects from the event were documented in two stages: before and after the surface subsidence. Pre- and post-event survey data help define the changes in topography. A brief summary of the results of the preliminary investigations is also included in this report.

PRE-SUBSIDENCE OBSERVATIONS

At 1115 hours on the day of the detonation, the geologic staff arrived at the MILAGRO cable hole pad and began to document the surface effects of the explosion.

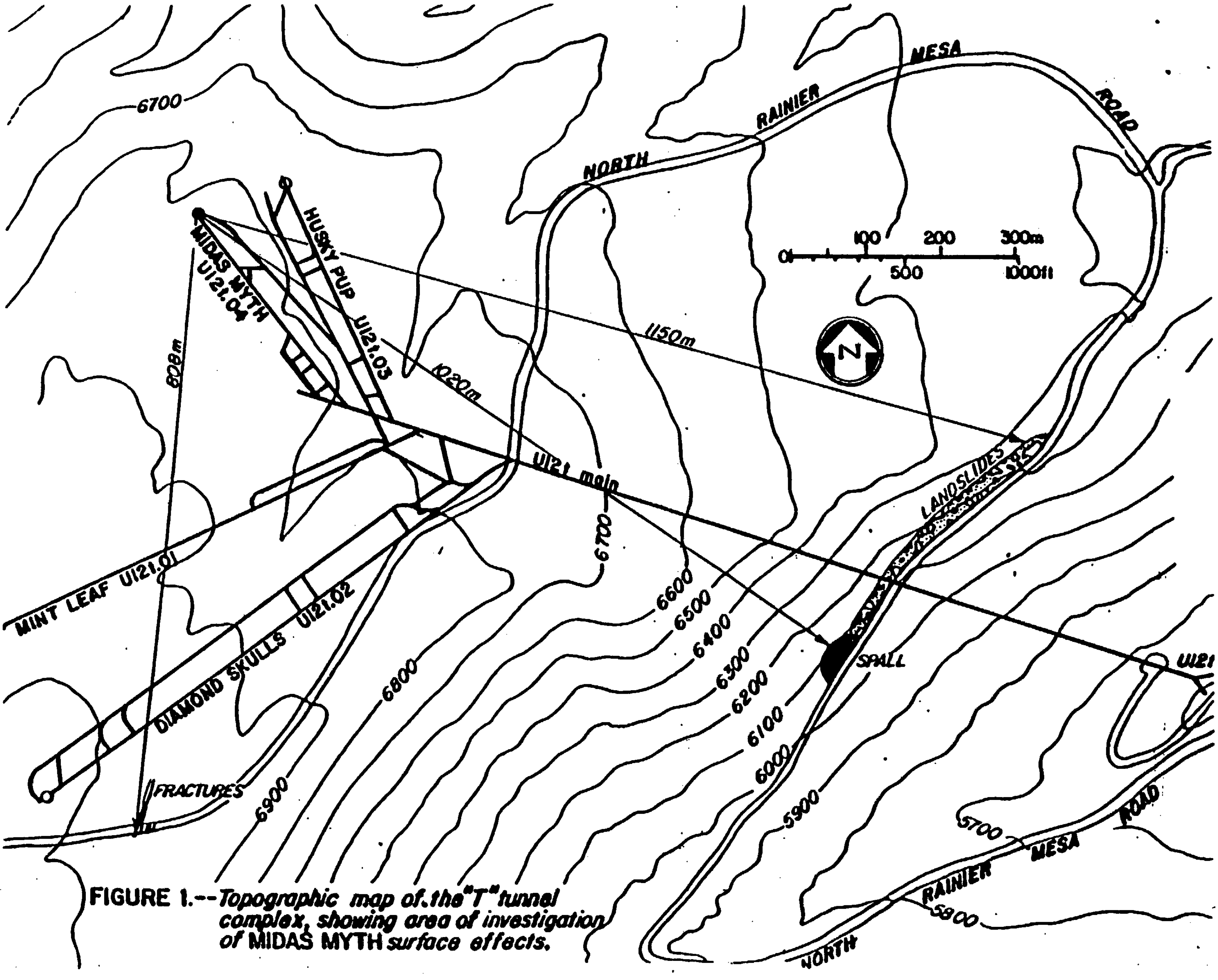


FIGURE 1.--*Topographic map of the "T" tunnel complex, showing area of investigation of* MIDAS MYTH *surface effects.*

A preliminary reconnaissance of the area indicated the absence of any widespread cracking or geologically related features such as faults with large vertical displacements. The MILAGRO cable hole pad was dissected by many randomly-oriented fractures similar to those seen on prepared surfaces above other underground nuclear explosions (fig. 2, Photo A). The area around SGZ (Surface Ground Zero) contained a small number of fractures, generally without vertical displacements, and with lengths less than five meters. The surface colluvium around SGZ was dislocated, a feature referred to as "disturbed ground." No obvious surface subsidence had occurred at this time.

A fracture zone with a length of approximately 95 m was traced towards the northwest, from the northwest edge of the MILAGRO pad. No significant fracturing was noted along the surface trace of projected Fault #3 (fig. 3, folded). In addition, widespread areas of disturbed ground were noted northeast and southeast of SGZ. But no additional faults or linear, continuously-cracked zones were noted in the area.

The North Rainier Mesa Road was blocked by landslides and rock spall above the "T" Tunnel portal area. Several large boulders of welded tuff (Rainier Mesa Member of the Timber Mountain Tuffs) caused minor damage to the "T" Tunnel portal facilities (fig. 2, Photo B). The upper section of the road, approximately 1150 m from SGZ, was blocked by material from the colluvial layer, as

PHOTO A.-North-south trending crack on the *MILAGRO* pad, prior to surface subsidence.

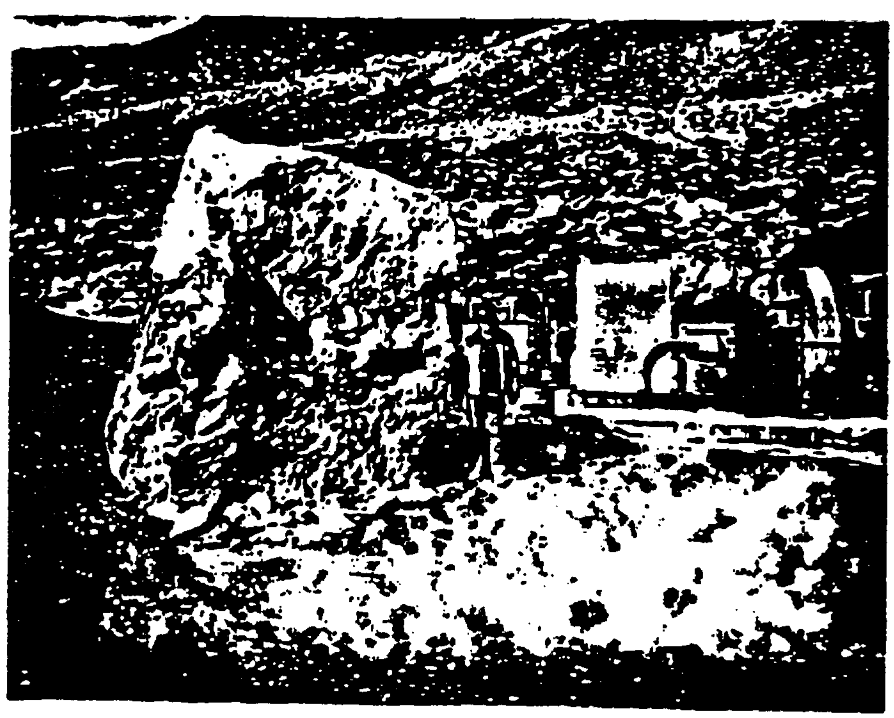


PHOTO B.-Large boulder of welded tuff on ventilation pad approximately 25m above the "T" tunnel portal.

FIGURE 2.--*Surface effects from the MIDAS MYTH event.*

shown on Figure 1 and Figure 4, Photo C. The lower blockage, 1020 m from SGZ, occurred as a result of the spall of large blocks of partially welded tuff, as shown on Figure 4, Photo D. Rock falls have occurred along this section of North Rainier Mesa Road following other detonations in the area.

At approximately 1215 hours surface subsidence occurred in the area of SGZ and the MILAGRO trailer park. Due to injuries and the uncertainty of ground stability, further investigation of the surface effects was temporarily suspended.

POST-SUBSIDENCE OBSERVATIONS

Observation of the collapse area from a helicopter was attempted on the following day. However, high winds forced the cancellation of the mission. It was decided to examine the MILAGRO pad on foot, and a party was dispatched to the mesa. Blizzard-like conditions forced the party to make only a very brief reconnaissance of the area. Several interesting observations were made, however: 1) The center of the resultant crater appeared to be on the MILAGRO pad at a distance of approximatley 30 m east of SGZ. 2) There were no linear (north-south) fractures extending away from the area as would be expected if the collapse had occurred along a preexisting structural feature such as a fault.

An aerial photographic survey was flown over the "T" Tunnel area on Saturday, 18 February. The photographs from the survey were

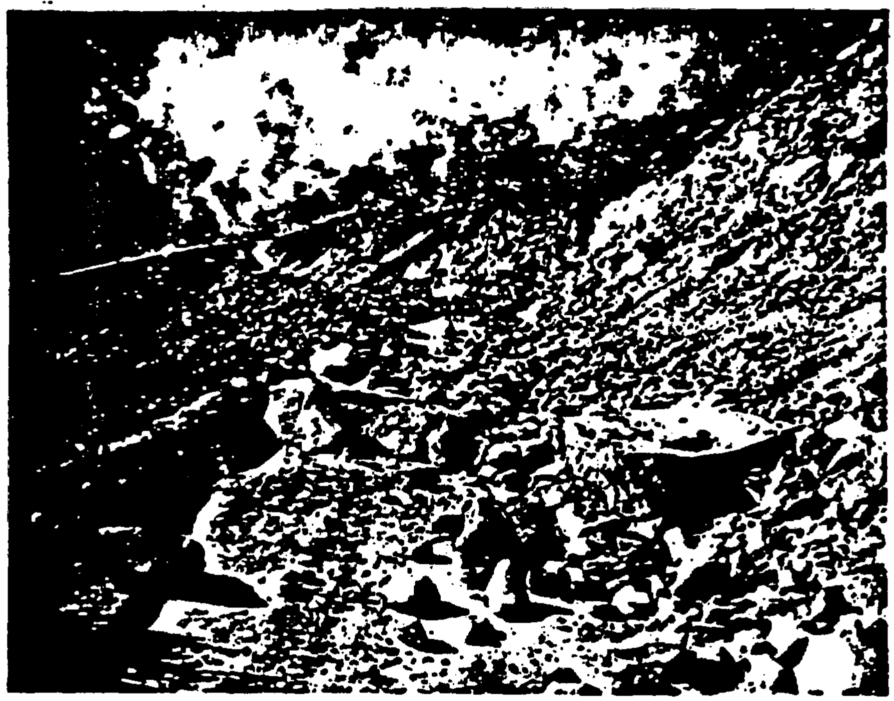


PHOTO C.—Landslide debris from the colluvial layer 1150m from SGZ. View looking southwest.

PHOTO D.—Rock spalled from the partially-welded Rainier Mesa Member. View looking northeast.

FIGURE 4.—*Damage to the North Rainier Mesa Road.*

utilized to perform the post-event mapping. However, these photographs are of marginal quality because of the snow cover and poor stereo coverage.

No further attempts were made to examine the surface effects on the mesa until Wednesday, 22 February.

To help simplify and clarify the presentation of the post-subsidence surface effects data, the discussions of the investigations have been subdivided into geographic areas.

1. OUTLYING AREAS

Initial observations indicated a lack of widespread fracturing. However, several fractures were mapped crossing the road in the vicinity of the DIAMOND SCULLS (U12t.02) SGZ, at a distance of 808 m from the MIDAS MYTH SGZ. These fractures parallel a fault mapped following the DIAMOND SCULLS event (1972), and this trend is represented as Surface Fault #2 (fig. 3). No other new cracks were mapped along the northward projection of Surface Fault #2. Other large surface cracks northeast of the DIAMOND SCULLS SGZ (DIAMOND SCULLS cracks) were not reactivated during the MIDAS MYTH event.

Random "hairline" cracking was mapped at several locations on roads and on the "T" Main Pad. None of these are thought to be fault-related. No cracking was mapped along the surface trace of

Surface Fault #1 (fig. 3).

Spalling of the welded-tuff caprock was mentioned above in the discussion of the North Rainier Mesa Road damage. Spalling also occurred at several other locations. On the north side of Aqueduct Canyon, approximately 275 m northwest of MIDAS MYTH SGZ, a large area of welded tuff spalled off into the canyon (fig. 5, Photo E). However, this area has also been disrupted by earlier events. Spall also occurred along the south edge of Aqueduct Canyon, approximately 150 to 180 m west of SGZ. Other spall zones will be discussed in the following sections.

2. MILAGRO TRAILER PARK PAD

Cracking on the MILAGRO pad can be subdivided into two types: First, the apparently randomly-oriented cracks produced by the event; and second, the concentric fractures produced or enhanced by the subsidence. Figure 6 (page size and folded) illustrates the relationships of the major cracks on the prepared surface. It should be noted that the area under and between the trailers was never directly examined following the collapse. The few fractures shown in the trailer area were mapped from aerial photographs.

Some of the non-concentric fractures have a west-northwest trend which parallels the trends of other fractures formed off the pad. Figure 5, Photo F shows a typical view of non-subsidence-related

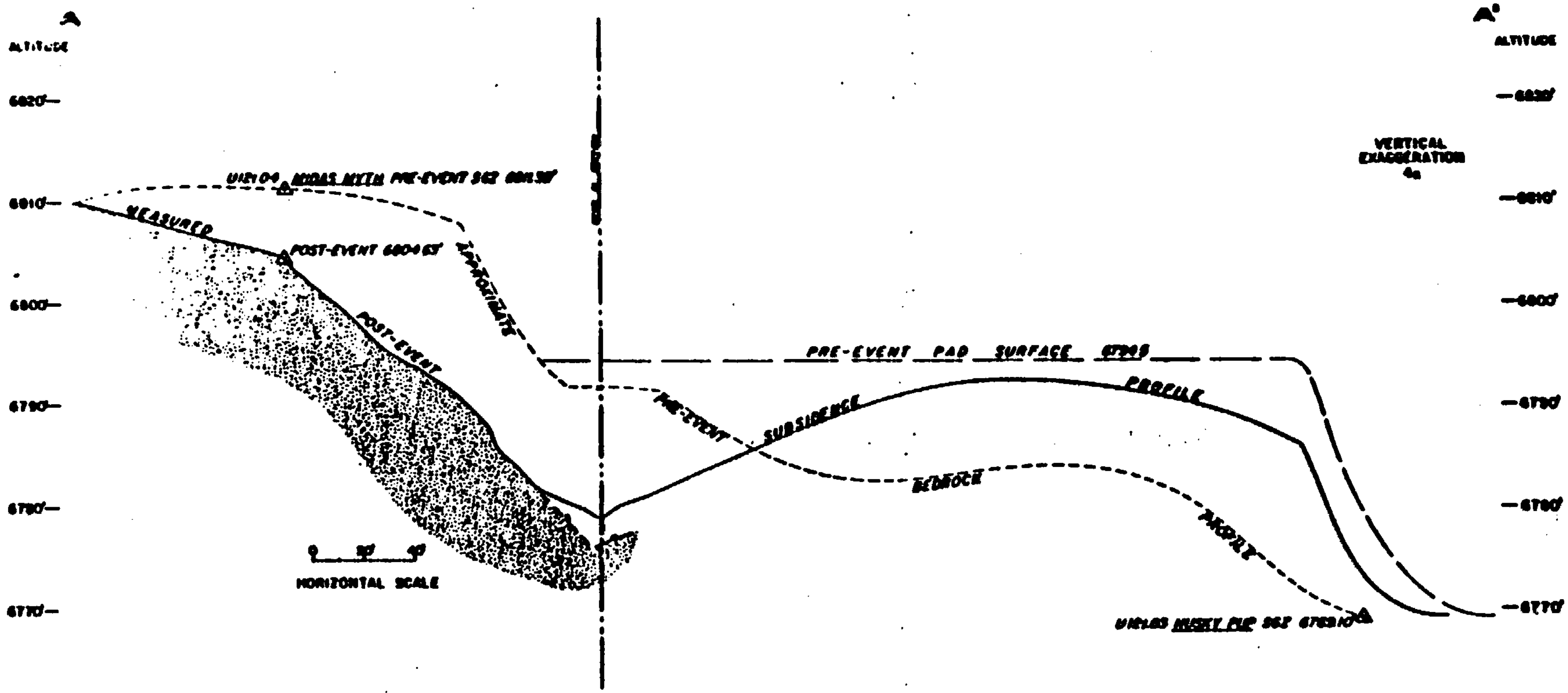


FIGURE 8.--*Cross section through MIDAS MYTH SGZ–subsidence crater–HUSKY PUP SGZ, showing pre-vs post-event topography.*

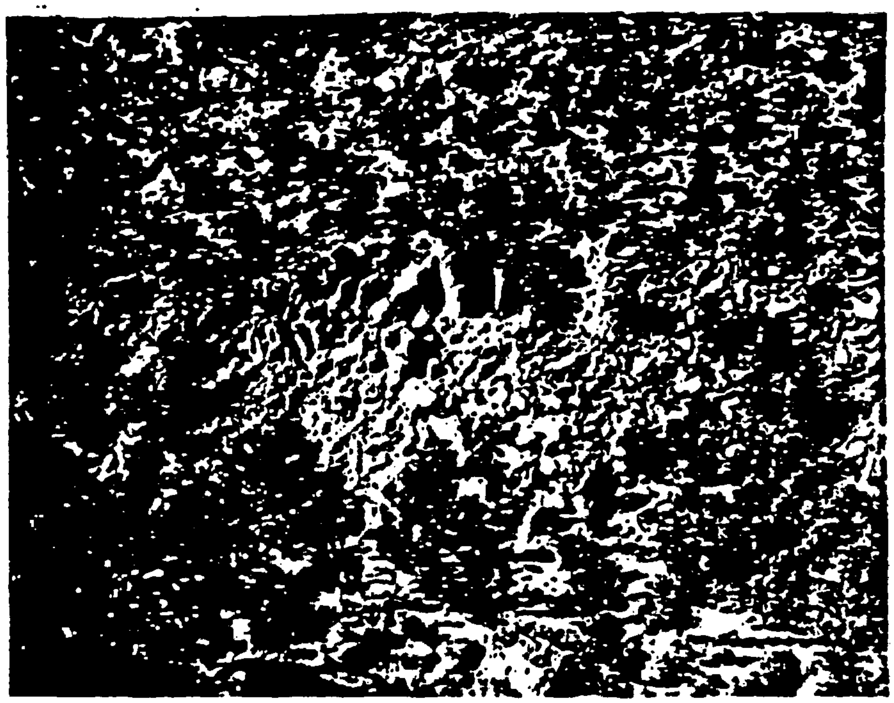


PHOTO E.– Isolated spall zone 275m northwest of SGZ (across Aqueduct Canyon).

PHOTO F.– Non-subsidence-related cracks on the *MILAGRO* pad. View looking west.

FIGURE 5.--*Surface effects from the MIDAS MYTH event.*

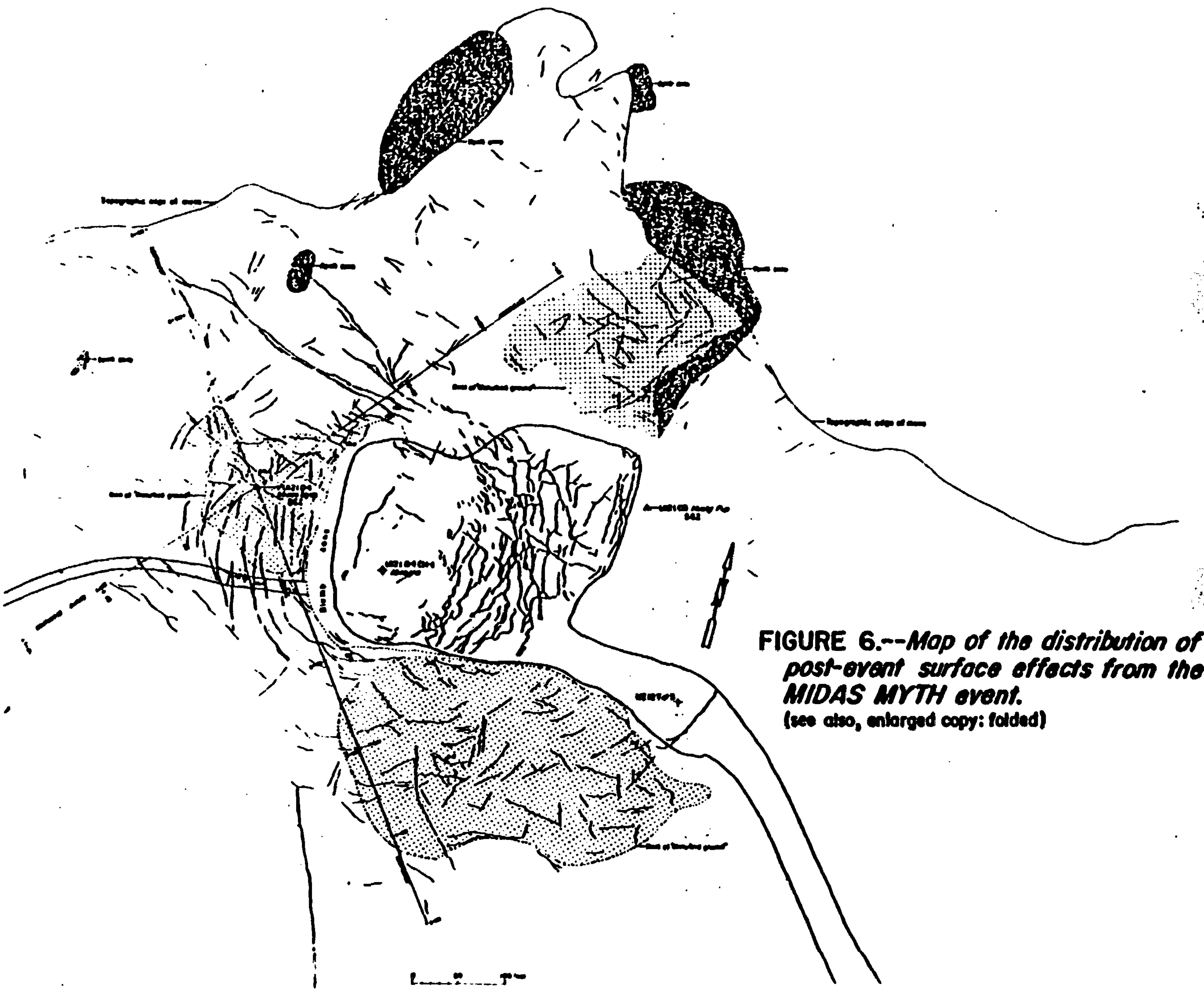


FIGURE 6.--*Map of the distribution of post-event surface effects from the MIDAS MYTH event.*
(see also, enlarged copy: folded)

cracks developed on the pad. These cracks are open from 1 to 50 mm, are nearly vertical, and generally are less than 0.3 m deep. The subsidence-related cracks trend north-south on the pad, and begin to curve slightly at the extremities (fig. 6). These cracks are irregular in form, probably because they were north-south oriented, pre-collapse fractures (fig. 2, Photo A) that have been enhanced by the subsidence. Photo G on Figure 7 shows a typical subsidence-related fracture. These fractures are open up to 0.6 m, have depths of over 3 m, and tend to dip away from SGZ.

The resultant surface expression of the subsidence crater is roughly circular, with a radius of approximately 50 m. Because of the irregular pre-event topography, the apparent low point of the subsidence is located 40 m east (S84°E) of SGZ. The difference (pre- vs post-event) in elevation at this point is 4.68 m. However, the actual point of greatest subsidence could be somewhat closer to SGZ; but due to lack of pre-event topographic data, the actual differences in elevation are uncertain.

The MILAGRO pad was constructed by cutting the west edge and filling towards the northeast. The cross sections shown on Figure 8 relate pre-event and post-collapse topography along an east-west line through the MIDAS MYTH and HUSKY PUP SGZs. The artificially-created slope between the pad and SGZ sustained only minor damage because of initial surface motion, but during the subsidence, slumping occurred on the slope causing a minor

PHOTO G.–Subsidence-related, north-south trending crack across the *MILAGRO* pad (compare to figure 2, photo A)

PHOTO H.–Slumping and rockfall across west edge of *MILAGRO* pad. View looking north.

FIGURE 7.--*Subsidence-related features on the MILAGRO pad.*

rockfall onto the pad. No individual displacement planes (faults) were mapped along the slope following the subsidence (fig. 7, Photo H).

3. SGZ AND THE AREA WEST OF THE MILAGRO PAD

Three types of surface effects have been mapped in this area. On Figure 6, the north-south-trending (subsidence-related) fractures are easily seen. These fractures curve around the south edge of the pad, but are indistinct towards the north. Slumping has also occurred along some fractures between SGZ and the artificial slope. Some of these fractures existed prior to the subsidence, but like the fractures on the pad, they have been extended and displaced by the secondary subsidence. The subsidence-related fractures are open up to 0.3 m, and have been measured to depths in excess of 5 m (fig. 9, Photo I). The west-northwesterly fracture trends, seen on the pad, also extend into this area. A study of the joint orientations near SGZ showed a pronounced north-south (10°) trend (fig. 10). The secondary trend appears to be N70-80°W, which agrees with the west-northwest fracture pattern. The jointing study also indicated a closer spacing on the north-south set (0.94 m, average; ranging from 0.3 to 1.6 m) than the west-northwest set (2.4 m, average; ranging from 1.5 to 3.1 m). The joint dips are generally vertical (most measurements within 5° of vertical).

The third type of surface effect seen in this area is disturbed

PHOTO I.—Subsidence-related crack located 6m southwest of the *MILAGRO* pad.

PHOTO J.—Disturbed ground in the vicinity of SGZ (man standing on SGZ). View looking w

FIGURE 9.—*Surface effects near the MIDAS MYTH SGZ.*

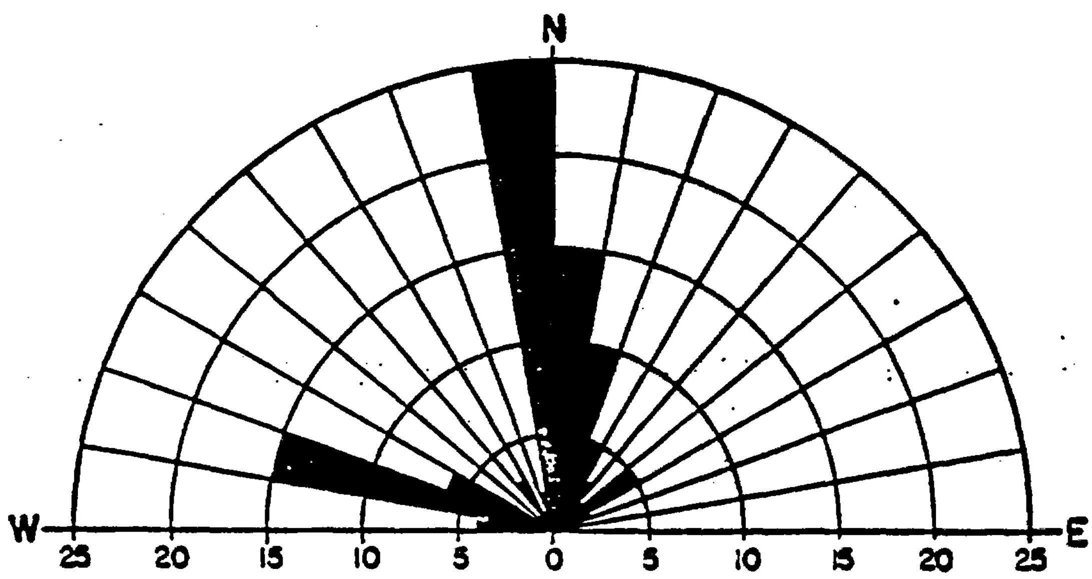


FIGURE 10.--*Rosette diagram of joint trends measured in caprock near the* MIDAS MYTH *SGZ*. (100 joints)

ground. Figure 6 shows the areal extent of the effect. It should be noted that within these zones only major fractures and fracture trends are plotted. This feature is characterized by overturned soil and rocks, many randomly-oriented cracks less than 1 m in length, and flat rocks which have been broken in half. Uprooted trees and bushes, and low, sinuous, ridge-like features which could be pressure ridges may also be present. Figure 9, Photo J shows the disturbed ground near SGZ. This effect is probably due to strong upward vertical acceleration.

4. THE AREA NORTH OF THE MILAGRO PAD

Concentric subsidence-related cracks are not well-documented north of the MILAGRO pad.

A system of west-northwest-trending fractures, exposed near the pad edge, has vertical displacments of up to 0.3 m and can be traced for a distance of over 100 m (fig. 6). This system is not thought to be fault-related, but rather a reflection of jointing within the caprock (fig. 11, Photo K). No major cracking was mapped along the projected trace of Surface Feature #3 (fig. 3). Several zones of spall and rock fall were mapped as shown on Figure 6. The severity of the rock spall due north of SGZ (122 m) was somewhat greater than that seen on recent Rainier Mesa events within the same yield range. Cracks up to 3 m in width were opened parallel to the topographic edge of the mesa (fig. 11, Photo L). Many large rocks were shattered by the force of

PHOTO K.- West-northwest trending fracture which follows joint orientation. Fracture open up to 0.3m. View looking northwest.

PHOTO L.- Rock spall and associated slumping 122m northeast of SGZ.

FIGURE 11.--*Surface effects mapped north of the MILAGRO pad.*

the ground motion. Rock fall and spall were not mapped at all locations along the mesa edge, but are confined to the areas shown on Figure 6. An area of disturbed ground was also seen northeast of the pad. The dislocating effects were confined to a small plateau area which is of slightly higher elevation than surrounding terrain.

5. THE AREA SOUTH OF THE MILAGRO PAD

A relatively large area of disturbed ground was mapped south of the MILAGRO pad. Some subsidence-related cracks were mapped near the pad edge, but the cracking pattern is somewhat random in this area. One long linear feature was mapped 100 m south of SGZ. Minor discontinuous cracking with no vertical displacements exists along the feature over a length of 67 m (fig. 6). Part of this crack system parallels a small topographic high. The true relationship of this feature to surface faulting is unknown. Long sinous mounds, previously referred to as pressure ridges, were also commonly seen in this area (fig. 12, Photo M).

6. THE AREA EAST OF THE MILAGRO PAD

This area is characterized by the nearly complete absence of mappable surface effects. A few hairline cracks, 1-2 mm in width, were mapped as shown on Figure 6. It should be noted that the HUSKY PUP (U12t.03) SGZ is located within this area, and the presence of its resultant chimney could have influenced the

PHOTO M.- An elongate, low ridge (pressure ridge?) mapped 150m southeast of SGZ.

FIGURE 12.--*Surface effects mapped south of the MILAGRO pad.*

surface effects from MIDAS MYTH. No evidence of subsidence was seen around the HUSKY PUP SGZ.

SURVEY DATA

Two surface survey lines were established across the MIDAS MYTH SGZ prior to the event. The lines were planned along bearings of approximately N40°E and N40°W, as shown on Figures 3 and 6. Elevations were measured along the lines at 25-ft intervals. The lines were resurveyed following the event and the resultant differences in elevation (pre- versus post-event) are shown in cross section on Figures 13 and 14. It should be noted that the vertical exaggeration is 100X on these figures.

The southwest-northeast line (fig. 13) shows a slight increase in elevation south of SGZ, and the subsidence crater starts approximately 200 ft southwest of SGZ. Toward the northeast, the subsidence extends to slightly more than 200 ft, and the remainder of the line is slightly lower than it was pre-event. The maximum decrease in elevation on this line is 8.72 ft, 50 ft northeast of SGZ.

The northwest-southeast line (fig. 14) also shows a slight (0.5 ft) increase in elevation north of SGZ, and the subsidence crater begins 125 ft northwest of SGZ. To the southeast, the survey data show a marked increase of 1.87 ft in elevation in the area

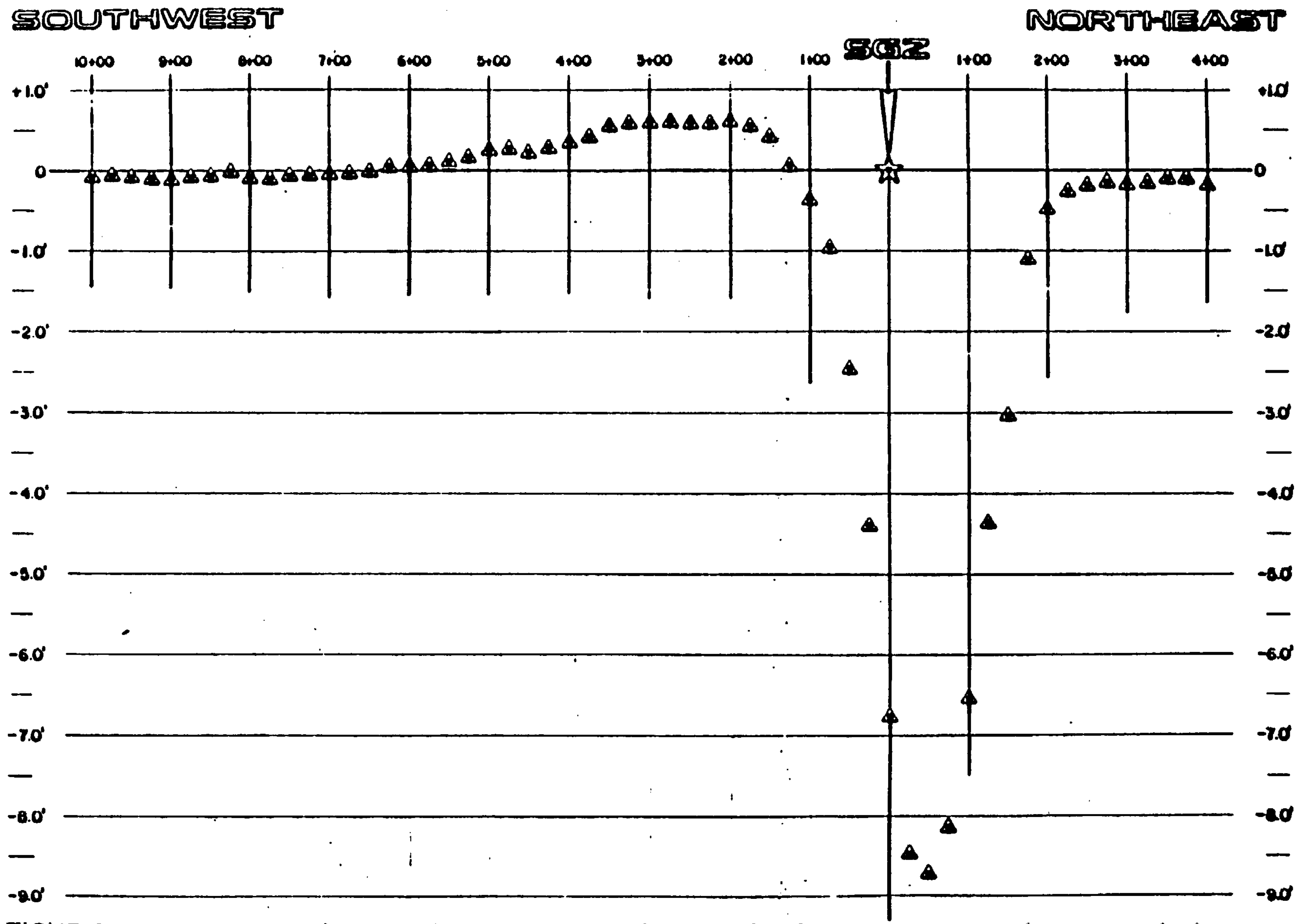


FIGURE 13.--*Cross section showing differences in elevation (pre-vs. post-event) measured along a N40°E line through MIDAS MYTH SGZ.*

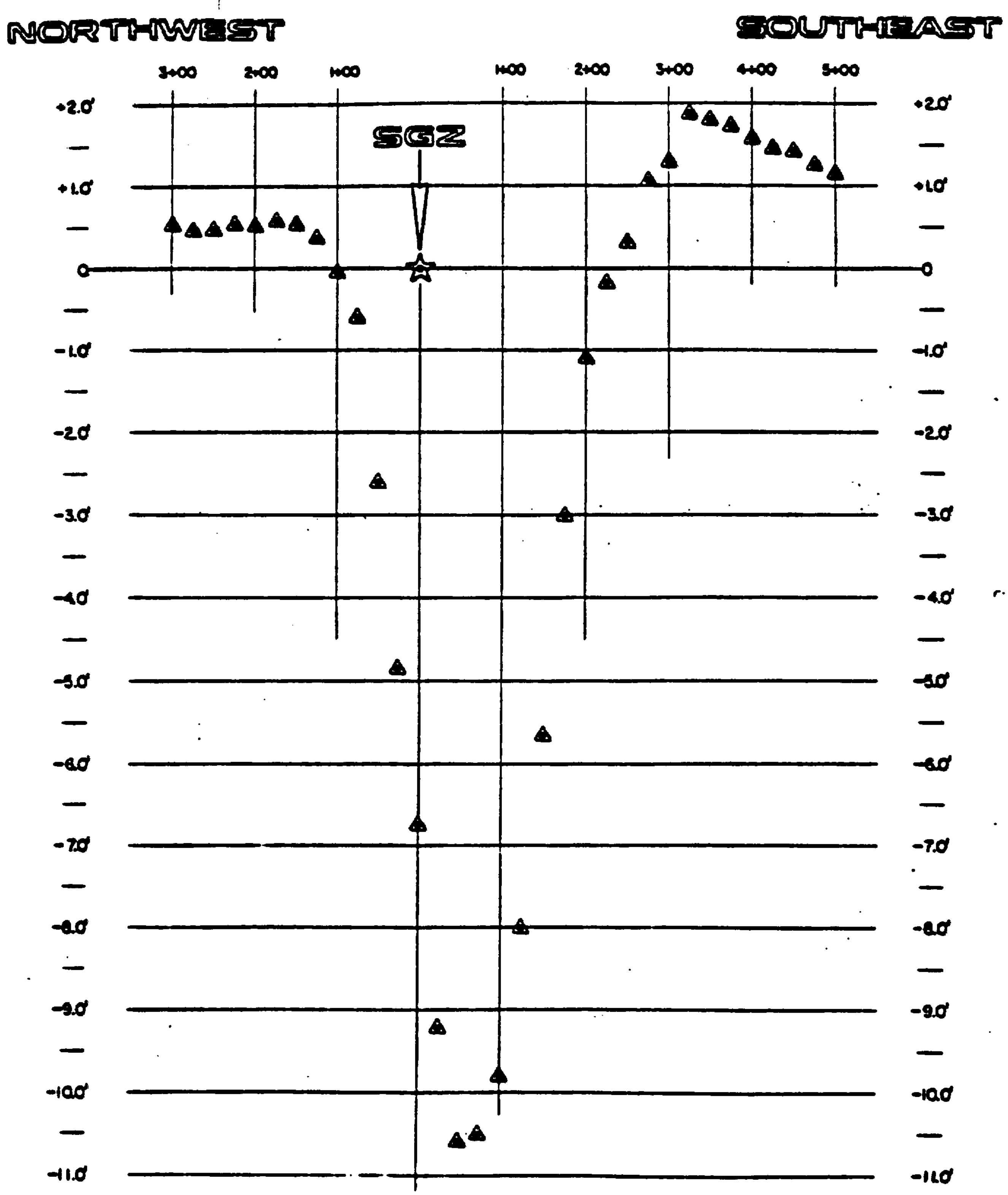


FIGURE 14.--*Cross section showing differences in elevation (pre-vs. post-event) measured along a N40°W line through MIDAS MYTH SGZ.*

mapped as disturbed ground shown on Figure 6. The subsidence extends to approximately 325 ft south of SGZ, with a maximum decrease in elevation of 10.6 ft located 50 ft southeast of SGZ.

Unfortunately, the majority of the surface subsidence occurred between the survey lines. Holmes & Narver Inc. has prepared a preliminary topographic map of the subsidence area (fig. 15). Cross section A-A', shown on Figure 8, gives the topographic relationships through the apparent deepest part of the subsidence.

Other data obtained from pre- versus post-event surveying show that the location of the MIDAS MYTH SGZ has moved 5.3 ft along a bearing of N83°E. The MILAGRO cable hole moved 5.6 ft on a bearing of N64°W. These data support the field observations of slumping toward the center of the subsidence, and of pre-subsidence fractures on the MILAGRO pad which now dip away from the center of the subsidence.

SUMMARY

The surface effects from the MIDAS MYTH event can be subdivided into two groups: the initial effects of the event, and the secondary effects related to the subsidence.

The mappable surface effects from the MIDAS MYTH event are somewhat more severe but less widespread than those from similar

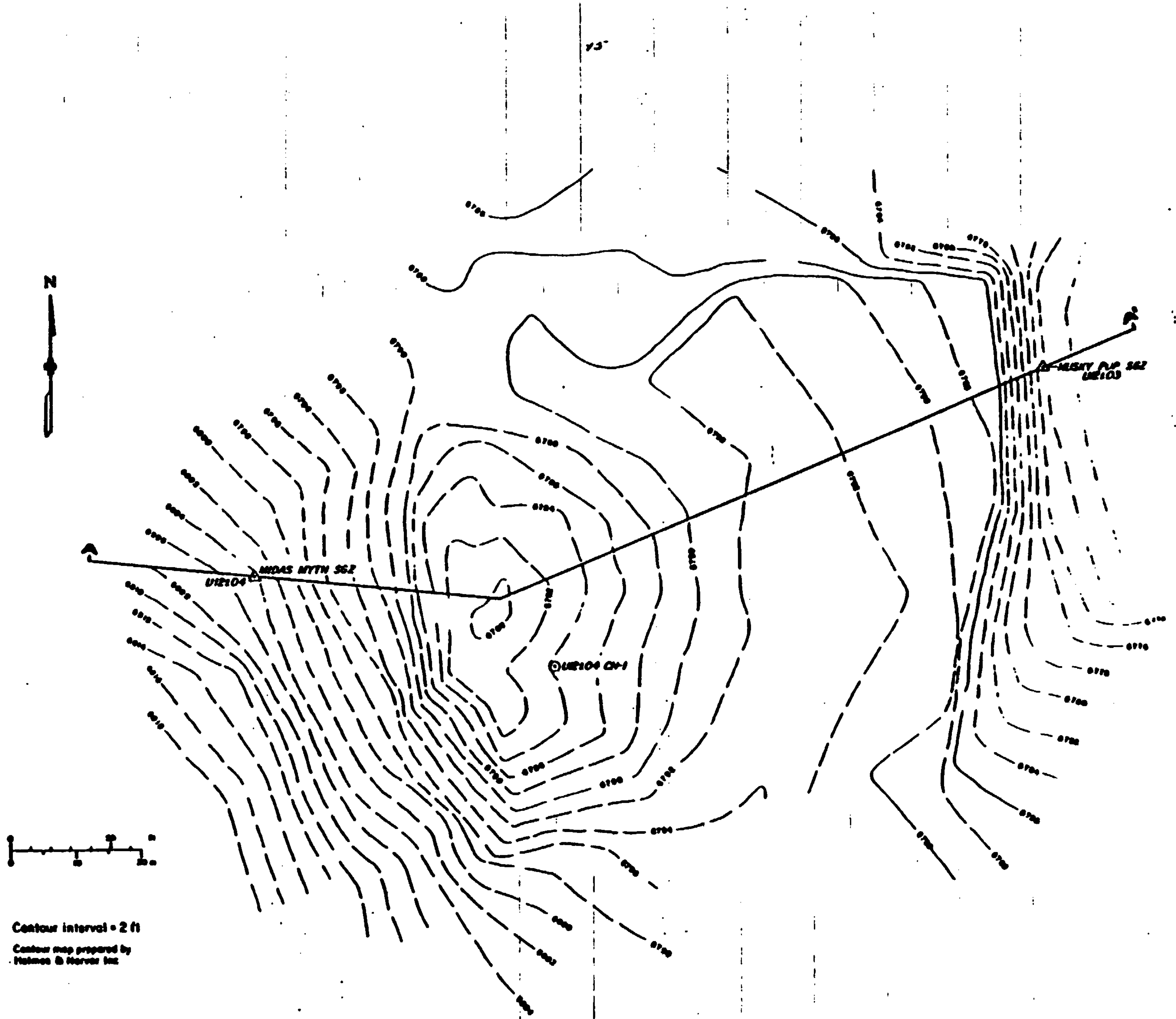


FIGURE 15.—*Post-event topographic map of the MIDAS MYTH area, showing location of cross section A-A' (fig-8).*

events in "N" Tunnel. Following MIDAS MYTH, no cracking or vertical displacements were mapped along any suspected or known surface fault traces, except minor cracking parallel to Fault #2 near the DIAMOND SCULLS WP. None of the other mapped effects are thought to be fault-related. The areas of disturbed ground and spall are large, but these effects have often been seen following other Rainier/Aqueduct Mesa events.

The initial event-related surface effects from the MIDAS MYTH event are as expected, given the somewhat high degree of coupling experienced during other detonations in the "T" Tunnel complex.

Prior to MIDAS MYTH, low yield events detonated within Rainier/ Aqueduct Mesa have not produced significant subsidence craters. Shallow (0.3-0.7 m) subsidences have been documented on recent events within the "N" Tunnel complex. It is not known if these subsidences coincide with or are directly related to cavity collapse or a chimneying phenomenon. However, a secondary collapse at the surface was documented over the MINERS IRON site following the nearby HURON LANDING detonation. The fact that the MIDAS MYTH event produced a surface subsidence is not unusual, given the enhanced coupling at the "T" Tunnel Complex. However, the magnitude of the subsidence is comparable only to that produced by the intermediate-yield WINESKIN event, detonated in the U12R emplacement hole in 1969.

The asymmetry (to the east) of the surface subsidence, though unexpected, is not unusual at sites with thick, welded ash-flow tuffs at the surface. The shallow subsidences measured over the HURON LANDING and MINERS IRON events were both asymmetric towards the east with respect to their SGZs. The WINESKIN subsidence was offset towards the south, and Pahute Mesa events often produce asymmetric surface subsidence craters.

The position and condition of the HUSKY PUP chimney probably influenced the distribution and character of the MIDAS MYTH surface effects. Additional studies, to be undertaken in the future, should help define the true relationships between the MIDAS MYTH and HUSKY PUP chimneys.

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GLOSSARY

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Apical void	Void at the apex of the chimney.
Cable head (Well head)	The top end of the cable hole.
Caprock	A layer of rock that lies at the top of a topographic feature, in this case, welded tuff.
Chimney	Upward growth of a rubble zone as rock falls into a cavity formed by a nuclear explosion.
CP	Control Point
DNA	Defense Nuclear Agency (Headquartered in Washington, D.C.)
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FCDNA	Field Command Defense Nuclear Agency
Geophone	An instrument to detect seismic activity.
GZ	Ground Zero--The point at which the nuclear device is emplaced.
HLOS	Horizontal Line-of-Sight
kt	kiloton-1,000 tons (equivalent of TNT)
LANL (LASL)	Los Alamos National Laboratory

LLNL	Lawrence Livermore National Laboratory
LOS	Line-of-Sight
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
NTO	Nuclear Test Organization
NTS	Nevada Test Site
NTSO	Nevada Test Site Office
OCC	Operations Control Center
Operations Room	Control center utilized by the test controller and his staff at shot time.
PST	Pacific Standard Time
RAMS	Remote Area Monitoring System
REECo	Reynolds Electrical and Engineering Company, Inc.
RERO	Radiological Emergency Response Operation
ROSES	Recording Oscilloscope Sealed Environment System
SDOB	Scaled Depth of Burial, a ratio of the depth of burial in meters to the cube root of the yield in kilotons--$m/kt^{1/3}$ or $m/n^{1/3}$
SGZ	Surface Ground Zero

SNL	Sandia National Laboratories
Subsidence	Settling or falling so as to form a surface depression or crater.
Triage	The sorting and allocation of treatment to disaster victims according to a system of priorities designed to treat the most seriously injured first.
USGS	United States Geological Survey
Welded	As applied to volcanic tuff, a unit deposited while hot enough to fuse minerals together.
WP	Working Point, the point at which the device is detonated.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

"PLATE 1, COMPOSITE MAP OF NTS CENOZOIC GEOLOGY"

WITHIN THIS PACKAGE..

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