VUF-1038

VELA UNIFORM PROGRAM

STERLING EVENT

ON-SITE HEALTH AND SAFETY

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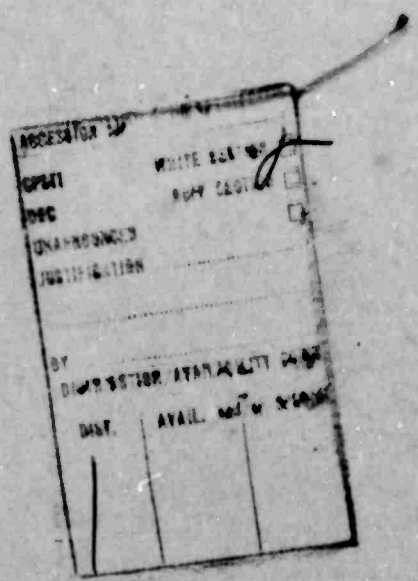

USAEC Division of Technical Information Extension, Oak Ridge, Tennessee

PROJECT STERLING
ON-SITE HEALTH AND SAFETY REPORT

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Site Facilities Division
Reynolds Electrical & Engineering Co., Inc.

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between
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and
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FOREWORD

The Project Sterling Event was detonated at the Atomic Energy Commission's Project Sterling Test Site, Tatum Salt Dome near Hattiesburg, Mississippi, on December 3, 1966. The device was emplaced at a depth of about 2,700 feet in the center of the 110-foot cavity created by the Project Dribble-Salmon Event. The designed yield was equivalent to 350 tons of TNT.

The experiment was sponsored by the Advanced Research Projects Agency, (ARPA) Department of Defense (DOD) and the U. S. Atomic Energy Commission (AEC). It was conducted by the Lawrence Radiation Laboratory (LRL). The project was a part of the Vela Uniform Program and was designed to test further the theory of decoupling, specifically within a cavity created by a previous nuclear explosion.

The Reynolds Electrical and Engineering Co., Inc. (REECo) Radiological Sciences (R/S) Department was requested by the Atomic Energy Commission to provide radiological services to all on-site agencies. In addition, the Radiological Sciences Department administered or implemented the medical, fire protection, and industrial safety support programs as required by the AEC Site Manager.

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SECTION I

RADIOLOGICAL SCIENCES PROGRAM

I. INTRODUCTION

The REECo R/S Department was delegated the basic responsibility of providing radiological safety services for all activities at the test site preparatory to and following the Project Sterling Event. During the event period, the R/S Department acted under the direction and in support of the Hazards Control Division of the Lawrence Radiation Laboratory.

The basic responsibilities consisted of:

- Controlling and documenting the presence and disposition of radioactive materials,
- Controlling, measuring and recording personnel exposures to hazardous materials,
- Maintaining and issuing all necessary protective clothing and equipment,
- Decontaminating personnel, equipment, and ground areas as necessary,
- Providing, maintaining and calibrating radiation detection instruments and sampling equipment,
- Performing qualitative and quantitative analysis of radioactive samples, including evaluation of data obtained.

The Project Sterling radiological safety program was initiated on August 29, 1966, and terminated on December 31, 1966. The extent of services provided and the personnel schedules varied in conformance with the work schedules of other on-site agencies and the conditions encountered.

II. EQUIPMENT AND FACILITIES

The facilities, equipment and instrumentation used for various phases of the overall program are summarized and described below. The resulting observations and data obtained through use of these items are recorded by appropriate subject later in the report.

A. Radiation Detection Instruments

1. Portable Survey Instruments

The three types of portable survey instruments used by monitoring personnel were:

Instrument	Meter Range and Scales	Radiation Detected
Eberline E-500B Geiger Counter	0 to 2 R/hr Five linear scales 0 to 0.2 mR/hr 0 to 2 mR/hr 0 to 20 mR/hr 0 to 200 mR/hr 0 to 2,000 mR/hr	beta gamma
Victoreen Radector Model AGB-500 SR	0.5 mR/hr to 500 R/hr Two logarithimic scales 0.5 mR/hr to 500 mR/hr 0.5 R/hr to 500 R/hr	beta gamma
Eberline PAC-3G Gas Proportional Counter	0 to 100,000 counts/min Three linear scales 0 to 1,000 counts/min. 0 to 10,000 counts/min. 0 to 100,000 counts/min.	alpha

2. Remote Area Monitoring System (RAMS)

The RAMS was a system of radiation detector probes located in a designated array about a point of interest (surface ground zero) with remote readout at a removed central location.

The Project Sterling RAMS detector units consisted of gamma detector probes (Nehr-White ionization chambers) with self contained power supply. One unit was installed 100 feet below ground surface in the stemmed emplacement hole. Seventeen additional units were located on a 500-foot arc around surface ground zero and at other related locations as shown in Figure 1. These units were connected, through #WD-7 field wire, to meters installed in the Radiological Sciences Mobile Laboratory Van located at the Technical Director's Manned Station (TDMS) with slave connection to Honeywell dual pen recorders in the Technical Director's Trailer. The meters were provided with remote polarity and range switching capability. The meters were logarithimically scaled in ranges of 1 mR/hr to 1,000 mR/hr and 1 R/hr to 1,000 R/hr.

A cesium-137 source of about 1 mR/hr was attached to the detector probe. This provided a positive reading to assure a continuous operability check and to afford a less than 1 mR/hr readout capability. The effective measurement range was therefore 0 to 1,000 R/hr. Each unit was calibrated, using a cobalt-60 source at 1 mR/hr and 1,000 mR/hr, and at 1 R/hr and 1,000 R/hr with intermediate scale checks.

Continuous operation of the RAMS commenced on H-3 days.

3. Stationary Detection Instruments

Stationary radiation detection equipment was strategically located at the test site to provide back-up monitoring of personnel and equipment.

Portal Monitor - This unit was installed in the check station doorway to provide external whole body monitoring of personnel entering the check station. The unit consisted of an array of Geiger-Mueller tubes framing the doorway and connected to individual alarm meters. Alarm levels were adjustable and were normally set at 0.5 mR/hr.

Gateway Monitors - These units were installed at the site access gates to monitor personnel and vehicular traffic. They consisted basically of scintillation detector probes connected to alarm meters. Alarm levels were adjustable and were normally set at 0.5 mR/hr.

B. Personnel Dosimeters

1. Film Badges

The du Pont Type 556 gamma film packet was used as the personnel film dosimeter. A 28-mil thick lead strip was attached to the packet to provide uniform gamma energy response of the film components. The film components used and their respective measurement ranges were:

Film Type 519 . . . 30 mR to 4 R
Film Type 834 . . . 4 R to 800 R

2. Pocket Dosimeters

Self-reading ionization dosimeters were maintained for local issue to personnel entering areas of potential radiation exposure. The measurement range of the dosimeters was 0 to 200 mR and 0 to 5 R respectively.

C. Air Sampling Equipment

1. Manifold Air Sampler

This air sampler was used principally in sampling for air-borne

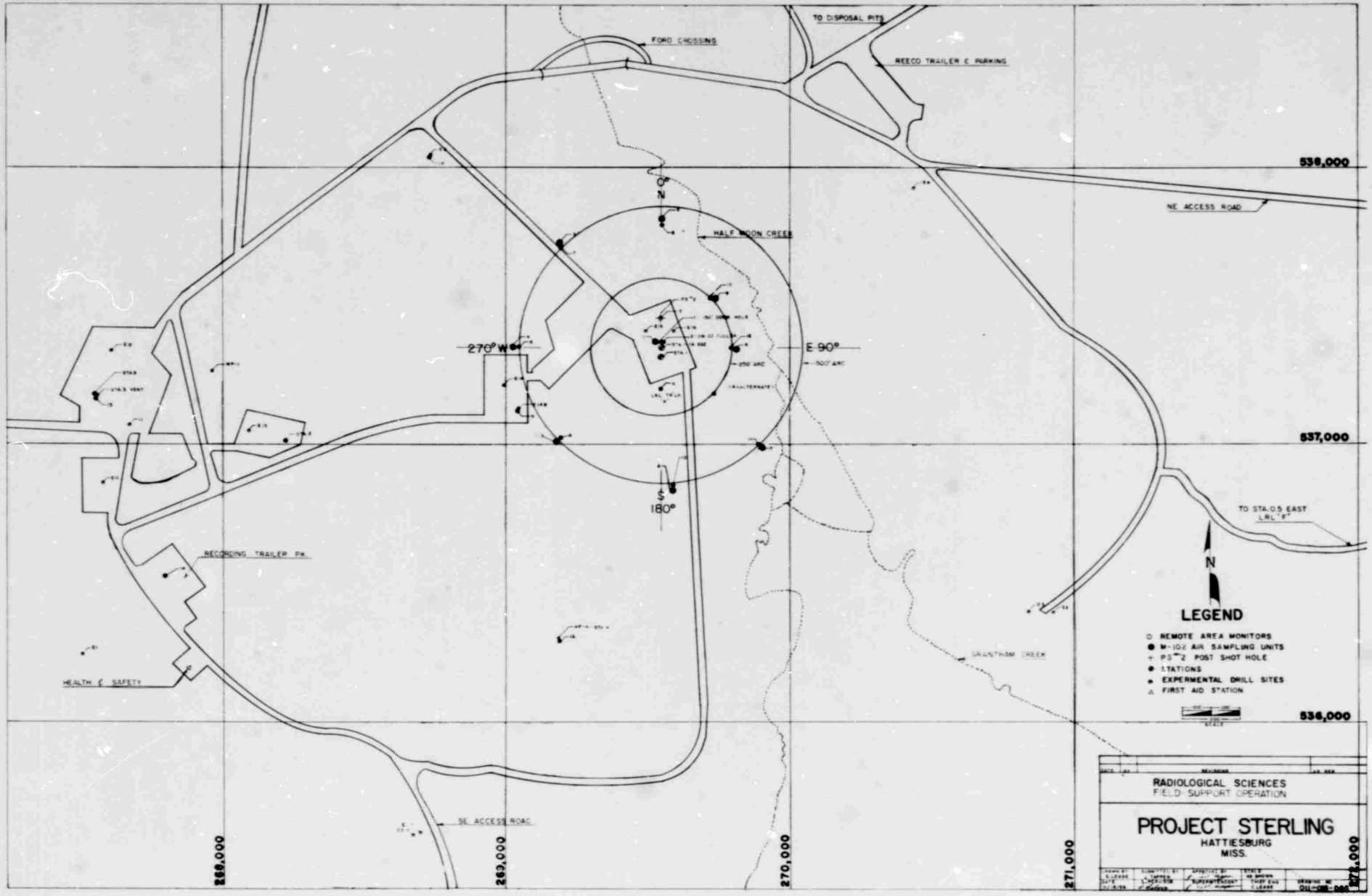

Figure 1 - RAMS and Air Sampler Locations

radioactivity at work locations related to pre-event drilling and emplacement activities.

The unit was an electrically powered positive displacement vacuum pump attached to a four-outlet manifold. The outlets could be utilized singly or in a combination. Extension hoses were used to locate the sampling heads at the immediate work areas. The sampling media used was 4-inch Whatman #41 filter paper backed by a MSA organic vapor (charcoal) cartridge.

2. Portable Air Samplers

These units were A-C powered, high volume, centrifugal air pumps. A 4-inch Whatman #41 filter paper was used as the collecting medium.

These units were used principally to collect particulate air samples from various site locations for environmental condition documentation.

3. Effluent Air Samplers (M-102)

These samplers were used to collect air samples in the event of effluent release directly associated with the event.

The samplers were positive displacement vacuum pumps driven by a gasoline engine, and were cradle-mounted for semi-portability. A calibrated air flow of 19 cfm was drawn through a 7-inch Whatman #41 filter paper backed by a MSA organic vapor cartridge.

The units were located around surface ground zero as shown in Figure 1. Continuous operation for the event commenced at H-4 hours.

4. Mobile Air Samplers

Two M-102 air samplers were Jeep mounted to provide immediate mobile air sampling capability.

5. Evacuated Cylinders

Scott "Air Pack" cylinders were evacuated to about 20-inches of water negative pressure with a Gelman positive displacement vacuum pump. The evacuated cylinders were used to obtain "grab" samples for gamma spectrum analysis as required.

6. Explosive and Toxic Gas Samplers

Although not radiological in nature, the following equipment was maintained and used by the R/S Department to routinely survey areas of potential explosive or toxic gas atmospheres:

Draeger Tubes - Glass tubes containing an appropriate desiccant type chemical were used to detect and measure the presence

of various toxic gasses. Air was drawn through the tubes with an aspirator bulb. Gas concentrations were determined by the corresponding color change of the chemical as measured on the scaled side of the tube.

Explosimeters - These units were used to detect and measure the presence of combustible gas mixtures. The instruments are small, compact electronic units based on the Wheatstone Bridge principle. Air is drawn through the unit with an aspirator bulb and combusted within the unit. The corresponding resistance change is indicated on a meter calibrated to correspond to a percentage explosive mixture.

D. Analytical Facilities

1. Mobile Laboratory Facility

A semi-van trailer was maintained as a laboratory facility at the test site. It housed gross alpha, beta, and gamma counters, a vibrating reed electrometer, and basic field laboratory apparatus for sample preparations and gross analysis.

2. Mobile Radiation Measurements Laboratory

A second mobile laboratory van was located at the TDMS and housed a multi-channel analyzer for gamma spectrum analysis, gross alpha, beta, and gamma counters, and other related analytical equipment for comprehensive evaluation of environmental samples.

E. Protective Clothing and Equipment

An ample supply of coveralls, gloves, hoods, rubber boots, and respiratory devices was maintained at the site area.

F. Decontamination Facilities

1. Personnel

A decontamination unit consisting of three sinks, a shower head and water storage tank was available for personnel decontamination.

2. Decontamination Pad

The Project Dribble decontamination pad was reactivated for the Project Sterling Program.

3. Laundry Facilities

The Project Dribble mobile laundry units were also reactivated. The units were located at the decontamination pad.

4. Steam Cleaner

A mobile steam generator was made available for decontamination of large equipment items or surfaces.

5. Decontamination Truck

The Project Dribble fire truck was reactivated and served also as a decontamination truck to provide a mobile pressurized water supply.

G. Support Facilities

1. Check Station

A modified mobile trailer was used as a control and issue facility for all associated radiological equipment and instrumentation. The check station was located at the junction of the north access road to ground zero and the main access roadway during pre-shot preparation. The trailer was relocated to the TDMS area for the event.

2. Instrument Repair Facility

A modified mobile trailer provided the necessary work and storage space for maintenance and repair of equipment.

III. PRE-EVENT ACTIVITIES

Radiological safety support activities during this period were primarily directed to the reopening and rehabilitation of the Salmon Event emplacement and postshot drill holes, and to the emplacement of the Project Sterling device and related instrumentation. Associated activities included the restoration and restocking of R/S facilities suspended from use following the Salmon Event, and the installation of equipment for post event radiation and effluent surveillance and documentation.

A. Monitoring and Surveillance

1. General Site Surveys

Radiation surveys of established Project Dribble radiation/security areas were conducted weekly. These areas included the Decontamination Pad and the Bleeddown Plant area, both of which served additionally as storage areas for contaminated waste materials.

2. Drilling and Emplacement

Continuous radiation monitoring coverage was provided for all drilling and emplacement activities at the ground zero area.

During drilling operations, routine radiation surveys were conducted on a one to two hour frequency dependent on the drilling depth. These included dose rate measurements, contact radiation measurements, and swipe surveys at all work locations. Locations of specific interest were the drill rig platform, the drill collar, and the discharge area of the drilling air return line (Blooie line).

Radiation and swipe surveys were performed on all equipment and instrumentation withdrawn from the drill holes.

Dose rate measurements were made at an average distance of three feet from the surface of interest. Contact measurements were made with the detecting probe on or adjacent to the surface being monitored. The average survey dose rate recorded during all preshot drill hole activities was 0.06 mR/hr. The maximum contact measurement detected on downhole equipment and instrumentation was 1.0 mR/hr which was easily removed on location. In one instance, the inside surfaces of the Blooie line were found internally contaminated to 4.0 mR/hr. This section of line was removed and stored in the bleeddown plant area for subsequent disposal.

Particulate samples were collected from the air flowing through the Blooie line as successive drilling depths of 10 feet were achieved. The maximum radioactivity recorded was 1.14×10^{-4} μCi gross gamma/gram. In all instances of positive radiation detection, the Blooie line discharge was already being routed through a water wash particulate settling tank (Blooie tank).

No toxic or explosive gas mixtures were detected at the surface ground zero (SGZ) drill holes. Toxic and explosive gas mixtures were detected at the Station #4 open casing after detonation of the high explosive calibration shot. The maximum concentrations noted were combustible mixtures equivalent to 100% of the lower explosive limit, 7,000 ppm of carbon monoxide, and 3.0% carbon dioxide. These were surge type encounters. Access to the immediate area was restricted until all gasses were thoroughly dissipated.

3. Event Assignments

Monitors with portable radiation detection instruments were assigned to the following functions or locations pending the event:

initial surveys
manned stations
muster area
helicopter flights
special surveys
preliminary surveys

Their locations at H hour are shown in Figure 2.

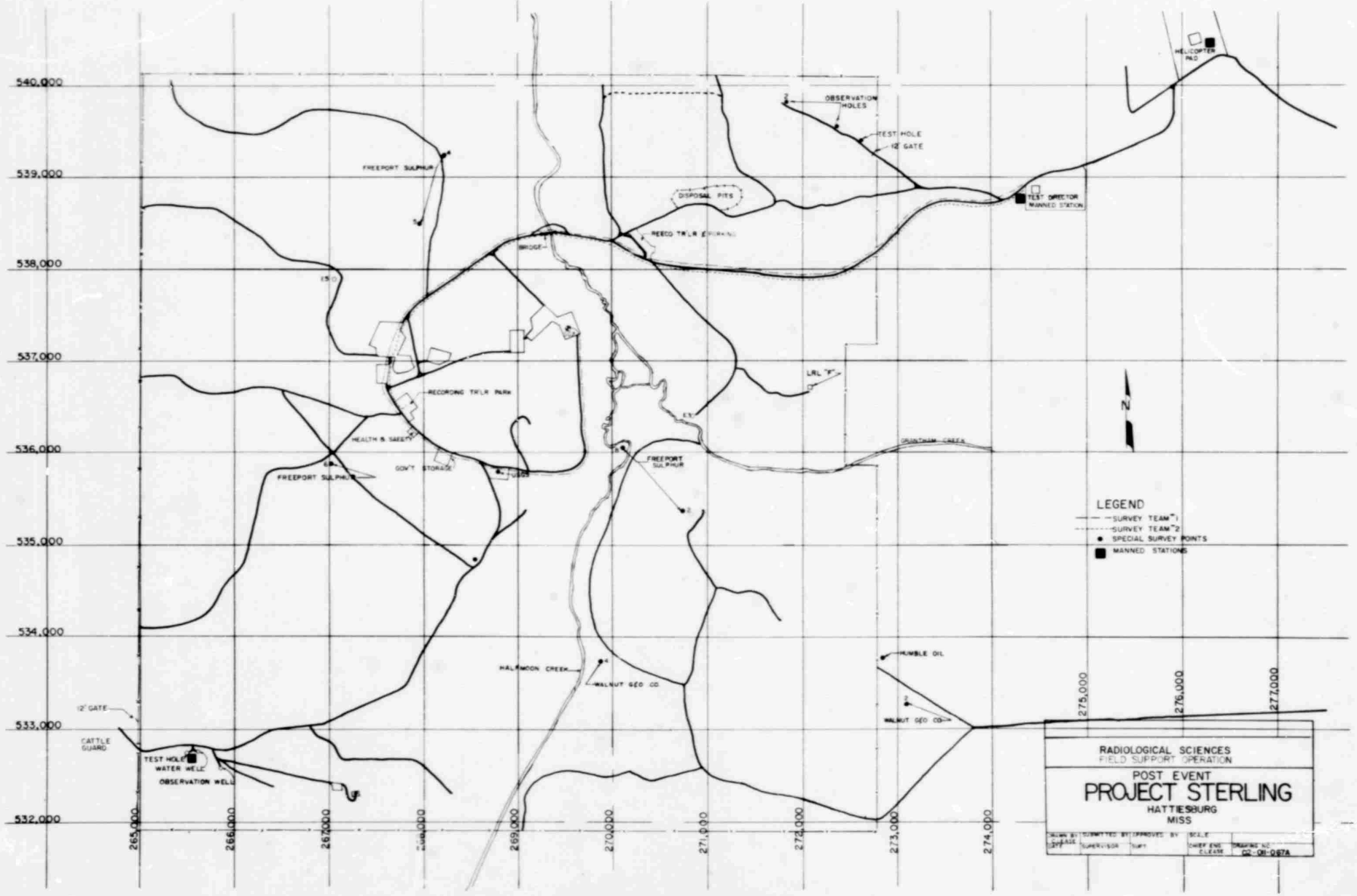

Figure 2 - Survey Routes and Personnel Locations

B. Personnel Dosimetry

During drilling and emplacement activities all personnel assigned to work areas of potential exposure to radiation were issued gamma film packets. These were exchanged at the beginning of each month.

C. Environmental Sampling

1. Air

a. During drilling and emplacement, continuous air samples were collected at work areas around ground zero at a frequency commensurate with work schedules and activities. Sampling locations were dictated by the work in progress and included the drill rig working platform, drill hole collars, Blooie line exhaust area, and open drill casings.

Samples were analyzed for gross alpha, beta and gamma activity. The maximum detectable activity recorded was 2.36×10^{-12} μCi gross gamma/cc of air. It was collected at the open casing of postshot drill hole #1 during instrument emplacement.

b. A twenty-four hour high volume air sample was collected monthly from each of six site locations as a continuation of the Project Dribble post event program. The sampling locations are shown in Figure 3.

The analytical results of this program will be compiled and evaluated in a subsequent Dribble-Sterling environmental surveillance report.

2. Soil

Soil samples were collected monthly from each of six site locations as a continuation of the Project Dribble post event program. The sampling locations are shown in Figure 3.

The analytical results of this sampling will be included in the environmental surveillance report.

3. Water

Water samples were collected weekly from the site industrial water well, and monthly from eight surface water locations (Figure 3).

No radioactive contamination was detected.

D. Radioactive Waste Management

1. The remains of radioactive waste materials generated during Project Dribble were stored in the Bleeddown Plant and the Decontamination Pad areas. These areas were fenced and posted, and access was controlled by the industrial guard force.

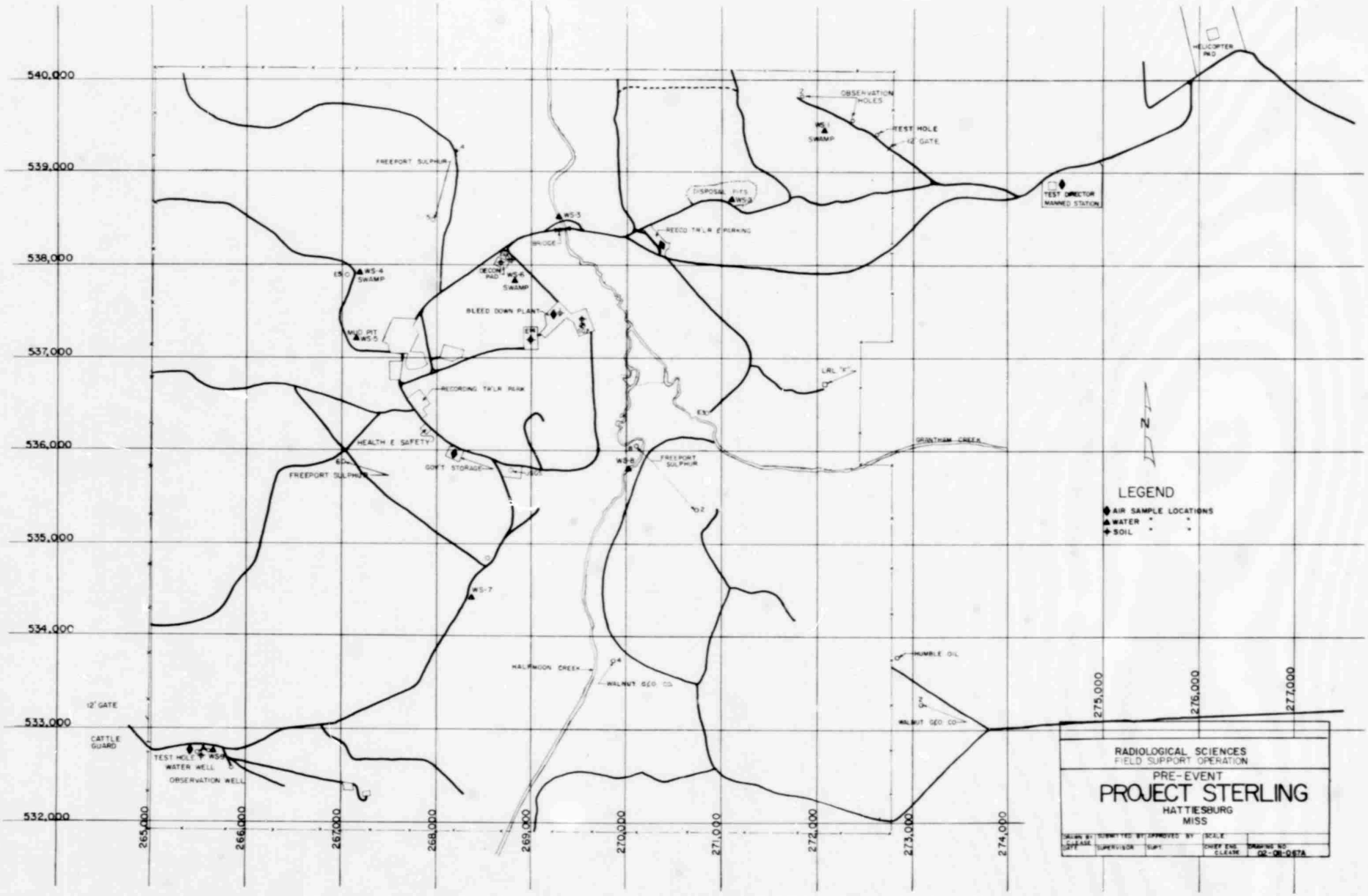

Figure 3 - Environmental Sampling Locations

Waste materials consisted primarily of miscellaneous piping and approximately 35,000 gallons of waste water stored in the Blooie tank, bleeddown storage tanks, and decontamination pad storage tank.

The minor amount of waste material generated during Project Sterling was appropriately stored in the above areas and tanks.

2. Prior to the Project Sterling event, all the liquid contents of the Blooie tank and bleeddown storage tanks were transferred to 55-gallon metal drums and jelled for later disposal.

Details of the jelling procedure and disposition of all radioactive waste materials associated with the Tatum Salt Dome Test Site will be compiled in a final report on cleanup of the Tatum Salt Dome Site.

IV. POST EVENT ACTIVITIES

Radiological safety support provided by the R/S Department during the post event period encompassed two phases of activity (1) surveillance and sampling immediately associated with the detonation and (2) radiological support services for all post event cleanup and removal activities.

These are reported sequentially as occurred.

A. Monitoring and Surveillance

1. Remote Area Monitoring System

There was no radiation detected immediately following the detonation; however, a positive radiation measurement was recorded on the down hole detector probe commencing at H + 155 minutes. Details of this encounter are reported in subsequent section - 5 "Detection of Gas Diffusion."

2. Initial Reentry Surveys

Two initial radiation survey teams were dispatched by the LRL Technical Director at about H + 30 minutes. These teams surveyed the surface ground zero perimeter road to the recording trailer park, where one team stopped to survey the area. The other team proceeded along the perimeter road to the surface ground zero area via the south access road.

Upon completion of comprehensive radiation surveys of the Recording Trailer Park and the SGZ areas, the teams remained in these areas to provide support for reentry parties.

All radiation measurements indicated only normal background activity (less than 0.03 mR/hr).

3. Site Surveys

Two survey teams were dispatched at about H + 1 hour to survey various test and observation holes and the related access roadways within the test site (Figure 2).

All radiation measurements indicated normal background only.

4. Detection of Gas Diffusion

At H + 155 minutes, a positive radiation measurement was recorded from the Station 1-A downhole gamma detector probe.

Radiation monitors were dispatched to the SGZ area to evaluate the situation and obtain air samples. The RAMS at this time showed only nominal exposure rates of 0.3 mR/hr. Preliminary surveys established the situation as one of gas migration contained within the timing and firing cables. This was substantiated by subsequent sample analysis, a complete area survey, and continuous surveillance of the remote area monitoring system.

In order to halt the gas migration and avoid potentially significant environmental release, the cables were cut and the ends placed in a 55-gallon metal drum filled with Cal-Seal (a plaster of paris type material). This action effectively halted the migration although a minor emission did occur during cutting and sealing. The release was nominal and quickly dissipated as determined by gamma spectrum analysis of air samples taken at the drum and environmental locations around SGZ. (See Section B "Air Sampling").

A continuous gamma monitor-recorder unit (consisting of detector probe, battery power supply and strip chart recorder) was installed near the top of the Cal-Seal drum to monitor any change in activity levels.

The maximum radiation measurements observed at specific locations were 150 mR/hr at the downhole gamma detector probe, 200 mR/hr at contact with the exposed surface cables, and 1.3 R/hr at contact with the drum containing the Cal-Seal. The maximum dose rate to which personnel were exposed for a short period was 190 mR/hr while working near the Cal-Seal drum. Radioactivity measurements at the cables reached maximum levels at H + 275 minutes.

B. Air Sampling

The M-102 air samplers located at SGZ and the 500-foot arc (Figure 1) were operated continuously from H-240 to H + 105 minutes. Analysis of the collected samples revealed only naturally occurring radioactivity.

An air sampler was operated continuously at SGZ from H + 105 minutes to H + 32 hours. Analysis of the collected samples revealed only natural radioactivity.

The full set of 500-foot arc samplers were restarted at H + 195 minutes and operated continuously to H + 435 minutes. Analysis of these samples

showed only natural radioactivity. At this time, radioactivity levels at the cables were on a definite decline and all observations indicated complete containment. Selected arc air samplers downwind from SGZ were continued in operation to H + 32 hours. Analysis of these samples also showed only natural radioactivity.

The only positive detection of gaseous escape was obtained in the immediate area of the cut cables and was insignificant as shown by the following:

- A filtered air sample collected over the Cal-Seal drum from H + 195 minutes to H + 5 hours contained the following isotopes:

  Prefilter - rubidium-88
  Charcoal - rubidium-88, xenon-135, and no detectable iodine.

- An evacuated cylinder "grab" sample was collected over the cut cables. A gamma spectrum analysis showed only rare gasses and their daughters. The radioiodine content was less than 0.01%. The xenon-135 content was less than 10%.

C. Personnel Protective Measures

All reentry and initial survey parties were fully suited and taped in protective clothing, and were provided with full face respirators incorporating MSA all purpose cannisters.

D. Personnel Dosimetry

All personnel entering the controlled access area following the event were issued gamma film packets and two pocket dosimeters (high and low range).

Following the release of access control, personnel were required to wear only the gamma film packet.

There were no cases of personnel exposure greater than 30 mR.

E. Site Demobilization

Radiation monitoring service was provided for all post event cleanup and removal activities as required. Radiation surveys were conducted on all equipment and materials prior to removal from the ground zero area. All items released for off site use measured less than 0.1 mR/hr at contact. Miscellaneous items, such as device cables, Cal-Seal drum, etc., reading greater than 0.1 mR/hr were removed and placed in the waste storage areas.

A working inventory of supplies and equipment were left on-site pending ultimate site disposal. The remainder of the equipment was returned to the NTS.

F. Environmental Sampling

Sampling of soil, water, and air was reinstituted on a preevent schedule as a continuation of the overall Tatum Salt Dome environmental condition documentation.

G. Radioactive Waste Management

The liquid contents of the decontamination pad storage tank were transferred to 55-gallon metal drums and jelled for subsequent shipment and disposal.

H. Decontamination

There were no cases of personnel contamination.

All equipment contamination detected was nominal and easily decontaminated on location.

All drums of jelled liquid waste were externally decontaminated in preparation for shipment to Oak Ridge National Laboratory for disposal. Swipe surveys of each drum after decontamination revealed no detectable contamination.

SECTION II

INDUSTRIAL SAFETY, FIRE PROTECTION
AND MEDICAL SERVICES

I. INTRODUCTION

The REECo Radiological Sciences Department was delegated the function of providing general Health and Safety services for the Project Sterling program. This implied direct responsibility for all REECo employees and for all REECo related or provided facilities. Health and Safety services were provided to other prime contractors in an advisory capacity and on an "as requested" basis.

II. INDUSTRIAL SAFETY

A. General Support

All areas of general occupancy or traffic were appropriately posted to reflect safety requirements and approved practices. This included such items as speed limits, power line height clearances, explosive areas, bridge load limits, barricades, hard-hat requirements, etc. Safety reminders and promotional materials were maintained and posted at distinct locations.

A stock of general safety equipment items were maintained and issued to Project Sterling personnel as appropriate. The equipment included such items as hard hats, safety goggles, face shields, etc.

Safety engineers from the AEC NV and the NTS REECo Safety Division periodically visited the test site to review and advise relevant to the safety program.

B. Safety Inspections

Routine safety inspections were conducted of all test site facilities and the Hattiesburg office areas. Safety discrepancies were reported to responsible REECo supervisory personnel for REECo related facilities and to the AEC Site Manager for non-REECo related facilities. A total of 49 hazards were detected in the course of 9 inspections. All hazards were corrected.

C. Safety Meetings and Orientations

Safety meetings and employee orientations were routinely conducted for field personnel. Unsafe work habits and conditions were discussed, and the current safety reports were reviewed.

D. Personnel Injuries

There were 13 cases of reported minor injuries. All contributing factors were investigated and corrected. Two lost time injuries were reported. These involved personnel of the drilling contractor.

E. Vehicle Accidents

One federal vehicle accident was incurred. It involved a minor collision with a non-federal vehicle and was caused by the driver of the non-federal vehicle. The federal vehicle was assigned to ESSA-AFRO (U. S. Weather Bureau). All appropriate report forms were submitted.

III. FIRE PROTECTION

A. Equipment

A 1000-gallon capacity, 4-wheel drive fire truck was maintained at the Project Sterling test site. Appropriate portable fire extinguishers were strategically located at the test site and the Hattiesburg office. The extinguishers were routinely inspected and maintained.

B. Personnel

All Radiological Sciences personnel and REECo field supervisors were trained in the operation and use of fire fighting equipment.

C. Emergency Call Procedures

Standard call procedures were published and appropriately posted throughout all areas to assure an effective response capability.

No fire emergencies were reported.

IV. MEDICAL

A. Physician

A local physician was retained as advisor for the medical program, and to provide professional service as required.

B. First Aid

Qualified Aidmen were assigned to provide first aid coverage in conjunction with test site activities.

A First Aid Station was established in a central location within the test site area. It was equipped with the necessary medical supplies and communications for immediate first hand treatment of occupational and non-occupational illness and injuries. An ambulance was maintained in continuous readiness and was provided with first aid kit, resuscitating unit, and related equipment.

C. Treatment Summary

A total of 26 occupational and non-occupational illnesses and injuries were treated at the First Aid Station.

Four minor injuries required referral to a physician for follow-up treatment.

PROJECT STERLING REPORTS

SAFETY REPORTS

Agency	Report No.	Title
ERC	VUF-1035	Analyses of Ground Motion and Containment
USPHS	VUF-1036	Off-Site Surveillance
ESSA/ARFRO	VUF-1037	Weather and Surface Radiation Prediction Activities
REECo	VUF-1038	On-Site Health and Safety
FAA	VUF-1039	Federal Aviation Agency Airspace Advisory
H-NSC	VUF-1040	Hydrologic Safety Evaluation
USBM	VUF-1041	Pre- and Post-Shot Safety Inspections of Oil and Gas Facilities
USGS	VUF-1042	Well Aquifer Response to the Sterling Event, Tatum Dome
USGS	VUF-1043	Chemical and Radio-Chemical Quality of Water Following the Sterling Event
JAB	VUF-1044	Structural Response

TECHNICAL REPORTS

LRL, SC	VUF-3025	Subsurface Phenomenology Measurements Near a Decoupled Nuclear Event
USC&GS USGS GEO TECH LRL	VUF-3026	Decoupling of Seismic Waves By a Shot-Generated Cavity
TI	VIF-3027	Radioactive Gas Analysis
II	VUF-3028	Detection of Radionuclides

List of Abbreviations for Technical Agencies
Participating in Project Sterling

ERC	Environmental Research Corporation Alexandria, Virginia
ESSA/ARFRO	Environmental Science Services Administration Air Resources Field Research Office Las Vegas, Nevada
FAA	Federal Aviation Agency Los Angeles, California
GEO TECH	Geotechnical Corporation Garland, Texas
H-NSC	Hazelton-Nuclear Science Corporation Palo Alto, California
II	Isotopes, Inc. Westwood, New Jersey
JAB	John A. Blume San Francisco, California
LRL	Lawrence Radiation Laboratory Livermore, California
REECo	Reynolds Electrical & Engineering Co., Inc. Las Vegas, Nevada
SC	Sandia Corporation Albuquerque, N. M.
TI	Texas Instruments, Inc. Dallas, Texas
USBM	U. S. Bureau of Mines
USC&GS	U. S. Coast & Geodetic Survey Las Vegas, Nevada
USGS	U. S. Geologic Survey Denver, Colorado
USPHS	U. S. Public Health Service Las Vegas, Nevada