

RADIATION SAFETY MANUAL

by

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U.S. Geological Survey
Water Resources Division
Nevada District Office

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In case of an EMERGENCY CONTACT:

DISTRICT CHIEF

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I. INTRODUCTION

The Nevada District Office has purchased a soil-moisture depth probe to identify the water-bearing properties of subterranean soils and rock strata in the field. The District has also purchased a gas chromatograph detector to analyze water samples in the Laboratory. The borehole logger and the gas chromatograph detector contain radioactive sources that generate "ionizing" radiation. The Nuclear Regulatory Commission (NRC) requires that the personnel handling alpha, beta, and gamma radiation, x-rays and neutrons have special training, use special equipment, and follow special techniques.

This manual provides information on radioactive emitters; their storage, transport, and use; emergency procedures that may be required; the equipment used for normal and emergency procedures; and the radiation safety program of the Nevada District. Copies of this manual will be kept in all vehicles used to transport the sources, and should be read by all personnel who use or supervise the use of radioactive sources.

The Nevada District purchased a 50 millicurie americium-241 neutron emitter for the 500 series Hydroprobe, a soil moisture probe, and several 15 millicurie nickel-63 beta emitters for the tractor gas chromatograph detector. The neutron source is encapsulated in a stainless steel cylinder designed to withstand pressures and temperatures much greater than would be encountered in normal use. This capsule is approximately 3/8 inch in diameter and 3/4 to 1 inch long. The beta sources are also encapsulated in sealed cylinders which are also placed inside of closed cells. They meet Department of Transportation (DOT) STANDARDS, 7-A CONTAINER (49 CFR 178.350).

Possession and use of these sources by the Nevada District is governed by NRC license No. 27-17597-02, expiration date, 5/88 for the neutron source and by NRC license No. 27-17597-03, expiration date, 9/92 for the beta sources.

Finally, it should be noted that license 27-17597-02 for the soil moisture probe does not authorize maintenance or repair of the model 500 series gages. Such operations should be conducted by the manufacturer. To conduct any maintenance or repair operations on the soil moisture probe one must first submit step-by-step procedures with a license amendment request. Likewise, license 27-17597-03 for the gas chromatograph does not authorize the removal, cleaning, or rinsing of the Ni-63 beta source from its cell. The cells are not to be opened. To open the cells, a special users training course approved by the NRC must be completed and the license amended to reflect those users with certified training.

II. RADIATION PROGRAM MANAGEMENT AND RESPONSIBILITIES

A. Direction

The soil moisture probe and the gas chromatograph detector are under the jurisdiction of the Nevada District Chief, who may be contacted at:

Rm. 224, Federal Building
705 North Plaza Street
Carson City, NV 89701

He has final authority and jurisdiction for operating equipment in the Nevada District. He will follow the rules of the Nuclear Regulatory Commission, the U.S. Department of Transportation, and the State of Nevada Department of Human Resources (Radiological Health Section) when considering the needs of the hydrologic projects and the concerns of the general public.

Actual operation of the hydrologic projects will be accomplished by those who are delegated by him to do so and who are trained and qualified to meet the requirements of NRC, and the Nevada District's Radiation Safety Program.

B. Duties of Neutron Logger Operator (NLO)

The duties of the Neutron Logger Operator, with regard to the radioactive sources include:

1. The safe and legal transport of the sources from permanent storage to the job site(s), temporary storage in transit, and return to permanent storage.
2. The safe and legal handling of the sources at the job site.
3. Conducting surveys to determine levels of radioactivity:
 - a. of the transport vehicles before, and after transport; and
 - b. at the job site.
4. The filing of reports concerning items 1-3 above with the Radiation Safety Officer. These reports include: the source storage and use record, the job site survey and the vehicle survey.
5. Having a personal radiation dosimeter to monitor individual exposures to any ionizing radiation.
6. Taking immediate actions in the event of an emergency.

7. Supervising the actions of the logger assistants to ensure their compliance with NRC regulations and the procedures outlined in this manual.
8. To make sure that the gage is kept locked within its case and the case well secured in or to the transporting vehicle at all times except when in use at temporary job sites. A 'yellow 2' radiation label must be attached to the outside of the case.
9. When you leave the transporting vehicle unattended, the case must be locked inside the vehicle and a radiation placard should be placed on the outside of the vehicle to protect and warn others. (An example might be an overnight stay at a motel while in transit.) No placard is required on the outside of the transporting vehicle while you are driving or with the vehicle.
10. When you have finished using the soil moisture depth probe at the job site, the source is to be pulled back into its shield, and the gage placed back into the locked case, and the case returned to the designated, locked, permanent storage facility at 2151 Lone Mountain Drive in Carson City, NV. or to the temporary approved storage site at the U.S. Ecology Center south of Beatty, NV. .

C. Duties of Chromatograph Operator (GCO)

The duties of the gas chromatograph Operator with respect to the radioactive sources, include:

1. To make sure the source cells used in the Lab are left in areas of limited access. For example, it is permissible to leave the cells under an exhaust hood if the Lab is locked when authorized personnel are not present. When cells are not being used for long periods of time, they should be placed in the designated, locked, permanent storage facility at 2151 Lone Mountain Drive or at 809 North Plaza Street, both in Carson City, NV. .
2. Supervising the action of the lab assistants to ensure their compliance with NRC regulations and the procedures outlined in this manual.
3. The safe and legal handling of the sources in the Lab or while in transit.
4. Conducting surveys to determine levels of radioactivity in the Lab or while in transit. Monitoring would include periodic measurements of background radiation in the lab or vehicle, with a radiation survey meter and conducting leak tests on source cells at time intervals specified in

license. It is not necessary to wear personal radiation dosimeters while using the source cells in the operation of the gas chromatograph.

5. The filing of reports concerning the location, transportation, and radiation monitoring of each source cell with the Radiation Safety Officer.
6. Taking immediate actions in the event of an emergency.

D. Duties of Radiation Safety Officer (RSO)

These duties include:

1. The responsibility of conducting or initiating:
 - a. job-site surveys,
 - b. transport vehicle surveys, and
 - c. permanent storage area surveys.
2. Compiling and maintaining personnel monitoring records.
3. Maintaining vehicle and job site survey records.
4. Monitoring and reviewing training records to ensure compliance with NRC regulations and to advise the District training officer of specific needs.
5. Performing or initiating periodic calibration checks of radiation survey meters.
6. Performing or initiating periodic wipe tests of radioactive sources to detect leaks.
7. Maintaining a continuous inventory of the quantity and intensity of radioactive sources.
8. Developing a radioactive safety program for the Nevada District and ensuring compliance with it.
9. To make sure that the soil moisture depth probe is kept locked within its case, stored in the shield, and well secured in the transporting vehicle at all times except when in use at temporary job sites, and is placed in the designated, locked, storage facility when not in use.
10. To make sure that the source cells for the gas chromatograph are kept in limited access areas or stored in designated, locked, storage facilities.

III. NEVADA RADIATION SAFETY PROGRAM

A. The program purpose

The purpose of a radiation safety program is to prevent exposure of living tissue to penetrating radioactive radiation and to control the amount of radiation absorbed (dose rate) to limits below those affecting the regenerative power of living tissue. Penetrating radiation has the greatest effect on the regenerative power of the living tissue which grow or change most rapidly, such as bone marrow, gonads, eyes, etc. For this reason, occupational dose limits for these type tissues are much lower than for tissues such as hair, fingernails, or skin, extremities which do not change rapidly. Also for this reason, persons under the age of 18 years are not permitted, by NRC regulations, to handle radioactive sources or work in high dose rate areas. Radiation absorbed by living tissue is measured in REMs (Radiation Equivalent Man) and millirems (1/1000 REM).

Since the long-term effects of low specific activity (LSA) radiation exposure are largely unknown, any exposure should be considered dangerous and kept to a minimum. This may be accomplished in three ways:

1. controlling the length of time of exposure,
2. controlling the distance between the source of radiation and the living tissue, and
3. introducing a shield between the source of radiation and the living tissue.

The Nuclear Regulatory Commission's rules and regulations (TITLE 10, CHAPTER 1, CFR part 20, Sec. 20.101) limits any individual from receiving in any period of one calendar quarter a total occupational dose (from radioactive material and other sources of radiation) in excess of the standards specified in the following table:

Millirems Per Calendar Quarter

- | | |
|--|--------|
| 1. Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads. | 1,250 |
| 2. Hands and forearms, feet and ankles. | 18,750 |
| 3. Skin of whole body. | 7,500 |

If warranted, an individual may be permitted to receive a greater occupational dose to the whole body following guidelines presented by the NRC in Section 20.101(b). However, a greater occupational dose by any individual while employed by the Nevada District is not generally warranted. To receive a greater occupational dose prior approval must be obtained by the individual from the District Radiation Officer with the consent of the District Chief.

The maximum accumulation of whole body radiation by workers in an occupational use of radioactive materials is, therefore, limited by NRC regulations to 5,000 MREM per year or 1,250 MREM/QR. This reduces down to 100 MREM/WK, allowing for two weeks vacation for the worker. This is to be considered the maximum recommended tolerance level. We must always strive to maintain accumulation as low as possible. The less radiation received, the better.

In comparison, we receive background radiation constantly from both the earth's crust and outer space. The average radiation dose we receive from these sources varies from place to place. In the mid-latitudes and at sea level we receive about 100 MREM each year (i.e., San Francisco, or New York). At higher elevations such as Denver we would receive about 125 MREM each year. On the average, we receive over 100 MREM per year or 2 MREM/WK. This amount of natural radiation is less by a factor of 50 than what the NRC regulations allow.

1. Soil Moisture Probe

The 500 series CPN Hydroprobe used by the Nevada District uses a 50 millicurie-ameridium-241 source which outputs the following radiation according to its manufacturer:

Gamma radiation on the surface of the gage is approximately 1 MREM/HR which reduces to less than 0.05 MREM/HR at two feet from the guage.

Thermal neutron output is approximately 0.2 MREM/HR on the surface of the gage.

Fast neutron output is approximately 4 MREM/HR on the surface of the gage with the source probe still housed within the wax side shielding of the hydroprobe housing. At 3 feet the radiation drops to 0.05 MREM/HR. Note: neutron output is approximately 9 MREM/HR on the bottom of the gage or within 4 inches of the exposed source probe. At 3 feet from the exposed source probe the radiation drops to 0.22 MREM/HR.

The manufacturer gives the following example: total gamma and neutron radiation at mid-trunk of the human body, with the Hydroprobe in its case and being carried by its handle, is approximately 0.3 MREM/HR. If you carry the probe for 2 hrs. per day you would accumulate (2 hrs. x 5 days x 0.3 MREM/HR) = 3.0 MREM in a week's time. This is 1/30 of the allowed weekly dose.

The above example does not take into consideration the radiation received while actually using the Hydroprobe. The ground is an effective radiation shield and at a depth of several feet little or no radiation from the source probe would be expected. However, when entering or leaving the borehole little or no ground is available to act as a shield.

Measurements made at the ground surface present the greatest risk to human tissues from neutron radiation. When taking surface or near surface readings, one must minimize the time of exposure and maximize the distance by stepping back a few feet while the counter is tallying. For example, kneeling next to the Hydroprobe while taking near surface readings during just one day of the week could expose one to an additional 20 MREM per week or 1/4 the allowable weekly dose (assuming 20 holes per day, 15 minutes per hole, and 4 MREM/hr).

2. Gas Chromatograph Radiation

The Tracor gas chromatograph detector uses a source cell containing a 15 millicurie nickel-63 beta emitter. Unlike neutron radiation, beta radiation is much less penetrating. A sheet of aluminum a few millimeters thick can stop beta radiation, while beta radiation can pass through only 1-2 centimeters of water or human flesh.

With the nickel-63 beta emitter within the source cell, there should be no radiation emitted from the source cell. The NRC feels that with proper handling of the source cell, the cell will not be damaged and no radiation will escape. For this reason wipe tests are performed only every 36 months and no dosimeters need be worn by individuals handling the source cells.

When operating the gas chromatograph, one should be careful not to overheat the source cell. This could cause the cell material to be vaporized and allow radioactive material to escape into the Lab and be inhaled into the lungs. The NRC has documented cases where this has occurred in gas chromatographs using Tritium sources. Although, there has been no known problems with the nickel-63 source, the NRC recommends venting gas chromatographs to protect the operators and the Lab from just such an accident.

B. The program definition and implementation

The definition and implementation of the Radiation Safety program of the Nevada District Office USGS WRD will be based on the maintenance of various types of logs. The completion of various data which will satisfy these logs will also satisfy the aforementioned purpose of the safety program and insure compliance with NRC regulations and the requirements of our radioactive materials license. These logs are as follows:

1. Utilization log

This log will contain the master file of the sources used by the Nevada District Office and will be maintained by the Radiation Safety Officer at the District Office in Carson

City. This log will contain:

- a. copy of the lease agreement listing type and strength (activity) of the source, the model, serial number, and manufacturer,
- b. packing slip and receipt of delivery,
- c. source storage record containing the date the source is removed and returned to permanent storage as well as its location of use. (fig. 1),
- d. emergency reports (fig. 2), and
- e. records receipt of disposal (fig. 3).

This log will be maintained at least five (5) years after the source is disposed.

2. License log

This log will contain copies of the Nevada District Office NRC license with all updates, copies of registration with interested state and local agencies, and all related correspondence. This log will be maintained by the Radiation Safety Officer and will be located in the District Office in Carson City.

3. Survey log

This log will contain the following reports:

- a. results of survey of source storage areas (fig. 4),
- b. results of job-site and vehicle surveys, list of holes logged (figs 5 and 6).

4. Personnel monitoring log

All personnel directly related to activities involving the neutron source will be required to wear a film badge to monitor and furnish permanent record of "ionizing" radiation exposure.

Film badge service will be provided by Gulf Nuclear Inc., 100 Nasa Road One, Suite 411, Webster, Texas 77598. Film badge monitoring reports will be determined and filed on a monthly basis.

All personnel indirectly related to activity involving radioactive material (e.g., as well drilling crews, incidental observers or assistants) will not be allowed in areas with an exposure level of 2 mRem/hr or greater.

5. Training Log

This log will contain records of formal and informal training received by those personnel involved in the use, handling or supervision of the sources. This log will be maintained by the Radiation Safety Officer in the District office in Carson City. The RSO will periodically, or on call, review this file and recommend needs to the training officer to satisfy the requirements of the well logging program, the Nevada District Office NRC license and the Nevada District Radiation Safety Program.

6. Radiation-Monitoring Instruments and Calibration Log

This log will contain records of radiation-monitoring instruments used by the Nevada District Office (fig. 7) and will include the type of instrument, its maker and the model and serial numbers of each one. The radiation-monitoring instruments (in active use) will be calibrated every 12 months by the Health Physicist at the Denver Federal Center nuclear reaction facility or by a private company licensed to do so. Records of each calibration will be maintained (fig. 8 or copy of calibration results) in this log.

7. Leak-Test Log

This log will contain records of all radioactive-source leak tests (wipe tests) (fig. 9 or copy of test results).

- a. Warning: a source is not to be used when a wipe test indicates a leaking source, or a wipe test has not been performed on the source during the time interval specified on the licence. The sources shall be tested for leakage and/or contamination at intervals not to exceed:

1. 6 months for the neutron source, and
2. 36 months for the beta sources.

- b. Wipe tests will be performed with a kit manufactured by Gulf Nuclear Inc., Model #-LTK-1, consisting of:

1. a detergent solution,
2. cotton swabs, and
3. plastic bags.

- c. The testing procedures is as follows:

CAUTION: Wear disposable vinyl or rubber gloves when making this wipe test.

Wipe the container holding the source with cotton swab wetted with the detergent solution. Wipe all around the container (sonde) concentrating on rusty, worn, or cracked places, along seams, and around vent parts or components which slide in or out of shields.

All disposed material such as gloves will be saved and tested for radioactivity. If radioactivity is found, disposal will be through the Ractor Center at the Denver Federal Center. If none is found, normal disposal will be used.

After wiping is complete, place swab into a plastic zip lock bag. Repeat the wipe test with a dry cotton swab, and place into zip lock bags.

Label the bags wet and dry and add serial number of probe and date of wipe test with a permanent marker. Place bags and cover letter in an envelope. Seal with tape. Do not lick the envelope to seal. Send this envelope to:

Gulf Nuclear, Inc.
100 Nasa Road One, Suite 411
Webster, TX 777598
Telephone: (713) 332-3581

The swabs will be evaluated and the results returned to the Radiation Safety Officer Nevada District Office in Carson City, for inclusion in this log.

If a wipe test indicates a leaking source, a second test will be performed immediately. If the second test is also positive, the source will be disposed of through the Nuclear Reactor Facility at the Denver Federal Center in Lakewood, CO, or returned to the manufacturer.

IV. STORAGE FACILITY AND PROCEDURES

A. Permanent

The permanent storage facility for the neutron source and other sources when not in general use is in the USGS Workshop located at 2151 Lone Mountain Drive, Carson City, NV 89701. This facility is illustrated by fig. 10 and its use is described as follows:

The neutron source will be stored in its shielding container and kept in a locked storage locker inside the USGS Workshop. The source will remain locked within its case at all times when in permanent storage except when leak tests are being performed. Access to the locker is limited to those persons named on the Nevada District Office NRC license. Penetrating radiation in the work area is less than two milliroentgens per hour, hence it is not a restricted area and no warning signs will be posted. However, a sign bearing the words "CAUTION RADIOACTIVE MATERIAL" will be posted on the locker door. The workshop is kept locked and only USGS personnel who use the area have a key.

B. Temporary

Temporary storage of the neutron source is anticipated during its use in well logging. During those times, a logging truck will be used as the storage facility. The source will be locked inside its case (see next section) and the case well secured at the rear of the logging truck (fig. 11). The shield is constructed and placed so that radiation detected at the surface of the logging truck will be 2mR/hr or less. For temporary storage at the U.S. Ecology Site in Beatty, Nevada (fig. 12), the source will be placed in a locked shed. The shed is inside a six foot high locked fence topped with razor wire. The source will remain locked within its case at all times during temporary storage, except when being used in logging operations. Since the source is of low specific activity and will usually be locked in its case, the truck is not considered a restricted area and no warning signs are posted.

Temporary storage of the beta sources is permitted with the gas chromatograph detector at 809 North Plaza Street in Carson City. The temporary storage area for the beta sources being in a "limited access area"--accessible only to authorized persons and locked when an authorized person is not present.

C. Shields

The storage shield for the neutron source while in permanent storage, is the same one used while the source is in transit. This shield, supplied by CPN, is a 7 inch x 14 inch surface instrument unit filled with silicon-based paraffin and placed in a locked carrying case. A locking device is attached to the tool preventing source from sliding out of the shield.

V. TRAINING

A. Personnel needs

Persons who will directly use or supervise the use of the neutron sources or who have radiological safety responsibilities will be required to attend a formal school to equip them to do their job. This school will give sufficient training to permit inclusion of this trainee's name on the Nevada District Office NRC license, to satisfy the needs of the Nevada District Office well-logging program, to comply with the Nevada District Radiation Safety Program. A certificate will be issued by the school to confirm individual training.

B. Record keeping

Records of all radiological training will be maintained by the Radiation Safety Officer in the file identified as the "Training Log."

C. Training Review

The Radiation Safety Officer will periodically review the "Training Log," to determine if needs of the Nevada District Office well-logging program and the requirements of the Nevada District Radiation Safety Program are met. The RSO will make recommendations to the training officer toward correcting any deficiencies which may be found.

VI. PROCEDURES FOR USE OF NEUTRON SOURCE

A. Normal Operations

U.S. Geological Survey personnel in charge of well logging with radioactive sources are responsible for the health protection of personnel associated with the sources and the general public. These personnel must personally supervise all source handling operations, transportation, storage and shipping according to the following regulations:

1. Only those USGS personnel who have reached the age of 18 years or more, who are properly trained, and who have been authorized to do so will be permitted to handle the source. Drivers of vehicles used to transport radioactive source must be 21 years of age or older.
2. Only approved tools or methods will be used when handling the source.
3. The source will be stored in the shield and transported in a locked placarded case. In transport, the locked case will be fastened securely to the floor at the rear of the logging truck. At the job site, the case may be left in the logging truck or may be set far enough away from any occupied areas that measured radiation exposure rates at the immediate job site or other occupied areas is less than 1 mR/hr over background count.
4. The Logger Operator or the Radiation Safety Officer will be present at all times when the source is removed from its shield and lowered into the well. They shall remain at the site until the source is returned to its shield. (This last requirement may be overruled when emergency procedures prevail).

Procedures to follow in a typical normal operating situation are as follows: (These steps may be modified to match conditions; however, no modification may be made which contradicts Nuclear Regulatory Commission (NRC) rules, Department of Transportation (DOT) regulations, or the Nevada District Office Radiation Safety Program.)

- a. Notify District Chief or RSO of intent to remove sources from permanent storage.
- b. Initiate "Source Storage Record" (fig. 1), "Vehicle and Job Site Survey" (fig. 5 and 6).
- c. Load shield containing the source into the truck and fasten them securely to the truck floor. Conduct a radioactive exposure survey

of the truck as designated on "Vehicle Survey" (fig. 6).

- d. Drive to job site, set up equipment and prepare for logging operations.
- e. If the hole has not been previously logged, conduct initial site survey (fig. 5).
- f. The sealed source owned by the Nevada District Office is a fast neutron emitter composed of americium 241: beryllium. It is always kept inside its sonde source holder and the source holder attached to the tool and stored within its shield. This assembly is removed from its shield only when actually used for well logging. When ready to log the well, the shield and sonde source are attached to the well head and once attached, the sonde and tool are removed from the shield and quickly placed down the access tube.

When logging operations are completed, return the sonde and tool to its shield immediately, reversing the handling procedures. When obtaining standard counts with the source in its shield, the operator moves as far away as is practical. (Step back several feet while the counter is tallying up counts. This is also recommended when the source is less than 2 or 3 feet into the ground.)

- g. Measure the radiation level at the well head and three feet from the well head in all four directions. Do this prior to logging any new hole and at the last hole logged during the day. Record all readings on Job Site Survey form (fig. 5 and 6). If a positive leak test is obtained, all storage and job sites used since last leak test will be resurveyed.
- h. When all logging operations are complete, return the sources to their permanent storage locations, complete "Source Storage Record" (fig. 1) and "Vehicle and Job Site Survey" (fig. 6) and file with the RSO. These records will be placed in the files under their appropriate log file designations.
- i. Notify the District Chief and RSO that the sources have been returned to permanent storage. This will include an oral report on activities pertinent to the handling of the sources if all went well and a written report if they did not.

B. Emergencies

Emergencies may involve vehicular accidents, thefts, spills, fires, explosions, leaking sources, or down hole loss of the sources. In the following, the handling of each of these general types of emergency is treated in a separate paragraph. The National Bureau of Standards Handbook #48, "Emergency Guides" was used as a general reference. These procedures not covered in this outline. In all cases, an Emergency Report (fig. 3) will be completed and filed with the RSO in Carson City for inclusion in the permanent file labeled "Utilization Log".

1. Vehicular Accidents

If an accident involving a vehicle transporting sources occurs, the operator should:

- a. remain at the accident scene until safe disposition of the sources is complete,
- b. do those things required by Nevada law when a vehicle accident occurs,
- c. notify the investigating officer that the vehicle carries radioactive material, the kind, activities (Curies), and type of shielding,
- d. notify the immediate supervisor, the Radiation Safety Officer and the District Chief,
- e. make a visual inspection of the shields to determine if they are damaged, then check them with the radioactive survey meter. If the shields are intact, the sources may be left in them. If the logging truck is disabled by the accident and the shields are intact transfer the shields to the rear of another vehicle, fill out another "Vehicle Survey Report" (fig.6) and transport the shields and sources to their permanent Carson City storage location. In the case of extensive damage to either of the shields, the sources should not be removed because the source capsules may be ruptured. People should be kept clear and a Health Physicist can recommend further actions. If damage to the

shields appears extensive enough to call a Health Physicist, contact:

United States
Department Of Energy (DOE)
Health Physics and Environmental Protection
P.O. Box 98518 , Mail Stop #505
Las Vegas, Nevada 89193
(702) 295-0995
JoAnne Burrows, Health Physicist

and / or

State Of Nevada
Department of Human Resources
Health Division
Radiological Health Section
505 East King Street, Room 202
Carson City, Nevada 89710
(702) 885-5394
Ask for a Health Physicist

2. Theft

If the sources are stolen, the operator in charge will notify (a) who will, in turn, notify a., b., c., d., as deemed necessary.

- a. District Chief and RSO in Carson City
Telephone: (702) 882-1388
- b. Federal Bureau of Investigation
Telephone: (702) 882-1248 in Carson City or
(702) 323-7143 in Reno.
- c. The Sherrif of the county involved.
- d. The Nevada Highway Patrol
Telephone: (702) 885-5300

3. Fire

If a fire occurs that involves the shields and sources, the operator will:

- a. notify the District Chief and RSO in Carson City, and
- b. when the fire has subsided and access to the shields regained, make a visual inspection of them to determine if they are damaged. This will be supplemented by a survey of shields with the radiation survey meter. If

the shields are intact, leave the sources in them, transfer the shields to another vehicle, fill out another "Vehicle Survey Report" (fig. 6) and transport the shields and sources to their permanent or temporary storage location. If the shields are found to be extensively damaged, the sources should not be removed because the source capsules may be ruptured. People should be kept clear of the area and a Health Physicist contacted through the RSO. Any further procedures at the site will be upon the Health Physicist's recommendations. If damage to the shields appears to be extensive enough to call in a Federal Health Physicist, the Nevada Department of Human Resources' Radiological Health Section should also be notified (see address and phone above).

4. Explosions

If an explosion occurs in which the shields and sources are involved, the procedures to follow will be similar to those outlined for vehicular accidents or fire.

5. Leaking Sources

Wipe tests must be performed at least every 6 months on the neutron source and every 36 months on the Beta sources to detect if the source containers have ruptured or cracked, exposing the raw radioactive material. This procedure is described in section III B of this manual. If the shields containing the sources are involved in a wreck, fire, or explosion, the sources will be given a wipe test immediately upon their return to permanent storage in Carson City. If the sources are stolen, a leak test will be performed immediately upon their recovery.

If the results of the wipe test are returned with negative results, no further leak testing will be done for 6 months except in the cases listed above. If the results of the wipe test are returned with positive results, a second wipe test will be performed immediately. If that second test also has positive results, the sources will be removed from service and disposed of through:

U.S. Geological Survey,
Nuclear Reactor Center
Bldg. 15, MS: 424
Denver Federal Center
Lakewood, CO 80225;
Telephone: (303) 236-4053,
 FTS: 776-4053
Bill Smith, Health Physicist.

6. Source Lost Downhole

- a. If a source is lost (or stuck) downhole, notify the well owner of the type and activity (Curies) and the efforts that are being made to retrieve the source.
- b. Contact the Radiation Safety Officer of the situation so that he may notify the proper agency or agencies that a source has been lost and keep them informed of progress being made in recovering the source.
- c. Keep unnecessary personnel away from the site. Monitor the well head area; if radiation levels indicate this is a restricted area (2 mr/hr or greater), furnish film badges or dosimeters to those involved in the recovery operation.
- d. The Nuclear Regulatory Commission (NRC) must be informed by telephone within 24 hours of the loss telling them how you plan to retrieve the source.

United States
Nuclear Regulatory Commission (NRC)
Region 5
1450 Meria Lane, Suite 210
Walnut Creek, California 94596
(415) 943-3700
Beth A. Riedlinger, Health Physicist

The NRC must then have a written confirmation of the telephone conversation. If the source is irretrievably lost, the loser is required, within 30 days to:

1. Immobilize and seal the source in place in the well with a cement plug.
2. Mount a permanent identification plaque with appropriate information at the wellhead.
3. Report the event in writing to the NRC and appropriate state agencies, providing information listed in 6.a. of this section.

Note: If the source capsules are intact, the sealed radioactive source used in the Carson City District Office well logging activities may be safely abandoned in a well. A gamma-ray source abandoned in a well cannot "induce" radioactivity in the well or water. For all practical purposes, this is also true for an americium 241: beryllium neutron source.

7. Techniques for Retrieving a Lost Radioactive Source

a. Large diameter cased holes

A radioactive source lost permanently in a borehole can be a very expensive proposition. For this reason, a probe containing a radioactive source should not be put down a well until it has been determined that the hole is "clean". The first logging run should be made slowly using a "non-source" tool, a "rabbit", or a weight on a steel tape, to determine if the hole is blocked or if any caving has or is occurring downhole. If a radioactive source does become stuck in a borehole, the following "fishing" procedures should be tried immediately:

1. Obtain about a 10-foot (or longer) length of black iron pipe or any other type of relatively heavy tubing having an inside diameter just slightly larger than the outside diameter of the tool or "fish". Have the length of tubing spirally cut for the entire length and thread it over the logging cable and attach the upper end to another wireline. After threading the logging cable through the tubing, place wraps of nylon tape spaced about 2 feet apart around the spirally cut tubing so that the tubing will not come off the logging cable as the fishing tool is lowered downhole. The fishing tool is lowered until it contacts the stuck probe. Then, while keeping tension on the logging cable, the fishing tool should be raised several inches to perhaps several feet and allowed to drop, striking the probe. Continue this procedure until the probe is free or until this method appears futile. In most cases, this technique will work and the probe can be retrieved by winding in both wirelines simultaneously to avoid entanglement and further logging wireline damage.
2. If the stuck probe becomes detached from the logging wireline, the probe might be retrieved using a drilling-type fishing tool called an overshot. This type of tool is available commercially from drilling or logging supply places. The overshot is usually run into the borehole on drill steel using a drilling rig to perform the fishing operation. Various type grapples are also available if the overshot method should fail to retrieve the probe. Like

the overshot, most grapples also utilize a drilling rig to do the fishing. Wireline overshots, made to fit the lost probe, have also been used successfully.

These techniques are just a few of the more successful methods to try for retrieving a lost or stuck probe. All efforts and means should be expended before giving up and cementing the probe in the hole.

b. Small diameter cased holes

Holes logged by the Nevada District Office will be 2 inch diameter access tubes installed and sealed for the sole purpose of neutron logging. These holes are usually fairly shallow, less than 100 feet deep. In the event of a stuck probe, a hoist or drilling rig will be used to pull the casing string from the ground while keeping tension on the logging cable. If this fails, fishing procedures outlined in section 7.1. or 7.2. will be used to free the probe. If both procedures fail to retrieve the probe the hole will be sealed according to procedures outlined in Section 6.a-d.

VII. NOTES

- A. The employer must display on a bulletin board accessible to all employees, a notice of employer responsibility in the event of radioactive exposure. A posted copy of the employer's NRC license is also desirable.
NOTE: substantial fines can be assessed by NRC against any Federal employees found in violation of the NRC regulations.
- C. An "agreement" state is one in which its own regulatory agency establishes and enforces its own regulations concerning radioactive materials and their handling.
- D. An "NRC" state is one in which the Nuclear Regulatory Commission establishes and enforces regulations concerning radioactive materials and their handling.
- E. The NRC license owned by the Nevada District Office, WRD, permits authorized and trained personnel, as named on the license, to work in either type of state provided:
1. The proper authorities are notified, in writing, prior to the work being performed.
 2. The operations do not last more than 180 working days.

Figure 1.--RADIOACTIVE-SOURCE STORAGE RECORD

Permanent Storage Location _____

Month of _____ 19____ WRD District _____

[illegible]

Figure 2.--EMERGENCY REPORT

Date and Time of Emergency _____

Location of Emergency _____

Name and Title of Person in Charge on Site When Emergency Occurred _____

Cause of Emergency _____

Name, Title, and Agency of Other Federal Employees Involved _____

Figure 2.--EMERGENCY REPORT--Continued

Description of Federal Employee Involvement _____

Name, Title and Company(s) of Civilian Employees Involved _____

Description of Civilian Employee Involvement _____

Source or Isotope Involved in Emergency _____

Source or Isotope Strength _____

Safety Measures Taken Immediately _____

Figure 2.--EMERGENCY REPORT--Continued

Sketch of Emergency Location (Mark Exact Spot With X.)

Results of Radiation Survey in mR/hr

Personnel:

Date _____

Time _____

Name _____

Head

Face

Body

Arms

Hands

Legs

Feet

[illegible]

Figure 2.--EMERGENCY REPORT--Continued

Area: _____ Date _____ Time _____

Site

Dose Rate

| | |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

Results of Wipe Test After Emergency

Date _____

Source

Dose Rate

| | |
|-------|-------|
| _____ | _____ |
| _____ | _____ |

WRD District

[illegible]

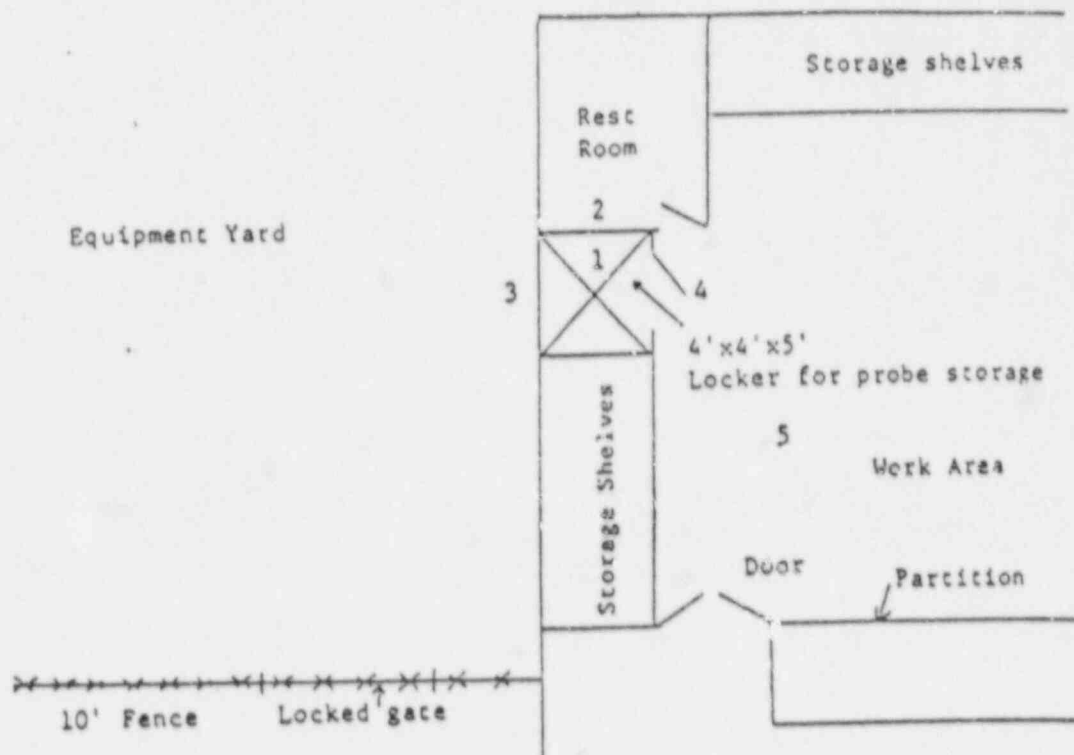
Figure 4.--SURVEY OF PERMANENT STORAGE AREA

Date _____ By _____ WRD District _____

Instrument Used _____

Probe Used _____

Date Calibrated _____



| Site Number | Neutron | | Beta-Gamma | | |
|-------------|---------|-------|------------|-------|-------|
| | c/m | mR/hr | mR/hr | c/m | mR/hr |
| 1 | _____ | _____ | _____ | _____ | _____ |
| 2 | _____ | _____ | _____ | _____ | _____ |
| 3 | _____ | _____ | _____ | _____ | _____ |
| 4 | _____ | _____ | _____ | _____ | _____ |
| 5 | _____ | _____ | _____ | _____ | _____ |
| 6 | _____ | _____ | _____ | _____ | _____ |

FIGURE 5.

INITIAL SITE SURVEY
BEFORE ANY LOGGING BEGINS

LOCATION _____ DATE _____

WELL LOCATION AND NUMBER _____

SURVEY METER SERIAL NUMBER Victoreen
4035 DATE CALIBRATED _____



mR/hr

NORTH _____
SOUTH _____
EAST _____
WEST _____
WELL-
HEAD _____

OPERATOR

FIGURE 6. JOB SITE AND VEHICLE SURVEYS

LOCATION _____ DATE _____

WELL LOCATION AND NUMBER _____

SOURCE NUMBER CPN MOD. 503, SN H34045351

SURVEY METER SERIAL NUMBER ^{victoreen} 4035 DATE CALIBRATED _____

Truck Survey before leaving: Front _____ mR/hr

Rear _____ mR/hr

Left Side _____ mR/hr

Right Side _____ mR/hr

Cab _____ mR/hr

| | |
|--|---|
| | C |
| | A |
| | D |

SURVEY OF LAST WELL OF THE DAY

mR/hr



NORTH _____

SOUTH _____

EAST _____

WEST _____

WELL- _____

HEAD _____

Truck Survey after Job:

Front _____ mR/hr

Rear _____ mR/hr

Left Side _____ mR/hr

Right Side _____ mR/hr

Cab _____ mR/hr

| | |
|--|---|
| | C |
| | A |
| | B |

OPERATOR

Figure 7.--RECORD OF RADIATION MONITORING INSTRUMENTS

Instrument Type _____

Model Number _____ Serial Number _____

Date Purchased _____

Condition _____ Date _____

Record

What Was Done?

Date _____

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper appears slightly aged or off-white. There is no handwriting or other markings on the page.

[illegible]

Figure 8.--INSTRUMENT CALIBRATION RECORD

Instrument Type _____

Model Number _____ Serial Number _____

Probe Type _____

Date _____ Time _____

Calibration Source _____

Downloaded from <http://ajphaphysocpharm.sagepub.com/> at 10:00 11 November 2014

Record

[illegible]

Calibration By _____

Title _____

Figure 9.--STATEMENT OF SOURCE WIPE TEST

Identification

Source Form _____ Model No. _____
Source Manufacturer _____
Isotope _____ Strength _____
Source Owner _____
Address _____

By Product License Number _____
Date of Test _____
WIPE Test By _____

Results

Gross Counts _____
Background Count _____
Disintegrations Per Minute _____
Efficiency _____
Removable Contamination _____
Counted By _____ Date _____
Title _____

Equipment Yard

15'

Rest
Room

Storage shelves

Storage Shelves

4'x4'x5'
Locker for probe storage

Work Area

Door

Partition

10' Fence

Locked gate

Locked
Door

Work Area

FIGURE 10--Diagram of
USGS workshop at 2151
Lone Mountain Dr., Carson
City, Nevada, showing
location of permanent
storage locker for neutron
probe.

Work Bench

Storage
Cabinets

Storage Cabinets

Locked
Door

Work Area

72'

30'

FIGURE 11--SKETCH OF LOGGING VEHICLE SHOWING LOCATION OF POINTS OF INTEREST.

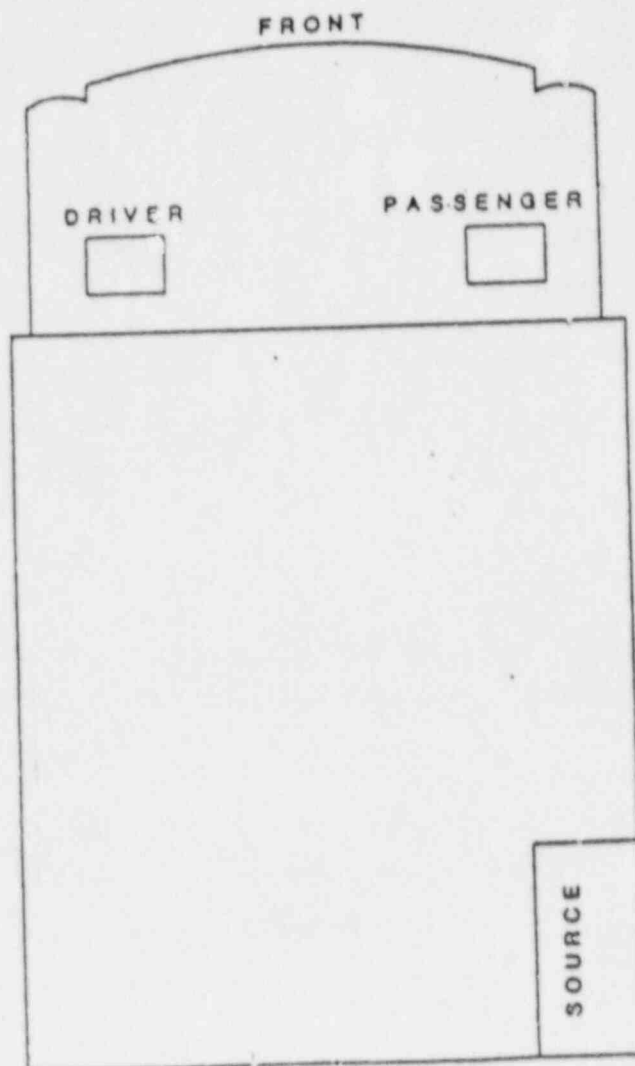


FIGURE 12. Temporary storage site at U.S. Ecology, Beatty, Nevada.

