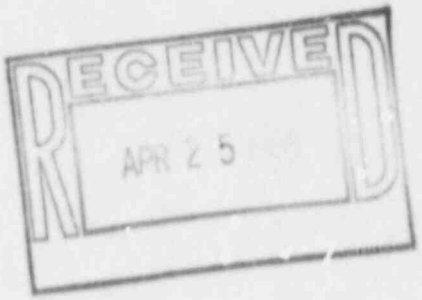
PRAIRIE WIRELINE SERVICE

OPERATING AND EMERGENCY

PROCEDURES MANUAL



PRAIRIE WIRELINE SERVICE

OPERATING AND EMERGENCY PROCEDURES MANUAL

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April 1988

WHENEVER THIS MANUAL REFERENCES THE STATE OR FEDERAL REGULATORY AGENCY FOR CONTROL OF RADIATION, IT IS TO BE UNDERSTOOD THAT FOR OPERATIONS IN THIS STATE THE AGENCY REFERENCED IS:

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV - OFFICE OF INSPECTION & ENFORCEMENT
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TEXAS 76012

TELEPHONE: (817) 860-8100

OPERATING & EMERGENCY PROCEDURES MANUAL

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OPENING STATEMENT:

This manual outlines procedures pertaining to the use and handling of radioactive materials in well logging applications. It is the intent of Prairie Wireline Service to comply in every way possible with State and Federal regulations for control of radiation. Although references are made to the maximum permissible dose and our operations are such that the levels of radiation provide a low risk of exposure, we will follow procedures and practices that will maintain doses to individuals as low as is reasonably achievable.

A safety committee will be formed to regularly review Prairie Wireline Service's safety procedures and policies, and to be made aware of any discrepancies which exist. Our health physics program will be reviewed and upgraded as it pertains to exposure, and new programs will be implemented if determined that improvement can be made.

It is the intent of Prairie Wireline Service to minimize safety problems and noncompliance problems, to minimize hazards to employees, and to ensure that all company personnel are committed to a safe and proficient safety program. We will make every effort to inform and train our employees in the proper use and handling of radioactive materials. We will provide appropriate handling tools, survey equipment and personnel monitoring devices for the protection of our employees. We will also have available at our facility and on our logging vehicles fire extinguishers, first aid kits, and decontamination kits (when applicable). These decontamination kits will contain the following items:

1. Absorbent napkins
2. Plastic bags
3. Disposable rubber gloves and boots
4. Wipe swabs
5. Small vial potassium solution - 10% per volume
6. Barrier rope with warning signs
7. Small bar industrial soap
8. Appropriately designed face mask

The only tracers used in our logging operations will be Iodine 131 and Iridium 192. At no time will cutting techniques be practiced by company employees anywhere within our operations.

The following pages give specific procedures.

I. MANAGEMENT RESPONSIBILITY

A. The Radiation Safety Officer (RSO) is responsible for the over-all coordination of the radiation safety program, serves as the licensee's liaison officer with the NRC on license or inspection matters, and acts in an advisory capacity to the licensee's management and logging personnel. Typical duties of the RSO include:

1. Develop and maintain up-to-date operating and emergency procedures.
2. Control procurement and disposal of licensed material, maintain associated records, and ensure that licensed materials that are possessed or used are limited to those specified in the license.
3. Ensure that the terms and conditions of the license are met and that required records, such as personnel exposure records, leak test records, etc., are periodically reviewed for compliance with NRC regulations and license conditions.
4. Conduct radiation safety inspections of licensed activities periodically to ensure compliance with the regulations and license conditions.
5. Establish and maintain storage facilities and ensure that licensed material is properly secured against unauthorized removal at all times.
6. Ensure that the licensed materials are used only by those individuals who have satisfactorily completed appropriate training programs or who are authorized by the license.
7. Examine and determine the competence of logging personnel, and establish and maintain the annual internal inspection program.
8. Establish and conduct in-house training of prospective logging supervisors and logging assistants.
9. Establish and maintain a personnel monitoring program and ensure that all users use personnel monitoring equipment, such as film badges or thermoluminescent dosimeters (TLD).
10. Establish and maintain the leak test program and supervise leak testing of sealed sources.
11. Procure and maintain radiation survey instruments and establish and maintain a survey instrument calibration program.
12. Conduct semiannual inventories and maintain utilization logs.
13. Review and ensure maintenance of records kept by others.
14. Establish and maintain proper transportation labels, placards, forms and records.
15. Establish a procedure for evaluating and reporting equipment defects and noncompliance pursuant to 10 CFR Part 21.
16. Serve as a point of contact and give assistance in case of emergency, for example, well logging tool damage, theft of licensed materials, fire, etc., and ensure that proper authorities, for example, NRC, local police, and State personnel are notified promptly in case of accident or other incident that may involve the release of licensed material.
17. Investigate the cause of incidents and determine necessary preventative action.

B. Master Radiation Files will be maintained at the base facility by the Radiation Safety Officer. Typical records contained in these files are:

1. Radiation License Information

   (a) License and Amendments
   (retain until license renewed or terminated)
   (b) Operating & Emergency Procedures Manual
   (retain until replaced or license terminated)
   (c) State/Federal Regulations -- update and keep current
   (retain until replaced or license terminated)

2. Personnel Exposure Records

   (a) Exposure reports from dosimetry service
   (retain until NRC authorizes disposition)
   (b) Employee termination exposure report letters
   (retain for 3 years after termination of employment)

3. Training Records

   (a) Certificates, tests and other documentation verifying training set out in 10 CFR 39.61.
   (retain for 3 years after termination of employment)
   (b) Records of annual inspection of job performance of logging supervisors. (retain 3 years)
   (c) Records of annual safety reviews for logging supervisors and assistants. (retain 3 years)
   (d) Records of instruction provided to ancillary personnel at time of initial employment and annually thereafter. (retain 3 years)

3. Survey Records

   (a) Survey meter calibration certificates (retain 3 years)
   (b) Bunker/Facility surveys (retain 3 years)
   (c) Job site/Vehicle surveys (retain 3 years)

4. Source Information

   (a) Receipts of purchase and disposal
   (retain until license is terminated)
   (b) Leak/wipe test reports (retain 3 years)
   (c) Source utilization log (retain 3 years)
   (d) Semi-annual physical inventory (retain 3 years)
   (e) Semi-annual visual inspection and routine maintenance of source holders, handling tools, storage/transport containers and logging tools. (retain records of defects for 3 years)

5. Tracer Material Use (Retain all records 3 years)

   (a) RA material receiving log
   (b) Packing slip and receipt of delivery
   (c) RA material use log
   (d) RA waste disposal log
   (e) Receipt for shipment for disposal of RA material

C. Bulletin Board

1. Post - "Notice to Employees"
2. Post - Current personnel exposure report (photocopy)
3. Post - Notice of where license, procedures manual, and regulations can be found.

D. Documents and records at temporary job sites:

1. Operating and emergency procedures.
2. Survey records for the period of operation at the temporary job site.
3. Evidence of current calibration for the radiation survey instruments in use at the temporary job sites.
4. A copy of radioactive material license, if operating under reciprocity.
5. Shipping papers.

E. Documents and records at field stations where radioactive materials are used or stored:

1. Copy of radioactive material license.
2. Operating and emergency procedures.
3. Applicable NRC and/or Agreement State regulations.
4. Records of latest survey instrument calibrations on each survey instrument assigned to field station.
5. Records of latest leak test results on each sealed source assigned to field station.
6. Semiannual physical inventories of radioactive materials stored at field station.
7. Utilization records. (for field station)
8. Records of equipment inspection and maintenance. (for field station)
9. Facility, bunker, vehicle, job site, etc. surveys. (for field station)
10. Training records for each logging supervisor and logging assistant assigned to and/or operating out of field station.

F. Training of Personnel

1. At the time of initial employment, any ancillary personnel whose duties may require them to work in/around or visit a restricted area (for example, secretarial and janitorial personnel or assistants other than logging assistants, such as riggers) will be instructed in the radiation hazards and appropriate precautions as prescribed in 10 CFR 19.12 "Instructions to Workers".

   a. Instruction will be given by the Radiation Safety Officer and will be approximately 1-2 hours in length.

   b. Topics to be included in the instruction are:

      (1) Storage, transfer, and use of licensed materials at our facility and temporary work sites.

      (2) Basic principles and fundamentals of radiation safety and good safety practices related to our use of radioactive materials.

      (3) Precautions and procedures to minimize exposure to radiation and radioactive materials.

      (4) Purpose and function of radiation protection devices.

      (5) Applicable provisions of NRC regulations for protection of personnel from radiation exposure.

      (6) Worker's responsibility to report to the licensee any condition which may lead to or cause a violation of NRC regulations, license conditions, or unnecessary exposure to or release of radioactive materials.

      (7) Appropriate response in the event of any unusual occurrence or malfunction which may lead to radiation exposure or release of radioactive materials to the environment.

   c. A review of these topics will be made annually either individually or in group sessions.

   d. Records documenting this instruction for each individual will be maintained for 3 years.

2. No company employee will be permitted to act as a logging supervisor (use or supervise the use of licensed material) until he has:

   (a) Completed a radiation safety training course covering subjects outlined in 10 CFR 39.61 (e), demonstrated by passing a written test. This course will be taught by an instructor approved by the NRC to give radiation safety training specific for well loggers. (24 hours classroom)

   (b) Received copies of, instruction in and demonstrated an understanding of: NRC regulations contained in the applicable sections of 10 CFR Parts 19, 20, and 39; our NRC license; and our Operating and Emergency Procedures manual. (8 hours classroom)

   (c) Completed three months* on-the-job training and demonstrated competence in the use of licensed materials, remote handling tools, and radiation survey instruments by a field evaluation. (* 13 weeks or 520 hours of actual work performing well logging with licensed sealed sources and associated operations; 3 months full-time equivalent or 50 operations for each type of tracer study performed.)

   (d) Successfully completed a 50 question written exam to determine the individual's understanding of the topics covered in (a) and (b) above.

3. No company employee will be permitted to act as a logging assistant (handle licensed material and perform surveys under personal supervision of a logging supervisor) until he has:

   (a) Received instruction in applicable sections of 10 CFR Parts 19 and 20, and our operating and emergency procedures. (2-4 hours classroom instruction)

   (b) Received instruction in the use of licensed materials, remote handling tools, and radiation survey instruments, appropriate for the logging assistant's job responsibilities. (1-2 hours on-the-job instruction)

   (c) Demonstrated understanding of the above by corpleting a 25 question written or oral exam. (Questions will be chosen by the RSO from the 50 question exam submitted herewith and identified as APPENDIX B.)

4. An individual who has been a logging supervisor for another licensee will not be permitted to act as a logging supervisor for our company until he has:

   (a) Received formal instruction in topics outlined in 10 CFR 39.61(e).
   (b) Received instruction in our Operating & Emergency Procedures.
   (c) Received instruction in NRC regulations (applicable sections of Parts 19, 20, & 39).
   (d) Received instruction in terms and conditions of our license.
   (e) Received instruction in use of licensed materials, remote handling tools and radiation survey instruments.
   (f) Successfully completed a 50 question written exam and a field (practical) examination.

5. "In-house" instruction and testing as described in items 2(b,c,d) 3(a,b,c) and 4(b thru f) of this section will be conducted by the Radiation Safety Officer. The field (practical) examination will consist of observing procedures in Section IV and items in APPENDIX A and written/oral exam questions are given in APPENDIX B. Passing grade for examinations is 80% and any employee not passing the examination will be retrained/reinstructed on all incorrect items and retested prior to being designated as a logging supervisor or logging assistant. Records of qualifications, certificates of training, tests, field evaluations, etc. indicating that the training requirements have been met will be maintained in the radiation files for inspection and retained for at least three years following termination of the individual's employment.

6. The Radiation Safety Officer will conduct an annual inspection (audit) of job performance of each logging supervisor as prescribed in 10 CFR 39.13(d) to ensure that NRC regulations, license provisions, and our operating and emergency procedures are being followed:

   (a) Annual inspections will be conducted on each logging supervisor at intervals not to exceed one year. Should a logging supervisor not perform well logging operations for a period that exceeds one year, the inspection should be carried out the first time that individual engages in well logging operations.

   (b) Annual inspections will be made at a job site and, insofar as possible, unannounced.

   (c) Annual inspection will be recorded on Annual Inspection Checklist (Appendix A) and this record for each individual will be retained for 3 years.

   (d) Any deficiencies identified will be discussed with the logging supervisor, instruction for correction of deficiencies will be given, and logging supervisor will be informed of actions that will be taken by management if the deficiencies are not corrected. A followup audit will be made to ensure that deficiencies have been corrected.

7. Safety reviews will be provided for logging supervisors and logging assistants at least once during each calendar year, as prescribed in 10 CFR 39.61.

   a. Topics reviewed will be: radiation safety principles, current regulations, new regulations or requirements, operating and emergency procedures, company policy with respect to radiation safety practices and any problems or deficiencies identified from our annual inspection program.

   b. Safety reviews will be conducted individually or in group sessions and instruction will be by the Radiation Safety Officer or Keith E. Moon of Support Consultants & Assoc.

   c. Records of annual safety reviews will include topics discussed and will be retained for 3 years.

II. RADIATION SAFETY AND MONITORING DEVICES

A. TLD Badges (Thermoluminescent Dosimeter)

1. A TLD badge will be assigned by name and number to each employee working with radioactive materials. Under NO circumstances will an employee be permitted to use a TLD badge other than his own.

2. The RSO will be responsible for the distribution of the TLD badges and the procedures governing their use. Care should be taken to prevent exposure of TLD badges to environmental conditions which involve excessive heat or moisture as such exposure will impair the ability of the badges to measure radiation dosage.

3. TLD badges will be worn attached to clothing in the trunk area of the body during all operations which involve possible exposure to radiation.

4. TLD badges will be returned to the RSO, or his designated representative, at the end of the control period for the badge. TLD badges will be exchanged on a monthly basis.

5. TLD badge reports will be kept current by the RSO and he will review them upon receipt noting any unusual or excessive amounts of exposure. These reports will become a part of each employee's personnel record by means of a quarterly individual exposure report. Each person to whom a TLD badge is assigned will be informed of his total radiation exposure upon request or within thirty (30) days after termination.

B. Survey Meters

1. A radiation survey meter shall be carried on each vehicle used for transportation of radioactive materials. Survey meters shall be sensitive to beta and gamma radiation and have a range of at least 0-50 mr/hr.

2. One or more operable radiation survey meter will be kept at the base facility as a spare and for emergency use.

3. A job site survey must be made before and after each operation using radioactive materials. A record of each survey will be kept in the radiation files.

4. A calibration check shall be performed on each radiation survey meter in service at six months intervals and after repair. The calibration check shall consist of testing the survey meter at two points other than zero, on each scale using a radiation source of known output. Calibrations will be performed by one of the following calibration service companys:

   G. E. Smith & Assoc., Pasadena, Texas TX License L00991
   Gulf Nuclear, Inc. Webster, Texas

C. Bioassays for Handlers of Iodine 131 Tracers

1. Regulations require that bioassays be performed whenever an individual handles more than 50 millicuries of liquid Iodine at any one time or a total of 50 millicuries of liquid Iodine within a one week period, in a field application (open air) such as well logging tracer studies.

2. In our operations we will not handle vials of Iodine 131 containing more than 40 millicuries, and we will not use more than 50 millicuries at any one time. If the situation should arise where more than 50 millicuries were required in a five day period, the tracer studies would be performed by different individuals, assuring that no one individual handles more than 50 millicuries in any five day period. If for some reason this could not be accomplished, the job would be turned down or performed using an alternative isotope for which we are licensed.

3. We commit to the above statements because it is not economically feasible for our company to comply with the bioassay requirements.

D. Leak/wipe Tests for Sealed Sources

1. A leak/wipe test shall be performed on each sealed radiation source at six months intervals. Leak/wipe tests will be performed by the RSO or other authorized radiation handler.

2. Leak/wipe tests will be performed through the use of kits according to the accompanying instructions. The kits will be supplied by one of the following:

   Suntrac Services, Inc., Webster, TX (SIT-1)
   G.E. Smith & Associates, Pasadena, TX (Leak Test Kit #2)
   Nuclear Sources & Services, Inc., Houston, TX (LT-1)
   Gulf Nuclear, Inc., Webster, TX (LTK-1)
   Eberline Instruments, Santa Fe, NM
   Assay Services, Inc., Friendswood, TX

3. After the leak/wipe test is performed, the kit will be checked with a survey meter prior to any shipment by U.S. mail or private carrier.

4. Leak/wipe test evaluations will be done in accordance with standard license requirements, and will provide data sensitive to 0.005 microcurie of removable contamination.

5. Results of leak/wipe tests (evaluation reports) will be kept in the radiation files.

III. STORAGE FACILITIES

A. Storing and Securing

1. When not being used, licensed materials will be stored in a secure area that is properly marked with appropriate radiation caution signs around the perimeter. This storage area will be locked at all times except when removing or returning materials.

2. Storage facilities are designed and positioned so that no person in an uncontrolled area will receive more than 2 mr in any hour or more than 100 mr in any seven (7) consecutive days.

3. Only persons authorized by the license (either named on the license or designated by the RSO) will be allowed to remove or replace licensed materials.

4. Surveys of the storage area will be made monthly by the RSO and maintained in the radiation files.

B. Posting Storage Areas and Restricted Areas

1. If survey of storage area is no more than 2 mr/hr at outside perimeter, it is considered "unrestricted" and should be posted with signs stating "Caution - Radioactive Materials".

2. If survey of storage area or any other area where radioactive are present is more than 2 mr/hr, the area is considered "restricted" and should be posted with signs stating "Caution - Radiation Area". In the event that radiation levels exceed 5 mr/hr, then signs stating "Caution - High Radiation Area", must be posted.

3. Signs will bear the standard radiation caution symbol and be magenta and safety yellow in color. They will be conspicuous and obvious from all directions.

C. Vehicle Storage

1. Licensed materials will be stored in an approved DOT 7A transport container which is kept locked at all times except when removing or replacing the materials.

2. The transport container will be placed in a designated area near the rear of the transport vehicle at the furthest point possible away from the driver or passengers, and fastened or chained to an integral part of the vehicle.

3. Vehicle may be used for temporary storage of sealed source at a job site, and at the field station for a day or two when job intervals are frequent to avoid unnecessary exposure when removing it to and from the storage bunker -- provided that "RADIOACTIVE" placards are replaced with "Caution - Radioactive Materials" signs and that vehicle is kept locked when unattended and parked within the confines of a locked fence or building, if possible.

IV. PROCEDURES FOR RECEIVING RADIOACTIVE TRACERS

A. When a shipment of radioactive materials is expected to be delivered, someone must be available at the facility to receive the package. If it is to be picked up at a carrier's terminal, someone must be sent to pick up the package as soon as possible after notification of its arrival. The employee receiving the shipment must physically check the package for compliance with Department of Transportation regulations. The package will not be accepted unless it meets the following criteria:

1. Box must reflect that it meets USA DOT 7A specifications.
2. Box must reflect the manufacturer's test seal, giving crush characteristics in pounds per square inch.
3. Box must have 4"x4" diamond shaped Radiation Yellow II or Yellow III labels, properly filled out giving isotope, curie quantity and transport index.
4. Packing slip and supplier's label must be attached to box.

B. As soon as practicable after receipt, the external surfaces of the package must be monitored with a low level, currently calibrated survey meter to insure the radiation levels do not exceed the following limits:

1. Yellow II label - Maximum of 50 mR/hr at surface and 1 mR/hr at 1 meter
2. Yellow III label - Maximum of 200 mR/hr at surface and 10 mR/hr at 1 meter

C. If there is any evidence of radioactive contamination, the Radiation Safety Officer will immediately notify the State or Federal regulatory agency, the carrier and the supplier.

D. If everything is in order, the radioactive material will then be logged in on a log sheet stating the date, isotope, survey (mR/hr), type of material (liquid, solid), chemical base and employee who made the log entry. (Ref: Figure #1 - RA Receiving Log)

E. Packages will be opened only by a licensed radiation handler (logging supervisor) using great care and avoiding any rough handling that might cause spillage. The package and/or tracer container must be placed in a licensed storage area pending transport to job site locations. Protective gloves shall be worn during the above procedures.

F. Packing material must be monitored for contamination after removing the tracer container from the package. Survey the packing material and packages in a low background area for contamination before discarding. If contaminated, treat as radioactive waste. If not contaminated, obliterate the radiation labels before discarding as ordinary trash.

V. TRANSPORTATION OF RADIOACTIVE TRACERS

A. The logging supervisor will log the quantity of radioactive tracer material to be used with date, isotope, form and chemical base, activity, location of use and signature. (Ref: Figure #2 - RA Material Use Log)

B. Each transportation vehicle will have a locked transportation area for radioactive materials designated by the RSO and located at the furthest point possible away from driver or passengers. Under NO circumstances will the radioactive material be transported in the cab of the vehicle.

C. Licensed material will be placed in the designated area in the vehicle, in an appropriately designed transport container meeting DOT 7A specifications (records of testing must be in radiation files), or may be shipped in the original shipping container received from supplier if no alteration in packaging has been made.

D. After the licensed materials are in place and prior to transporting, exterior surfaces and passenger compartment of the vehicle must be surveyed to ensure that the radiation levels do not exceed 2 mR/hr at any exterior surface and 2 mR/hr in the passenger compartment.

E. Transport container must have a durable label with the identification and activity of the radioactive material and the standard three bladed radiation symbol. The label will also state "DANGER (or Caution) -- RADIOACTIVE -- NOTIFY CIVIL AUTHORITIES (or Name of Company) IF FOUND".

F. Transport container must be marked with letters at least 1/2 inch high, "USA DOT TYPE A". Radiation Yellow II or Yellow III labels (4"x4") must be affixed to the transport container giving the contents, activity and transport index (TI), which is the maximum radiation level in millirem, per hour at one meter from the external surface of the container.

   1. TI less than 1.0 -- Yellow II

   2. TI more than 1.0 and less than 10.0 -- Yellow III

G. All vehicles transporting radioactive materials in the Yellow III category must be placarded on both sides, the front, and the back with "RADIOACTIVE" placards approximately 11" x 11" and diamond shaped, with yellow top half and white bottom half and black lettering. "RADIOACTIVE" placard must not be displayed when radioactive materials are not on the vehicle.

H. Shipping papers containing information set out in DOT regulations (Subpart C of 49 CFR Part 172) must be properly completed and signed, and must be located in the cab of the transport vehicle within reach of the driver. (Example of completed shipper's certification on following page.)

SHIPPER'S CERTIFICATION FOR RADIOACTIVE MATERIALS

NATURE AND QUANTITY OF CONTENT					PACKAGE			
PROPER SHIPPING NAME	RADIONUCLIDE	ID NUMBER	FORM	ACTIVITY	NO. OF PKGS.	LABEL CATEGORY	TRANSPORT INDEX	TYPE
EXAMPLE								
RADIOACTIVE MATERIAL n.o.s.	I-131	UN 2982	LIQUID	10 mCi	1	RADIOACTIVE YELLOW II	.2	TYPE A

NAME AND FULL ADDRESS OF SHIPPER:

I HEREBY CERTIFY THAT THE ABOVE NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED, AND LABELED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION.

Signed: _____

Date: _____

DESTINATION: _____

BORDER IS ALTERNATING RED AND WHITE

VI. PROCEDURES FOR HANDLING AND USE OF RADIOACTIVE TRACERS

A. The only tracer materials used in our operations will be Iodine 131 and Iridium 192. Tracer materials will be purchased in "ready to use" form and there will be no cutting or mixing by any of our employees anywhere in our operations. The maximum per unit or vial will be 40 millicuries, however, materials are usually purchased in units of 10 millicuries as this is the amount normally used in a well logging application. Handling and use of tracer materials will be done with respect to time, distance and shielding for protection from radiation exposure. No smoking, eating or drinking is permitted while handling or using tracer materials.

B. Protective gloves will be worn at all times when handling or using tracer materials, and when appropriate, protective clothing and face masks will also be worn. Of course, TLD badge will be worn at all times when handling or using tracer materials.

C. An appropriate remote handling tool for loading vials or cans of tracer materials and a currently calibrated survey meter will be on hand at job site locations.

D. Following are job site procedures for use of tracer materials in liquid form. A "handler" is a logging supervisor, or logging assistant working under direct supervision of logging supervisor, who has met the training qualifications set out in Section I-F of this manual and have been named on the license or designated by the RSO under authority of the license.

1. Upon arrival at the job site and positioning of the logging vehicle, handler must establish a restricted access area of not less than 30 feet from the work area to prevent access during the loading procedures. Only company personnel (wearing TLD badges) will be allowed within the perimeter. Surveys are made within the perimeter do determine that there is no contamination and to establish a background reading.

2. "Before" surveys are made of the well head to determine that there is no contamination from previous logging and to establish a background reading. These readings are recorded on Job Site Survey form (Figure #6).

3. Ejector (logging tool) will only be loaded outside at the rear of the logging vehicle. There will be no loading in the logging compartment of the logging vehicle.

4. The handler loading the ejector must be wearing disposable plastic/rubber gloves during the complete loading operation. The loading of the ejector must be done over absorbent paper napkins/diapers to contain any spilled materials. Handling tool (tongs) is used to pour the vial of tracer material into the ejector. In some instances, due to weather conditions or design of the ejector loading is quicker and spills are less likely to occur by using a syringe.

5. After loading of the ejector is completed, all implements used and empty containers must be confined to a properly labeled box and placed in the designated storage area for radioactive materials in the logging vehicle. All absorbent napkins, disposable gloves, and other paraphernalia which came in contact with radioactive material are classified as waste materials and will be put into a plastic bag and placed in the designated storage area in the logging vehicle for transport back to the facility for disposal

6. A survey must be made of the loading area to determine if any tracer materials were spilled. If there is any evidence of contamination, implement the decontamination procedures outlined in this manual.

7. At the completion of the logging operation, any remaining isotope will be ejected into the well being logged. This will ensure the proper disposal of the remaining isotope. Ejector will then be returned to its storage area on the logging vehicle.

8. A survey of the well head is made to determine that there is no contamination and readings are recorded on "after" portion of Job Site Survey form.

E. Procedures for handling radioactive isotopes when in a chemical base that is volatile, such as iodobenzene, free iodine in carbon tetrachloride, ethyl iodine, and methyl iodine, are the same as those set out in Section VI-D, however, particular precautions should be taken to prevent inhalation of these volatile materials.

1. All loading of toxic based isotopes will be done outside and at the rear of the logging vehicle.

2. The handler loading the logging tool will have the wind at his back and will not allow anyone to be downwind of the loading operation.

3. The handler must also wear a disposable face mask during the loading operation.

F. Radioactive isotopes baked on sand are used in small quantities as a tagging agent to determine the point of fluid entry in the well bore. Tagging procedures using radioactive sand will vary somewhat depending on the company performing the hydraulic frac operation because of blender design. Ultimately good judgment will have to be used where flexibility is required. Basic procedures are as follows:

1. A certified calibrated survey meter, disposable rubber gloves, disposable face mask, and absorbent paper napkins will be within the working area and visible to the handler (logging supervisor) during the entire tagging operation.

2. Complete "before" portion of Job Site Survey form. (Figure #6)

3. Handler must be wearing disposable rubber gloves, disposable face mask, and duly approved TLD badge while handling the radioactive sand.

4. Handler will use great caution to make sure that the dust bi-product of the radioactive sand will not contaminate the area. He will have the wind at his back to ensure that the dust does not contaminate his clothing, and he will not allow anyone to be downwind of the tagging operation.

5. Handler will put the radioactive sand into the blender on the well stimulation service company's vehicle using a remote handling tool. The sand should be sprinkled as close to the fluid face as possible in order to reduce the dust factor.

6. Upon completion of the tagging operation, rubber gloves, face masks, and all other paraphernalia which came in contact with radioactive material are classified as waste materials and will be placed in a plastic bag for transportation back to the licensed facility for waste disposal.

7. A survey will be made with an approved surveying device to determine if any radioactive materials were spilled. If any were spilled, implement the decontamination procedures outlined in Section IX of this manual.

8. Complete "after" portion of Job Site Survey Form. (Figure #6)

9. Any remaining unused radioactive sand will be returned to the facility in accordance with transportation procedures set out in Section V, and placed in the storage container at our licensed facility for temporary storage until it can be disposed of in accordance with procedures set out in Section VII-B.

10. In the event that a sandout occurs during a hydraulic frac operation where a radioactive tracer material is being used, personnel should ensure that all reverse circulation materials are jetted to the temporary work pit and that the temporary work pit is covered up when the well operation workover is completed.

VII. WASTE DISPOSAL PROCEDURES FOR TRACERS

A. On completion of logging operations using tracer materials and having complied with items outlined in Section VI, a residual contamination will be present. Having confined this contaminated material to a plastic bag (Ref: Section VI-B 7), these procedures will be followed:

1. All radioactive waste materials will be transported from location to the temporary waste storage location for our company, which is:

   Highway 2, West of Havre, Montana and
   Highway 2, East of Cut Bank, Montana

2. The radioactive waste materials (lead pigs, empty vials and cans, gloves, napkins, etc.) will be separated by isotopes and dated. The container (plastic bag) will then be placed in a secured and placarded area designated for waste. This can be a section of the radioactive material storage bunker or a 55 gallon barrel with lockable lid, painted yellow, surrounded by a barrier or fence with warning signs on each side.

3. Upon placement of the radioactive waste material in the designated area, an entry will be made in a waste disposal log. This log must reflect the date material is placed in bunker, isotope description (name, type, chemical base), a survey reading in mr/hr taken at one yard, and signature of employee. (Ref: Figure #3)

4. On completion of the log, the waste disposal procedures have been accommodated by the employee. From this point forward, the disposal of radioactive waste comes under the direct responsibility of the Radiation Safety Officer.

B. The Radiation Safety Officer will dispose of all radioactive waste materials using one of the following means:

1. Ship radioactive waste materials to a supplier authorized to receive such waste, or to a designated waste disposal site which has been approved by the State or Federal agency governing radioactive waste disposal. Shipments must be in compliance with D.O.T. regulations. Receipts from supplier or waste disposal site should be attached to the waste disposal log.

2. Retain radioactive waste materials in the designated waste area (see #2 above) at our licensed facility until it can safely be disposed of as ordinary trash. For example: Store for ten (10) half lives, then survey in a low background area to determine that reading (within 6" of unshielded container) is not discernable above background. Prior to disposing as ordinary trash, all radiation labels will be removed or obliterated. Records of surveys made prior to disposal will be maintained with our waste disposal records.

VIII. EMERGENCY PROCEDURES

A. Because of the low curie level (millicurie quantities only) it is to be understood that a valued judgement must be rendered by a qualified employee in the definition of a spill before emergency procedures should be implemented. Minor spills would involve millicuries quantities of tracer materials released on equipment or soil. A spill which would demand the implementation of emergency procedures would be one in which the general public could be at risk. Minor spills are commonplace and should not be considered an emergency. However, great effort should be taken in order to clean up the area and implement decontamination procedures.

B. Emergency procedures should be implemented in the event of a spill and an Emergency Procedures Report must be completed. (Ref: Figure #7)

C. Spills involving radiation hazards to personnel. At no time will there be on location radioactive material in a liquid form other than Iodine 131 or Iridium 192, nor will there be any radioactive material in volumes greater than 40 millicuries per unit. In other words, no vial will contain more than 40 millicuries of radioactive tracer material. Therefore, it is very unlikely that a major spill will be experienced in our line of work, however, in the event a spill does occur, the following procedures will be followed:

1. Notify all personnel not involved in the spill to vacate at once. Only employees who are licensed radiation handlers will be allowed in the spill area, and then only with a calibrated survey meter and proper dosimeter devices.

2. If the spill is liquid, pinpoint the area of the spill with a survey instrument, then put on protective clothes, disposable gloves and boots and proceed to institute docontamination procedures outlined in this manual.

3. If the spill is on the skin, obtain a bucket and fill with water, Scrub the area with an industrial soap. Check the contaminated area with a survey meter to insure thorough cleaning of the area. The contaminated area may have to be scrubbed 2 to 3 times for a thorough cleaning. If Iodine 131 is the isotope involved, use a potassium base solution (10% per volume located in decontamination kit). This water will be treated as waste and put in a liquid waste barrel for disposal by the supplier.

4. If the spill is on clothes, discard the clothes as soon as possible. Utilize the waste disposal procedures outlined in this manual.

5. If the spill is in a room or enclosed area, switch off all exhaust fans and vacate the room.

6. Notify the Radiation Safety Officer as soon as possible for detailed decontamination procedures.

7. Permit no person to resume work in the spill area. If necessary, post a man to insure that the contaminated area is not disturbed.

8. After decontamination procedures have been completed, an Emergency Procedures Report should be completed and placed in the radiation files.

9. Because of the judgment evaluation involved, the Radiation Safety Officer is responsible for notifying the State or Federal regulatory agency. (Address and telephone number given in front of manual.)

D. Injuries to personnel involving radiation hazards:

1. Place a bucket under the facet, and wash minor wounds under running water while spreading the edges of the gash. Dispose of this liquid in a liquid waste drum.

2. Call a physician, preferably one who is qualified to treat radiation injuries.

3. Permit no person involved in a radiation injury to return to work without the approval of the attending physician.

4. Report all radiation accidents (wounds, over-exposure, inhalation) to your supervisor.

5. Prepare a complete history of the accident and give the details in the Emergency Procedures Report.

E. Fire and other major emergencies:

1. Notify all personnel in the area immediately.

2. Attempt to put out the fire if radiation hazard is not immediately present.

3. Notify the Fire Department.

4. Notify the Radiation Safety Officer.

5. Govern the fire fighting or other emergency activities by the restrictions of the Radiation Safety Officer.

6. Following the emergency, monitor the area and determine the steps necessary for safe decontamination.

7. Decontaminate

8. Permit no person to resume work without approval of the Radiation Safety Officer.

9. Monitor all persons involved in combating the emergency.

10. Prepare a complete history of the accident and give the details in the Emergency Procedures Report.

F. Monitoring Techniques for Personnel:

1. Check hands (finger tips), shoes (soles and heels), and face (nostrils first).

2. Remove any contaminated clothing to a covered bin (or plastic bag) and continue monitoring.

3. ALWAYS Monitor hands before eating, drinking, or smoking. If contaminated, wash area and dispose water as liquid waste. Please refer to Emergency Procedures VIII, C3.

G. Emergency While Transporting Radioactive Materials:

1. Do not leave vehicle unattended.

2. In case of vehicle wreck, notify investigating officer.

3. Notify the Radiation Safety Officer.

4. Survey the area and close off access to area where the radiation level is above 2 mr/hr.

5. In case of a spill where there is contamination, decontaminate the area before leaving the scene.

6. Radiation Safety Officer will notify State or Federal regulatory agency.

H. Emergency Storage of Radioactive Materials:

1. Radioactive materials should be temporarily stored in a suitable shielded container covered at all times with a lid to prevent unnecessary exposure, and locked if possible.

2. Only authorized personnel shall have access to the storage container.

3. Container will be marked to indicate contents are radioactive.

IX. DECONTAMINATION PROCEDURES

A. Contamination Survey Techniques

1. Surveying of area and equipment

a. The ideal mixing and injection operation would have no spills and leave no residue of tracer material in any of the vessels or pipes through which the tracer was injected. In practice such an ideal may not be realized, and a survey of the area is necessary so that the proper procedures may be followed to assure that no remaining contaminant can cause harm to company personnel, the customers' personnel, or the general public.

b. The survey meter must be used with the beta shield open to survey the entire area where mixing has been done, and the pipes and associated components through which the mix was conducted to the well, to be sure that no concentration remains that may cause harm, either by external radiation or by possible contamination of food or water supplies.

c. Contamination of the probe must be avoided completely. If any contact survey is made, the probe is to be protected with a sheet of paper between the object and probe. A contaminated probe can render the survey meter useless for low level measurements.

d. Spills should be cleaned up and, if possible, injected into the well with the main tracer unit. The area of the spill should then be surveyed with the probe approximately one inch above the surfaces.

e. Any areas or items of equipment which indicate any amount of detectable radioactivity, above background, shall be considered contaminated and appropriate measures taken to remove such concentrations.

2. Surveying of Individuals

a. The greatest care in survey measurement is taken on items of personal equipment such as shoes, gloves, clothing and handling tools, as well as exposed portions of the body of personnel working with radioactive materials. This is because of the much greater probability of ingestion from such items.

b. The survey meter should also be used with the beta shield open to read the radiation level of clothing worn by the individual performing the mixing operation or any other clothes suspected of contamination. This should be done immediately following the mixing operations. If any indication of radioactive contamination is found on items of clothing, equipment, etc., or on the person of personnel involved in the operation, every effort should be made to remove the activity. See "Decontamination Procedures" below.

B. Decontamination Procedures

1. The radioactive tracer preparations are down by factors of 50 to 200 below the dangerous levels for external radiation hazards. The major hazard involved with these tracer preparations is the factor of ingestion. The ingestion tolerance is from one part per thousand to one part per ten thousand of the typical activities used. Thus, great care is exercised by company personnel to avoid contamination of hands, clothing and other personal items. Accidental concentrations of radioactive material are cleaned up, dispersed, or disposed of safely.

2. Decontamination shall, in general, be accomplished by rinsing and flushing fresh water through the equipment, or washing and scrubbing of contaminated items of clothing or portions of the individual's body. A detergent may be added to the water to aid this process. Portions of the equipment which cannot be decontaminated by this method shall be disassembled and scrubbed with water and detergent followed, if necessary, be steam cleaning. A 15% hydrocloric acid solution may be used to remove contamination from the surface of non-porous materials. Other chemicals may be used for decontamination, but their use should be limited due to their toxic nature.

3. Articles of clothing can normally be easily decontaminated by washing and scrubbing with water containing a strong detergent. This also applies to portions of the exposed individual's body. If efforts to decontaminate items of clothing on the job are unsuccessful, the clothing should be removed immediately to be washed after returning to the company station nearest the job location. Contaminated articles of clothing, rags, etc., should never be laundered in a home or commercial laundry. Such washing and scrubbing is restricted to the job site or the company station. If the contamination cannot be removed economically, the clothing shall be discarded and treated as radioactive waste.

4. As indicated above, every effort should be made to decontaminate any contaminated area of the body. Scrubbings should be repeated until activity is removed. The same safety precautions shall be applied to the above operations as were applicable for tracer mixing and injection in particular.
   a. Rubber gloves shall be worn during decontamination procedures involving personal contact with the equipment.
   b. Food, cigarettes, etc. shall be kept outside the clean-up area. Quantities of radioactive material which present no hazard outside the body can be very dangerous if the same abount is internal.
   c. The wash water shall be treated as radioactive waste. It will be contained in a liquid waste barrel for disposal by the supplier of the tracer material. Every effort shall be made to thoroughly decontaminate rented or borrowed equipment. If all efforts to decontaminate items of equipment, clothing, etc., have failed to render the radioactive contamination to background and the measurable activity is apparently "fixed", the user in charge has three alternatives. They are as follows:

1. If the "fixed" contamination measures less than 0.2 mr/hr at one centimeter, the item of equipment, article of clothing, etc. can be returned to normal use.
2. If the "fixed" contamination measures more than 0.2 mr/hr at one centimeter, the item or items in question shall be treated as radioactive waste and disposed of accordingly.
3. If the item containing the "fixed" contamination (measuring more than 0.2 mr/hr at one centimeter) is such that it is continually used in tracer operations e.g. parts of a dump bailer, tracer injector, etc., and will be used in no other operation, then it may continue to be used if it is labeled properly and treated as a radioactive source, provided the radiation measures less than 2.0 mr/hr at three inches from the surface.

d. More persistent activities remaining on injection apparatus, customer's equipment, etc. must be steam cleaned or chemically treated for contamination.

e. The Logging Supervisor in charge shall be responsible for all contaminated equipment. That is, for any equipment, waste area, or wash water that falls within the above alternative situations. He shall personally supervise its safe disposition either by staying on the job until the contamination is removed or transporting the equipment to the company's licensed storage facility where it can be stored awaiting further decontamination efforts.

5. After decontamination procedures have been completed, the personnel, equipment, or area which was contaminated must be remonitored/resurveyed by the Logging Supervisor in charge to ensure that decontamination procedures have completely removed the contamination or reduced it to acceptable levels. The before and after readings must be recorded on the Emergency Procedures Report.

ANY EMERGENCY SITUATION MUST BE IMMEDIATELY REPORTED TO THE RADIATION SAFETY OFFICER FOR OUR COMPANY:

Radiation Safety Officer: _____

Telephone Number: _____

EMERGENCY TELEPHONE NUMBER FOR REGULATORY AGENCY IS IN FRONT OF THIS MANUAL.

X. SOURCE HANDLING PROCEDURES

A. At no time will a source holder be handled by hand. Loading and unloading will be done with the aid of an approved source handling tool.

B. All employees involved in operations using a source will wear a personnel monitoring device (TLD badge). A certified calibrated low level survey meter (beta/gamma) will be available during all operations using a source.

C. Prior to each use, logging supervisor will visually check source holders, logging tools, and source handling tools for defects to ensure that equipment is in good working condition and required labeling is present.

1. Notation that inspection was made is recorded on the Job Site/Vehicle Survey form (Ref: Figure # 6)

2. If defects are found, the equipment must be removed from service until repaired and a record made of the following: (a) date of check; (b) name of inspector (logging supervisor); (c) equipment involved; (d) defects found; and (e) repairs made. (See page XII-3)

3. Radiation Safety Officer must be notified of equipment malfunctions or defects and report certain defects to the NRC in accordance with 10 CFR Part 21.

D. Remove source holder from the storage bunker using source handling tool. Place source into transport container* and secure in the designated area on the transport vehicle. A survey of the vehicle is made and recorded on the Job Site/Vehicle Survey form.

E. At the well location, and prior to beginning operations utilizing the source, operator will complete "before" portion of the well head survey on Job Site/Vehicle Survey form.

F. A restricted area of not less than 30 feet around the work area is established and marked with signs, barrier rope, or other designation. Direct surveillance is maintained by the Logging Supervisor or designated employee during all source handling procedures to protect against unauthorized and/or unnecessary entry into the restricted area.

G. Using the source handling tool, the source holder is removed from the transport container. The source holder is attached to the logging tool and lowered into the well.

H. When well logging procedures have been completed, the logging tool is returned to the surface. Using source handling tool, source holder is removed from logging tool and placed back into the transport container. A vehicle survey is taken to check for contamination and transport index, and "after" portion of well head survey completed to ensure there is no contamination of the work area.

I. Upon return to facility, source holder is removed from the transport container and returned to the storage bunker using the source handling tool.*

* If storage bunker is designed to hold the transport container, source holder need not be placed into or removed from the transport container other than at job site location.

XI. LOST SOURCE PROCEDURES (Ref: Figure #10)

A. Prior to performing well logging operations using a sealed source, a written agreement* (Ref. 10 CFR Part 39.15) must be executed between licensee and the well owner/operator, stating that:

1. Should a well logging source be lodged in a hole:

   a. A reasonable effort will be made to recover the source.

   b. No attempt will be made to recover a lodged source in a manner which, in the licensee's opinion, could result in its rupture.

   c. Licensee will continually monitor, with an appropriate radiation detection instrument or a logging tool with a radiation detector, the circulating fluids from the well, if any, to check for possible contamination resulting from damage to the source.

   d. Should the environment, any equipment, or personnel become contaminated with licensed material, they must be decontaminated before release from the site to an unrestricted area.

2. Within thirty (30) days after a well logging source has been classified as irretrievable:

   a. The source will be immobilized and sealed in place with a cement plug.

   b. A whipstock or other mechanical device will be set well above the cement plug unless the source is not accessible to any subsequent drilling operations.

   c. A permanent identification plaque will be mounted at the surface of the well.

(The actions outlined in Items 1 & 2 above are to be carried out through a joint effort between the licensee and the well owner/operator, however, the licensee takes primary responsibility for actions in Item 1 and the well owner/operator takes primary responsibility for actions in Item 2.)

* If the well owner or operator are part of the same corporate structure or otherwise affiliated, a written agreement is not required.

B. In the event a well logging tool containing a sealed source of radioactive material is stuck/lodged in an oil or gas well, the following procedures should be followed to insure maximum safety:

1. Well logging supervisor will remain in contact with the well operator to ensure that a reasonable effort is made to recover the source, offer advice and recommendations regarding safe fishing (retrieval) procedures making sure that well operator is aware of the possibility that fishing procedures might damage the source, and ensure that no retrieval attempt is made in a manner that might result it rupture of the source.

2. During the retrieval operations, the logging supervisor will continually monitor for radiation at the surface, using a gamma logging tool near the pipe for fluids circulating from the hole, or using a low level beta/gamma survey meter with a thin window beta probe, or a scintillation probe with high enough energy resolution to accommodate the pipe thickness.

3. Upon retrieval of the source, if no radioactive contamination is detected, logging supervisor will remove the source assembly from the logging tool (using source handling tool) and physically check it for any damage such as abrasions brought about by metal to metal contact or any disfigurement brought about by pressure.

4. Should any radioactive contamination be detected during retrieval or if the source appears to be damaged, logging supervisor will immediately notify our Radiation Safety Officer who will immediately thereafter notify the State or Federal regulatory agency governing radiation. (Emergency telephone number on cover page of this manual.) Should there be any radioactive contamination of the environment, equipment or personnel, they must be decontaminated before release from the site to an unrestricted area.

5. If there is no evidence of radioactive contamination or physical damage, the source will be returned to a licensed storage facility for our company where it will be leak/wipe tested and the wipe sent for immediate analysis. The source will be kept in the storage container out of service pending receipt of the analysis results.

C. If it becomes apparent that the source cannot be retrieved and will have to be abandoned downhole, our Radiation Safety Officer will notify the State or Federal regulatory agency having jurisdiction over radiation and any regulatory agency governing the drilling of oil and gas wells. Following are procedures for safe abandonment of a source downhole:

1. After notifying the regulatory agencies, the Radiation Safety Officer should determine steps to be taken to abandon the source in such a way as to protect persons and property now and in the future, considering what the well operator wishes and can reasonably do, and then present this proposal to the regulatory agencies for final approval or further recommendations.

2. A source left below a producing zone presents little difficulty. In most cases the normal cementing of the production string of casing or tubing will isolate the source. If the well is to be produced from open hole completion, cement should be spotted around and/or above it to prevent the movement of fluids past the capsule and eventual destruction of the capsule through abrasion.

3. In questionable cases the life of the capsule and the solubility of radioactive material might influence the acceptance of the proposal. (The source capsules have an estimated life of 500 years in undisturbed salt water. The solubility of the radioactive materials is in the order of one part per billion per week.)

4. Production of gas, water or oil past a source should be prohibited unless the capsule is protected from abrasion. Casing or tubing should be adequate. The spotting of cement, if practical and feasible, adds to the protection. Care should be taken in setting casing past the location of the tool to avoid dislodging it. A gamma-ray survey run after the casing is below the zone will give assurance that the tool and source will not be encountered and damaged at a lower level.

5. In the event a source is left in a producing zone, it should be cemented in place if possible. Extreme caution should be used to avoid re-entering the original hole and damaging the source container. Normally, the source is at or near the bottom of the tool. If there were sufficient clearance to place cement around the source, the tool would, in most cases, be retrievable. However, the drilling mud would probably harden in a short time to prevent appreciable flow of fluids by the source. In addition, the separation between the new and old holes would reduce the rate of flow at the tool to a very small figure. It is recommended that the new and old holes be separated by at least 15 feet to preclude any possibility of damage to the source by perforating.

6. Upon abandonment of a radioactive source in an oil or gas well, licensee shall provide a permanent plaque for posting the well or well bore. It shall be constructed of long-lasting material such as stainless steel, brass, bronze, or monel and contain the following information engraved on its face:

   a. The word "CAUTION" in large letters.

   b. The radiation symbol (color not required).

   c. The date of abandonment.

   d. The name of the well operator or well owner.

   e. The well name and well identification number(s) or other designation.

   f. The sealed source(s) by radionuclide and quantity of activity.

   g. The source depth and the plug back depth (depth to the top of the plug).

h. An appropriate warning, depending on the specific circumstances of each abandonment, such as (1) "DO NOT DRILL BELOW PLUG BACK DEPTH", (2) "DO NOT ENLARGE CASING", (3) "DO NOT RE-ENTER HOLE", followed by --- BEFORE CONTACTING (whichever is appropriate) THE U.S. NUCLEAR REGULATORY COMMISSION //or// THE STATE BUREAU OF RADIATION CONTROL.

7. A written report must be filed with the Regional Office of the NRC or the Agreement State Bureau of Radiation Control within 30 days of abandonment, giving description of attempts to recover the source and results of retrieval attempts; steps taken to isolate and protect the source; all pertinent well information; and information contained on the permanent identification plaque. A copy of this report should also be furnished to the State agency issuing permits for or controlling the drilling of oil and gas wells.

XII. SOURCE MAINTENANCE AND DISPOSAL PROCEDURES

A. Every radioactive source must be accounted for. Licensee must have records of receipt and disposal and maintain a current source inventory. A source cannot be sold or transferred to anyone who does not have in his possession a current radioactive material license authorizing possession of that particular source (manufacturer, model, and curie quantity).

B. A semi-annual visual inspection and routine maintenance of source holders, logging tools, source handling tools, storage containers, and transport containers will be conducted by the Radiation Safety Officer at the time of the leak/wipe tests, to ensure that no physical damage is visible and that labeling is legible. If defects are found, the equipment will be removed from service and a record made listing (a) defects found, (b) maintenance operations performed, (c) actions taken to correct defects.

C. Each source, source holder, or logging tool containing radioactive material shall bear a durable, legible and clearly visible marking or label, which has, as a minimum, the standard radiation caution symbol, without the conventional color requirement, and the following wording:

DANGER (OR CAUTION)
RADIOACTIVE

This labeling shall be on the smallest component transported as a separate piece of equipment.

D. Each transport container should have permanently attached to it a durable, legible, and clearly visible label which has, as a minimum, the standard radiation caution symbol and the following wording:

DANGER (OR CAUTION)
RADIOACTIVE
NOTIFY CIVIL AUTHORITIES (OR COMPANY NAME)

E. Under NO circumstances will any employee of licensee remove a source from a source holder or assembly. It is prohibited to make effort to remove sources stuck in a handling tool, logging tool, etc., which involve chiseling, drilling, cutting, etc.

F. Any maintenance or service operations which require direct hand contact with the source assembly, such as cleaning or "O" ring exchange will be performed as follows:

1. Since the source assembly is threaded, a hand tool with the appropriate thread, no less than 24" in length, will be made and screwed into the source assembly. The hand tool then will be secured in a table mounted vice. Note: If there is thread damage, the source will be sent back to the manufacturer for repair or replacement.

2. The "O" rings will be cut off with a razor knife. The source assembly will be cleaned with a long nosed solvent spray apparatus, which can be purchased at any automotive supply.

3. Upon completion of the cleaning, a piece of PVC pipe, 18" in length and of the appropriate diameter to fit over the source assembly, will be used to transfer greased "O" rings to the two grooves that have been cleaned. The PVC pipe will be placed over the source assembly with only the "O" ring groove exposed. A modified round wood stick with a flat end will push the "O" ring off of the PVC pipe into the "O" ring groove. Repeat procedures for second "O" ring.

4. Upon completion of replacement of the "O" rings, the handling tool used for normal operations will be used to unscrew the source assembly from the support holding tool while still in the vice and replaced to its assigned transportation container/ shield.

G. Sealed sources will be returned to the manufacturer for disposal, or transferred to a licensee authorized to possess said source (isotope, activity, and model number). Receipt from the manufacturer or transfer certificate must be placed in the radiation files as a record of disposal. When license is terminated, a certificate of disposition of materials must be sent to the State or Federal regulatory agency.

10 CFR Part 39.43 (a) requires:

* A visual inspection of source holders, logging tools, and source handling tools for defects must be made before each use to ensure that the equipment is in good working condition and that required labeling is present. If defects are found, the equipment must be removed from service until repaired and a record made.

10 CFR Part 39.43 (b) requires:

** A semi-annual visual inspection and routine maintenance of source holders, logging tools, injection tools, source handling tools, storage containers, and transport containers must be made to ensure that the required labeling is legible and that no physical damage is visible. If defects are found, the equipment must be removed from service until repaired and a record made.

Following is a form to be used to record defects found and the actions taken to correct the defects. This record must be retained for three years.

* Recorded on Job Site/Vehicle Survey form.
** Recorded on Radioactive Source Inventory & Inspection form.

REPORT OF DEFECTS AND REPAIRS

DATE: _____

EQUIPMENT INVOLVED: _____

INSPECTION & MAINTENANCE OPERATIONS PERFORMED: _____

_____

DEFECTS FOUND: _____

_____

INSPECTOR: _____

_____

ACTIONS TAKEN TO CORRECT DEFECTS: _____

_____

_____

_____

DATE RETURNED TO SERVICE: _____

INSPECTOR: _____

XIII. TRANSPORTATION OF SEALED SOURCES

A. Sources will be transported in accordance with applicable Department of Transportation (DOT) regulations (49 CFR Part 172).

B. Documentation must be on file for each source transported by the licensee as follows: (49 CFR Part 173)

1. Safety analysis containing the results of performance tests demonstrating that the source meets the "special form" requirements.

2. Written results of the Specification 7A package tests performed on the transport container.

C. Sources must be packaged, labeled, marked and accompanied with appropriate shipping papers in accordance with NRC regulations (10 CFR Part 71).

1. Packaging: Must be contained in Specification DOT 7A transport/storage container.

2. Labeling: Label categories for well logging sources are Yellow II and Yellow III (White I not applicable). The proper label to affix to the source transport container is based on the transport index (TI), which is the maximum radiation level in millirem per hour at one meter from the external surface of the container.

a. TI less than 1.0 -- Yellow II

b. TI more than 1.0 and less than 10.0 -- Yellow III

c. Labels are 4" x 4", yellow top half and white lower half.

3. Markings: Transportation container must be marked with letters at least 1/2 inches high, "USA DOT TYPE A". Additional markings are outlined in Section XII, Items C & D of this manual.

4. Shipping Papers: Must contain information set out in Subpart C of 49 CFR Part 172; must be properly completed and signed; must be located in the cab of the transport vehicle within reach of the driver. (Example of completed shipper's certification on following page.)

SHIPPER'S CERTIFICATION FOR RADIOACTIVE MATERIALS

NATURE AND QUANTITY OF CONTENT					PACKAGE			
PROPER SHIPPING NAME	RADIONUCLIDE	ID NUMBER	FORM	ACTIVITY	NO. OF PKGS.	LABEL CATEGORY	TRANSPORT INDEX	TYPE
EXAMPLE								
RADIOACTIVE MATERIAL, Special form, n.o.s.	Am-241	UN 2974	Sealed Source (or Special Encapsulation)	5 Curies	1	RADIOACTIVE YELLOW III	1.1	Type A

NAME AND FULL ADDRESS OF SHIPPER:

I HEREBY CERTIFY THAT THE ABOVE NAMED MATERIALS ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED, AND LABELED, AND ARE IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO THE APPLICABLE REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION.

Signed: _____

Date: _____

DESTINATION: _____

Border is ALTERNATING RED AND WHITE

D. During transportation to and from location and for temporary storage on the vehicle:

1. Each source must be in its approved DOT 7A transport/storage container.

2. Container must be locked and physically secured to prevent tampering or unauthorized removal of source.

3. Transport container should be positioned in a designated area of the vehicle located at the furthest point possible away from driver or passengers.

4. Transport container must be locked in a storage compartment or fastened to an integral part of the transport vehicle to prevent accidental loss, tampering, or unauthorized removal.

E. Surveying:

1. Prior to transporting, exterior surfaces and passenger compartment of the vehicle must be surveyed to ensure that the radiation levels do not exceed 2 mR/h at any exterior surface and 2 mR/h in the passenger compartment.

2. If the radiation levels exceed 2 mR/h in the passenger compartment, the source should be repositioned within the vehicle or more shielding added.

F. Placarding:

1. Vehicles transporting sources which require a Radioactive Yellow III label must be placarded on both sides, the front, and the back with "RADIOACTIVE" placards.

2. Placard is approximately 11" x 11" and diamond shaped, with a yellow (top half) and white (bottom half) and black lettering.

3. "RADIOACTIVE" placard must not be displayed when sources are not on vehicle.

4. If vehicle is being used for temporary storage at a job site or the field station, the "RADIOACTIVE" placard will be removed and "Caution - Radioactive Material" signs substituted. Radiation level may not exceed 2 mR/h at any external surface of the vehicle. Vehicle must be locked when it is used for storage.

XIV. THEFT, LOSS OR RUPTURE OF SOURCES

A. The RSO shall report by telephone or telegraph to the State or Federal Regulatory Agency (telephone number and address in front of manual) the theft or loss of any source of radiation immediately after such occurrence becomes known.

B. Every investigative method should be taken to recover source and if source is recovered it should be reported to State or Federal Regulatory Agency immediately.

C. If the radioactive source is not recovered, RSO must make a written report to the State or Federal Regulatory Agency within thirty (30) days after the theft or loss, giving all pertinent facts such as, description of source, circumstances and probable disposition, exposures to individuals, actions taken to recover source and measures adopted to prevent recurrence of the theft or loss.

D. Subsequent to filing the written report, should any additional information regarding the theft or loss become available to the licensee, it must be reported to the State or Federal Regulatory Agency.

E. If there is indication that a source is leaking or ruptured, the RSO should be contacted immediately and if he determines that the source may be leaking, the transport container (with source inside) will be isolated in a restricted area and kept in storage and out of service pending leak/wipe test analysis. RSO will direct procedures for leak/wipe test and monitoring of location/facility and personnel.

F. If at a job site location, all operations must be shut down and a control area set up around the source to keep personnel out. Well operator must be informed of the situation and steps that are being taken.

G. RSO will notify State or Federal agency governing radiation immediately upon determining that source is leaking, and follow up with a written report within thirty (30) days with information set out in item C above.

Figure #1

RADIOACTIVE RECLIVING LOG

DATE	ISOTOPE	FORM (Liquid - Solid) AND CHEMICAL BASE	CURIE QUANTITY	MR/HR*	SIGNATURE

* Survey of package made on receipt.

Figure #2

RADIOACTIVE MATERIAL USE LOG

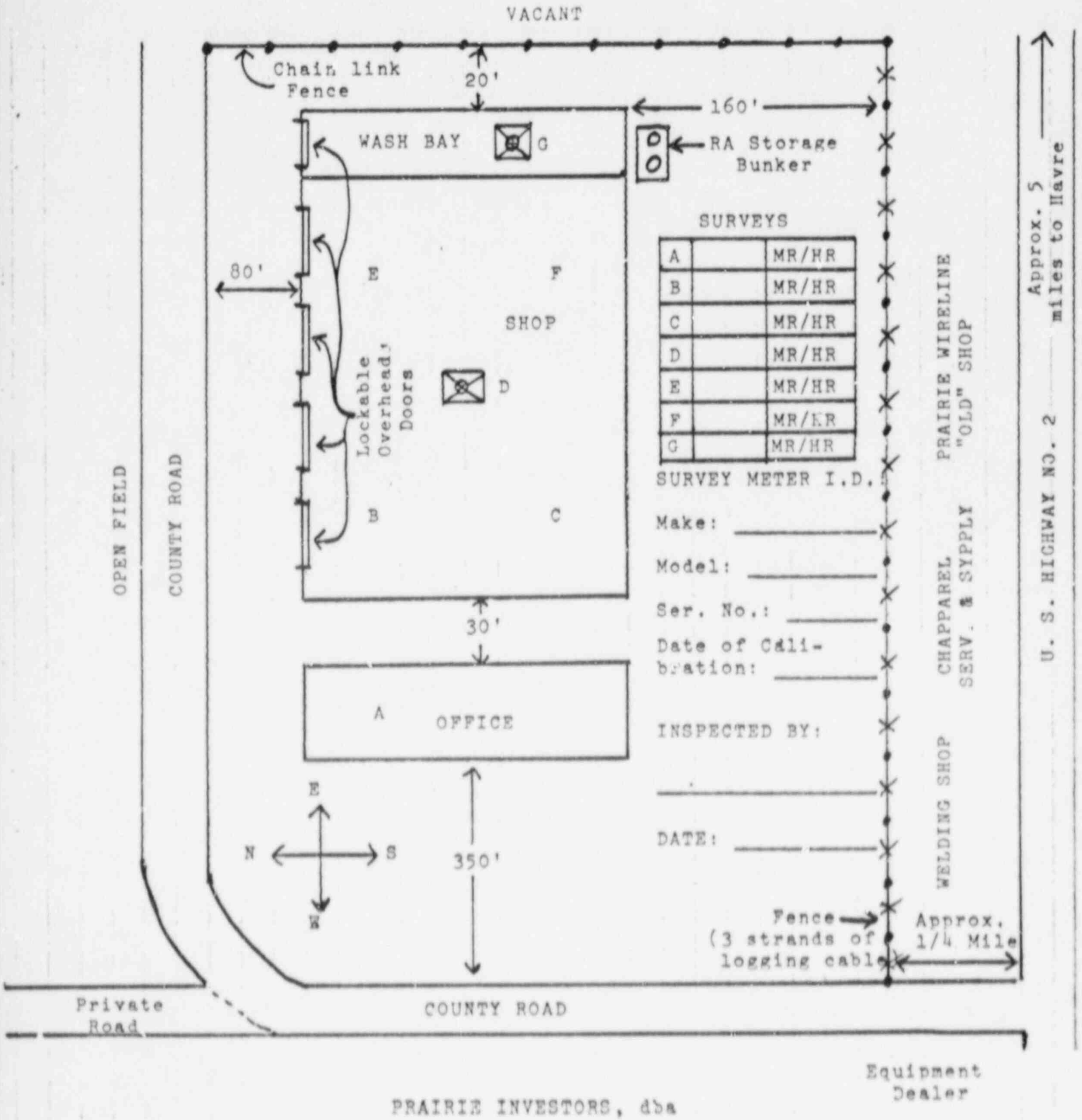
DATE	ISOTOPE	FORM (liquid - Solid) AND CHEMICAL BASE	CURIE QUANTITY	LOCATION OF USE	SIGNATURE (R/A HANDLER)

RADIOACTIVE WASTE DISPOSAL

DATE	ISOTOPE	DESCRIPTION	MR/HR SURFACE	MR/HR 1 YARD	DISPOSITION (Supplier/WD Site)	SIGNATURE

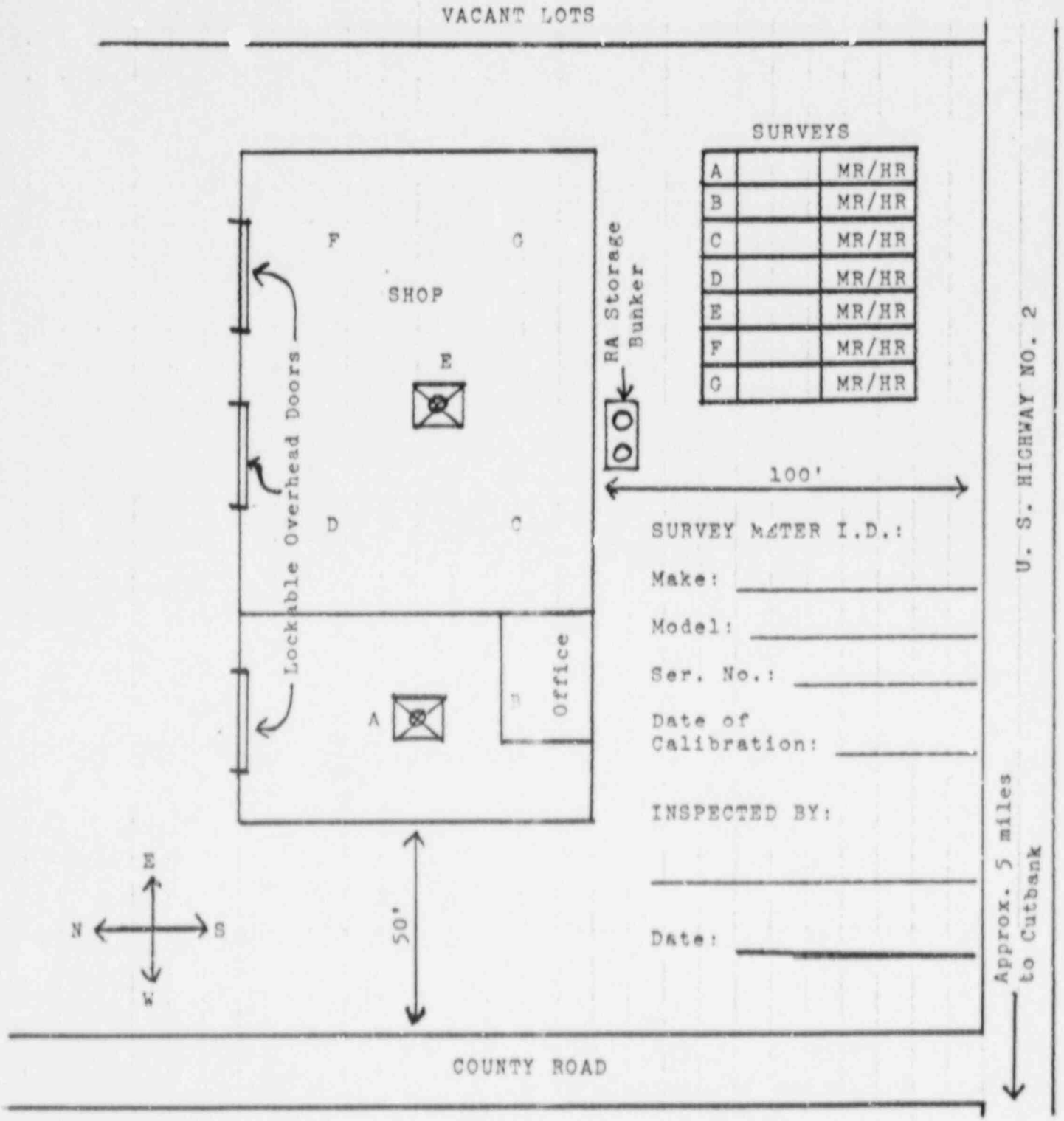
Figure #4(a)

FACILITY DRAWING AND MONTHLY SURVEY



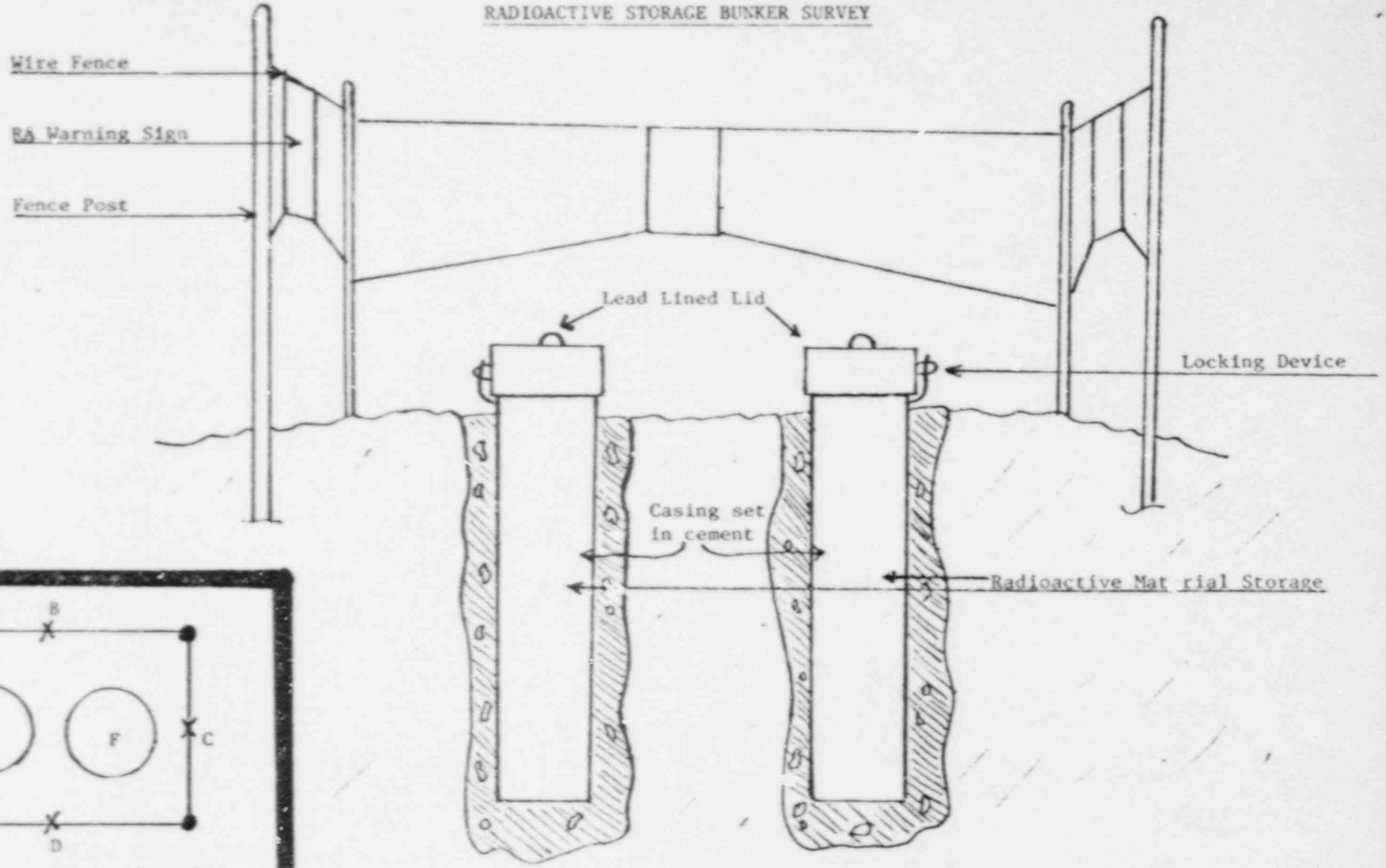
PRAIRIE INVESTORS, dba
PRAIRIE WIRELINE SERVICE
P. O. Box 1564
HAVRE, MONTANA 59501
(406) 265-8251

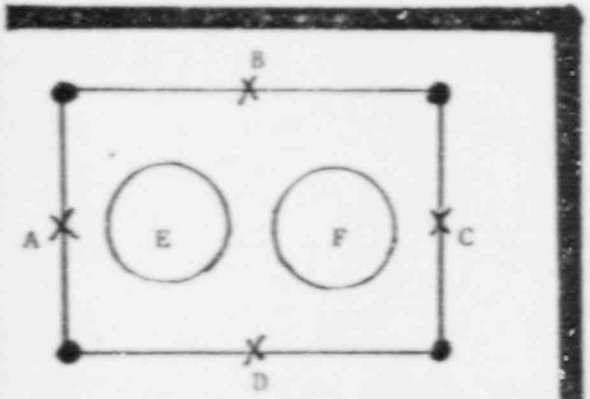
FACILITY DRAWING AND MONTHLY SURVEY



PRAIRIE INVESTORS, dba
PRAIRIE WIRELINE SERVICE
U. S. HIGHWAY NO. 2
CUTBANK, MONTANA

RADIOACTIVE STORAGE BUNKER SURVEY





"X" denotes RA warning sign

A		MR/HR
B		MR/HR
C		MR/HR
D		MR/HR
E		MR/HR
F		MR/HR

Survey Meter Make: _____ Model: _____

Serial No.: _____ Calibration Date: _____

Surveyed By: _____

Date: _____

Figure #5

JOB SITE AND VEHICLE SURVEY

DATE: _____

WELL IDENTIFICATION:

Field Name _____ Number(s) _____

County _____ State _____

SURVEY METER IDENTIFICATION:

Manufacturer _____ Model _____

Serial No. _____ Date of Calibration _____

RADIOACTIVE MATERIAL USED:

TRACER MATERIALS: Isotope _____ Volume _____ mCi

Supplier's

Type of Use _____ Invoice No. _____

SEALED SOURCES: Isotope _____ Activity _____

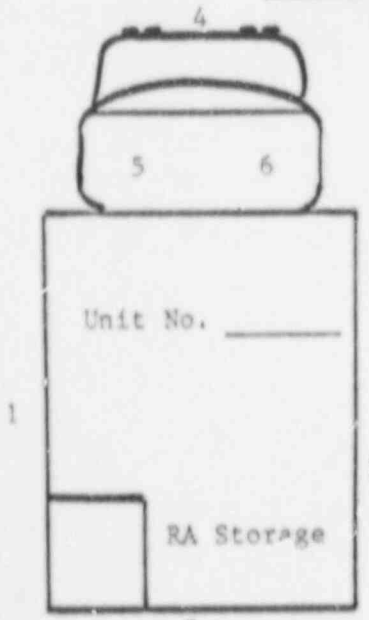
Source Serial No. _____

Make and Model _____

VISUAL INSPECTION MADE: Source Holder
Source Handling Tool
Logging Tools

☐ Check indicates no defects found.

VEHICLE SURVEY

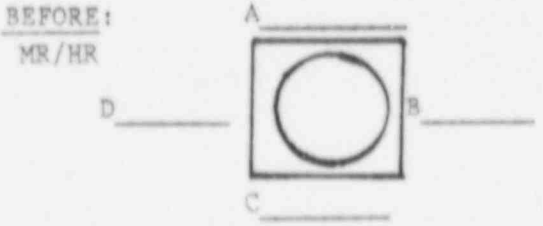


1 _____ MR/HR
2 _____ MR/HR
3 _____ MR/HR
4 _____ MR/HR
5 _____ MR/HR
6 _____ MR/HR

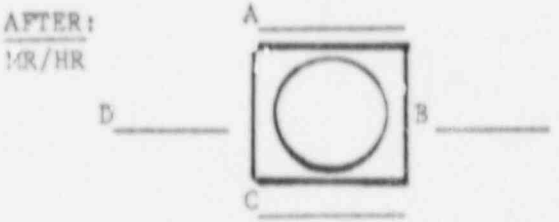
RA Storage Area
_____ MR/HR

WELL HEAD SURVEY

BEFORE:
MR/HR



AFTER:
MR/HR



LOGGING SUPERVISOR IN CHARGE SIGN HERE: _____

NAMES OF ALL ASSISTANTS AT JOB SITE: _____

EMERGENCY PROCEDURES REPORT

1. Location: _____

2. If job site, (a) Name of customer _____

   (b) Customer's representative _____

3. Logging Supervisor in charge: _____

4. Other company personnel present: _____

   _____

5. Cause of emergency: _____

   _____

   _____

   _____

   _____

6. Radioactive material involved: _____

7. Quantity or activity of material involved: _____

8. Reason to suspect contamination: _____

   _____

   _____

   _____

9. Safety precautions immediately enacted: _____

   _____

   _____

   _____

10. Draw a sketch of the area, marking location of contamination and indicating points where survey readings were taken including a background reading. Attach hereto.

11. After decontamination procedures have been completed, resurvey the area at all locations initially surveyed and indicate on the sketch the "after" readings. There should be no readings above background.

12. If personnel are involved who were not wearing a TLD badge or other personnel monitoring device, make an isodose chart if the level is greater than 10 mr @ 1 foot.

    (a) _____ @1 foot; (b) _____ @3 feet; (c) _____ @6 feet

13. List any persons suspected to have been exposed to contamination.

	Name	How Exposed?	TLD Badge?
1.			
2.			
3.			
4.			
5.			

14. Monitoring of personnel suspected to have been exposed to radioactive contamination. First line for initial reading, second line for reading after decontamination procedures have been completed.

	Name	Head	Face	Body	Hands	Legs	Feet
1.							
2.							
3.							
4.							
5.							

15. Suggestions for future prevention of this accident: _____

_____

_____

_____

RADIOACTIVE SOURCE INVENTORY AND INSPECTION

ISOTOPE	ACTIVITY	SERIAL NO.	LOCATION	LEAK TEST DATE	PHYSICAL INSPECTION*			
					SOURCE HOLDER	TRANSPORT CONTAINER	HANDLING TOOLS	LOGGING TOOLS

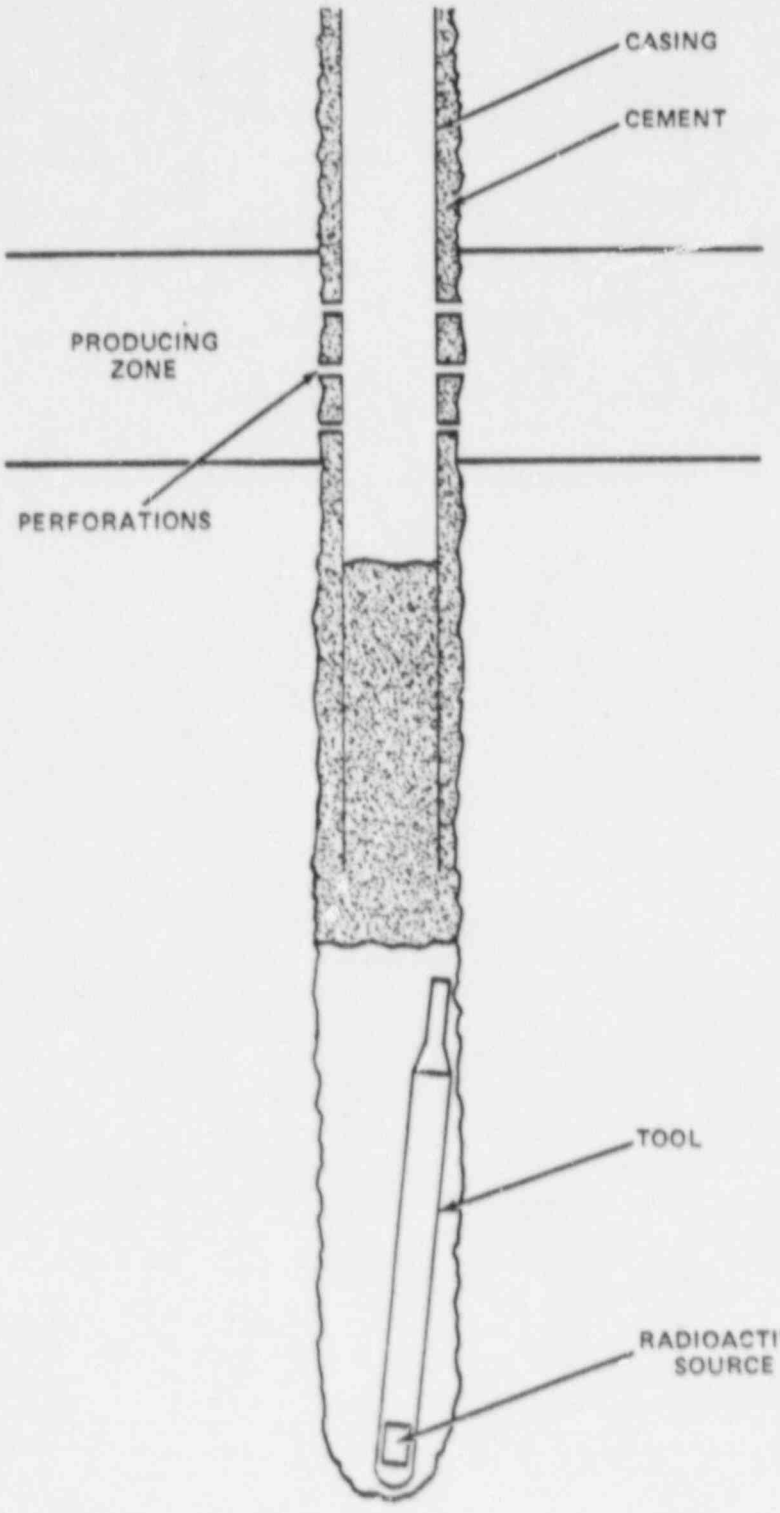
* Visual inspection of physical condition and proper labeling.

Note: Physical inventory and inspection must be conducted every six months and kept on file for 3 years. Can be done at the same time as the leak tests. Ref. 10 CFR Parts 39.35(c); 39.37: 39.43(b)

BY _____

DATE _____

Figure # 8


CASING
CEMENT
PRODUCING ZONE
PERFORATIONS
TOOL
RADIOACTIVE SOURCE

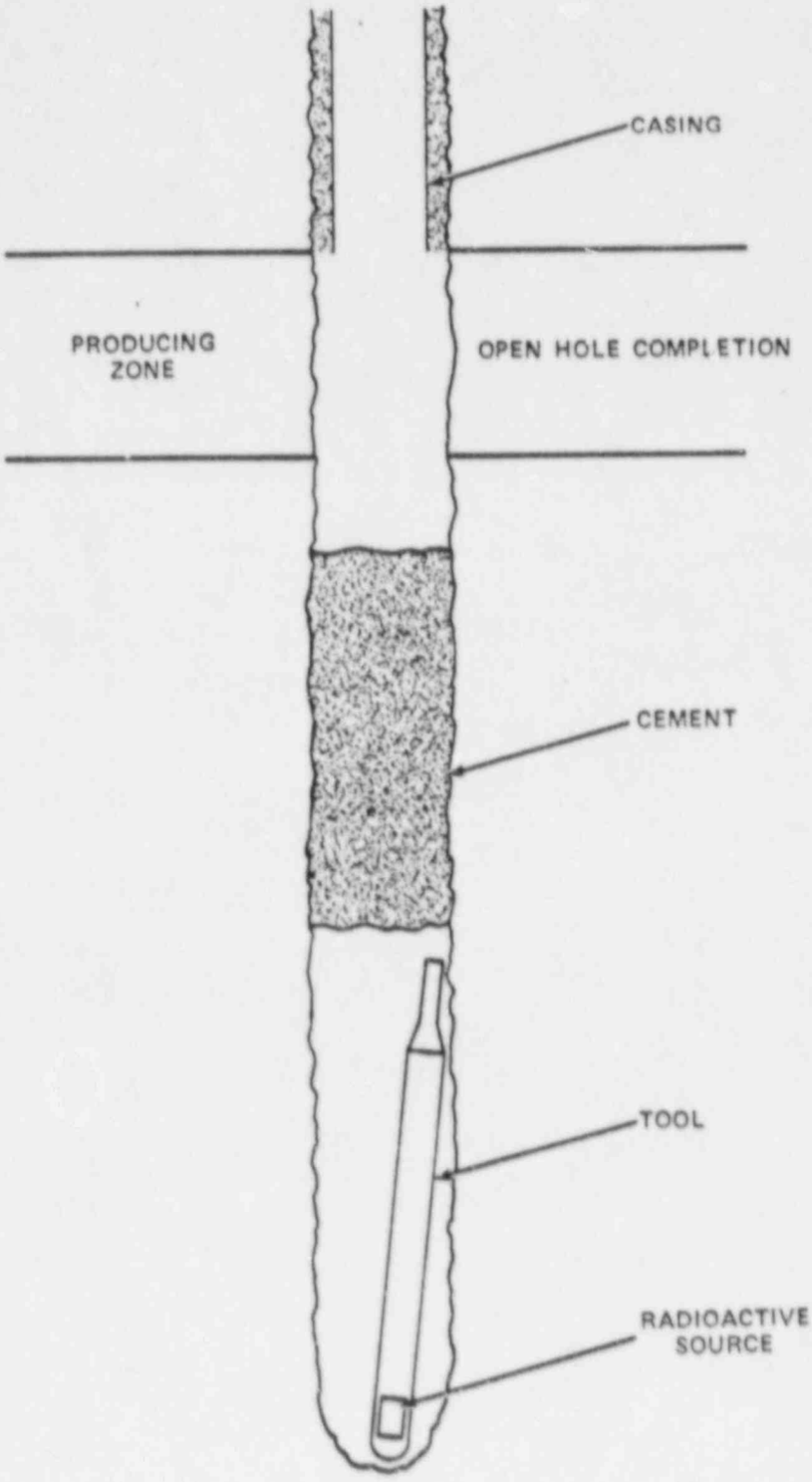
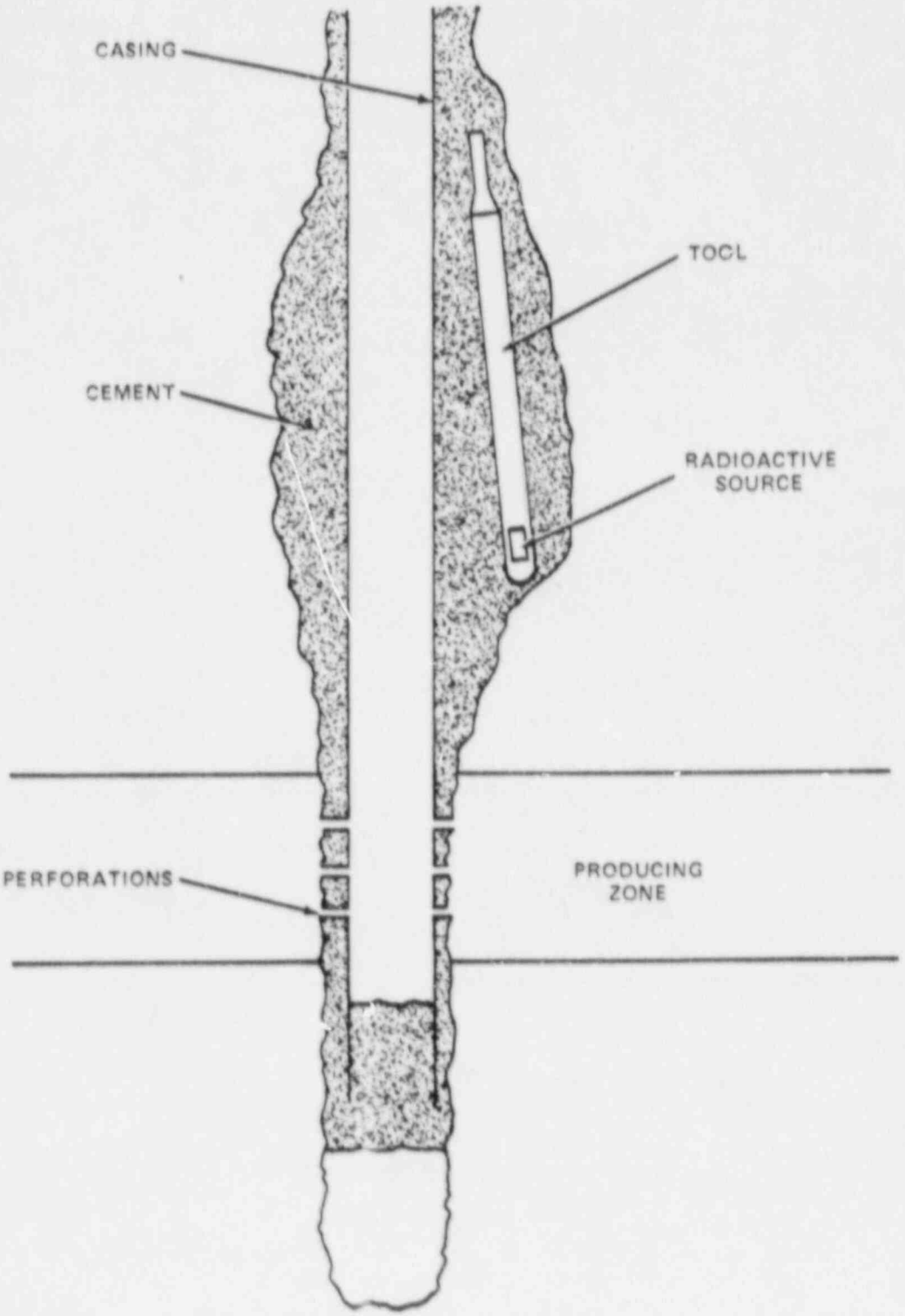
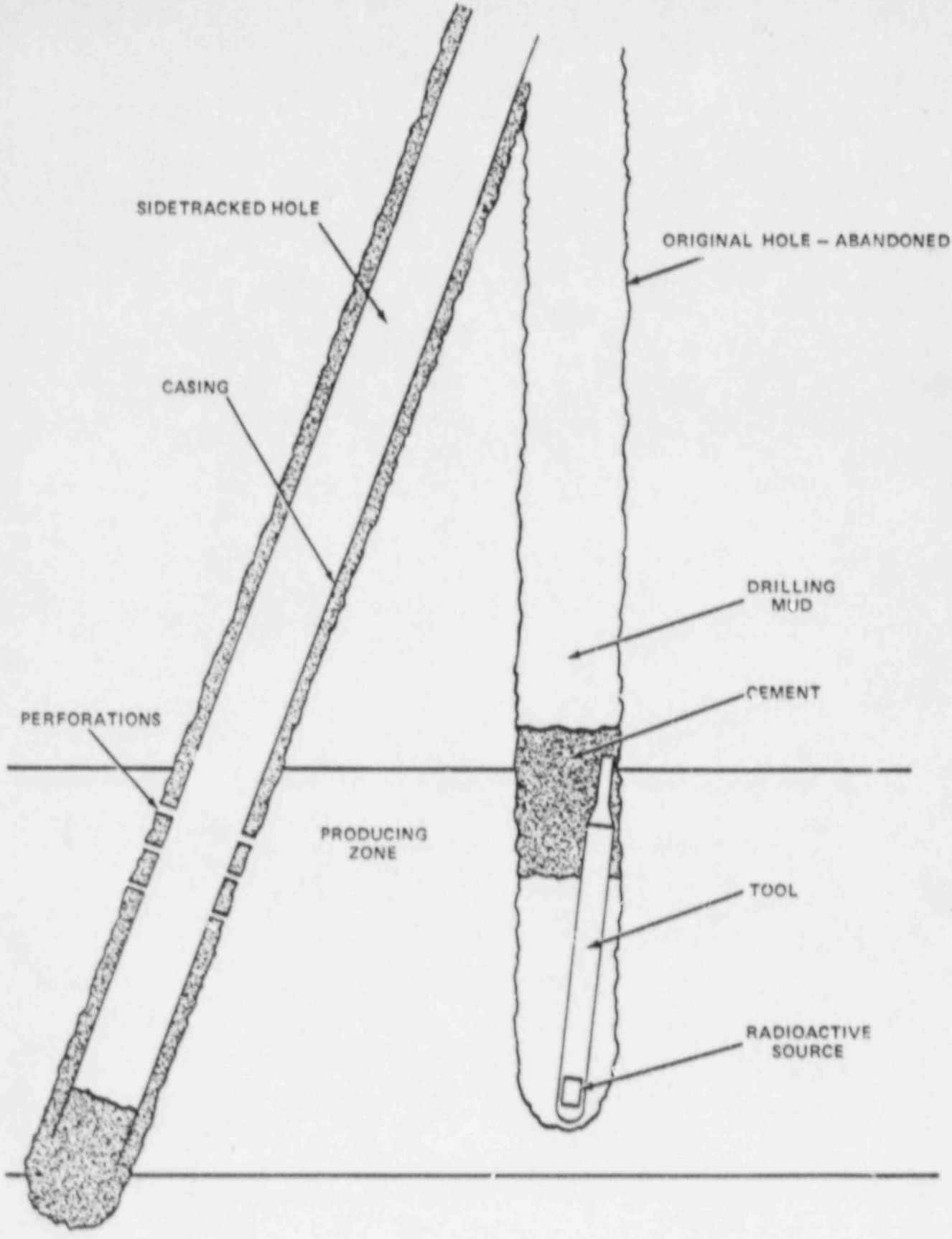
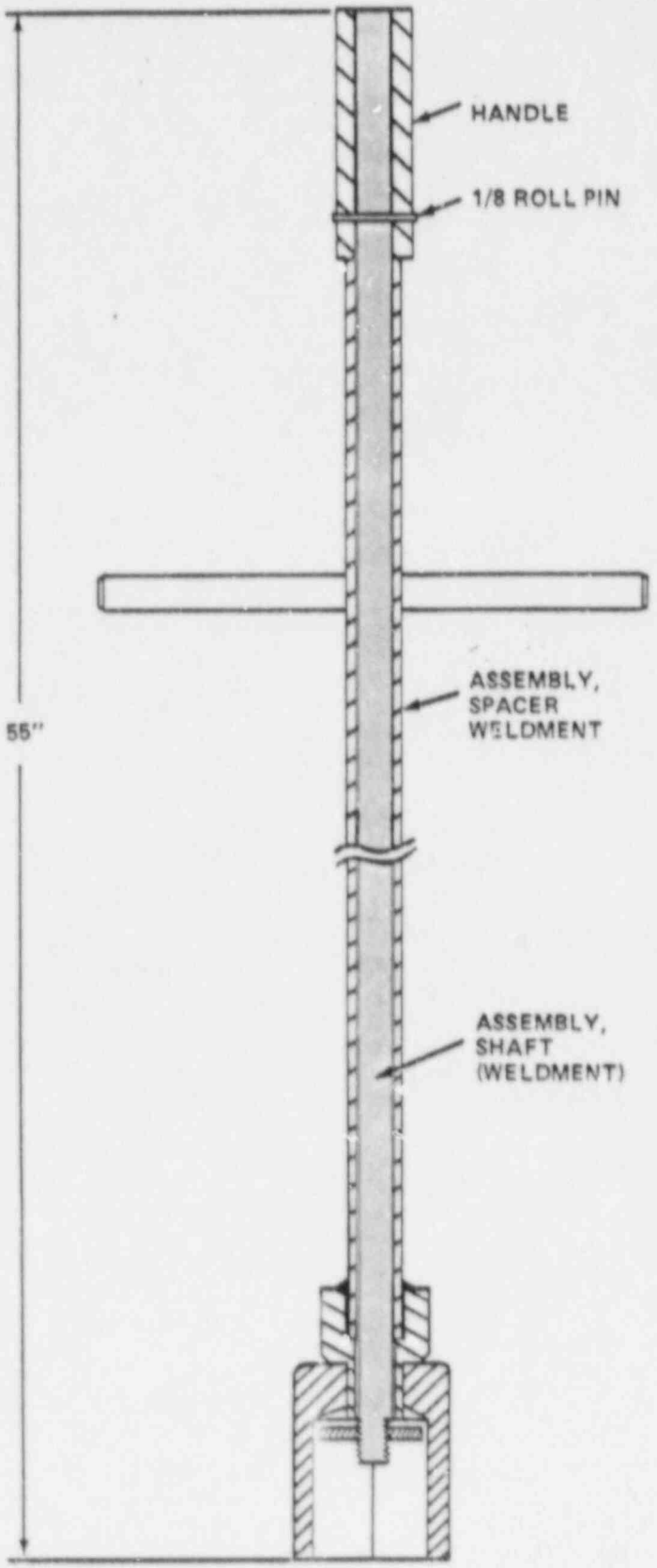

CASING
PRODUCING ZONE
OPEN HOLE COMPLETION
CEMENT
TOOL
RADIOACTIVE SOURCE

Figure # 9

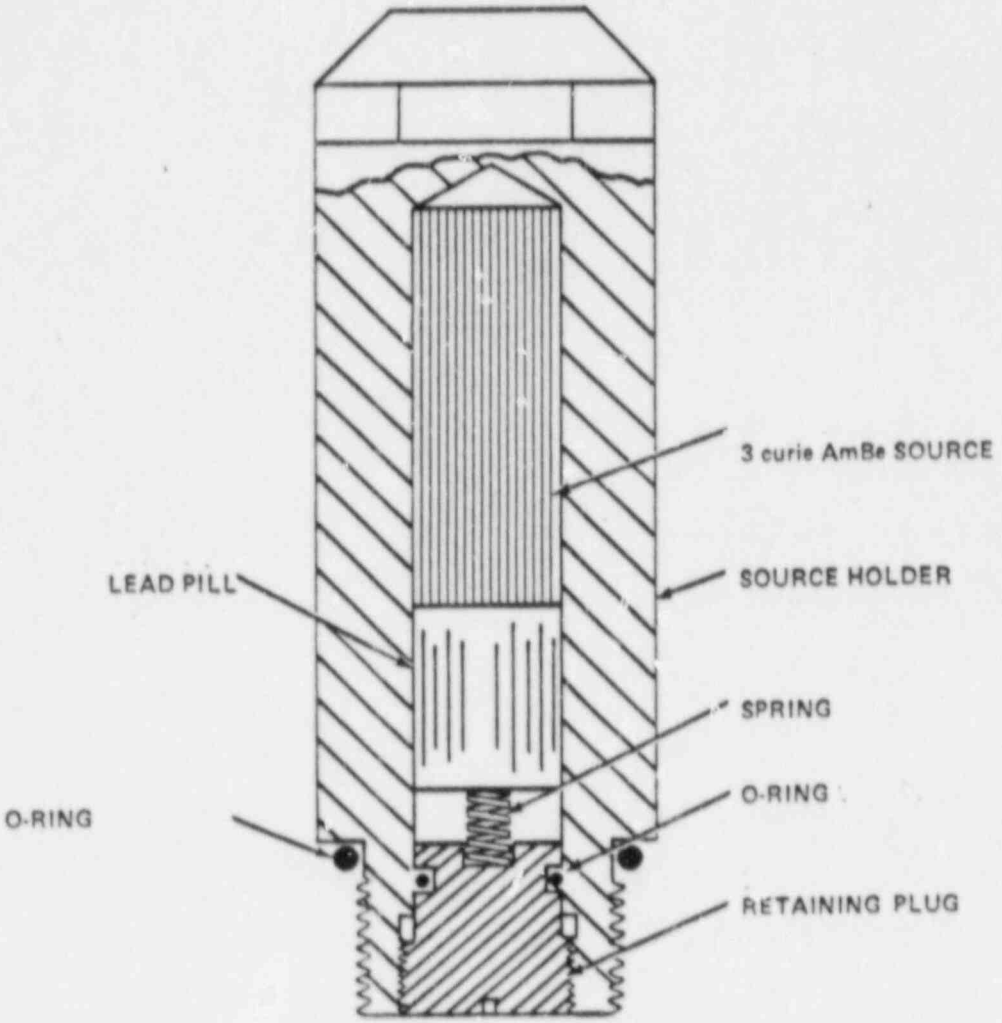

CASING
TOCL
CEMENT
RADIOACTIVE SOURCE
PERFORATIONS
PRODUCING ZONE


SIDETRACKED HOLE
ORIGINAL HOLE – ABANDONED
CASING
DRILLING MUD
CEMENT
PERFORATIONS
PRODUCING ZONE
TOOL
RADIOACTIVE SOURCE

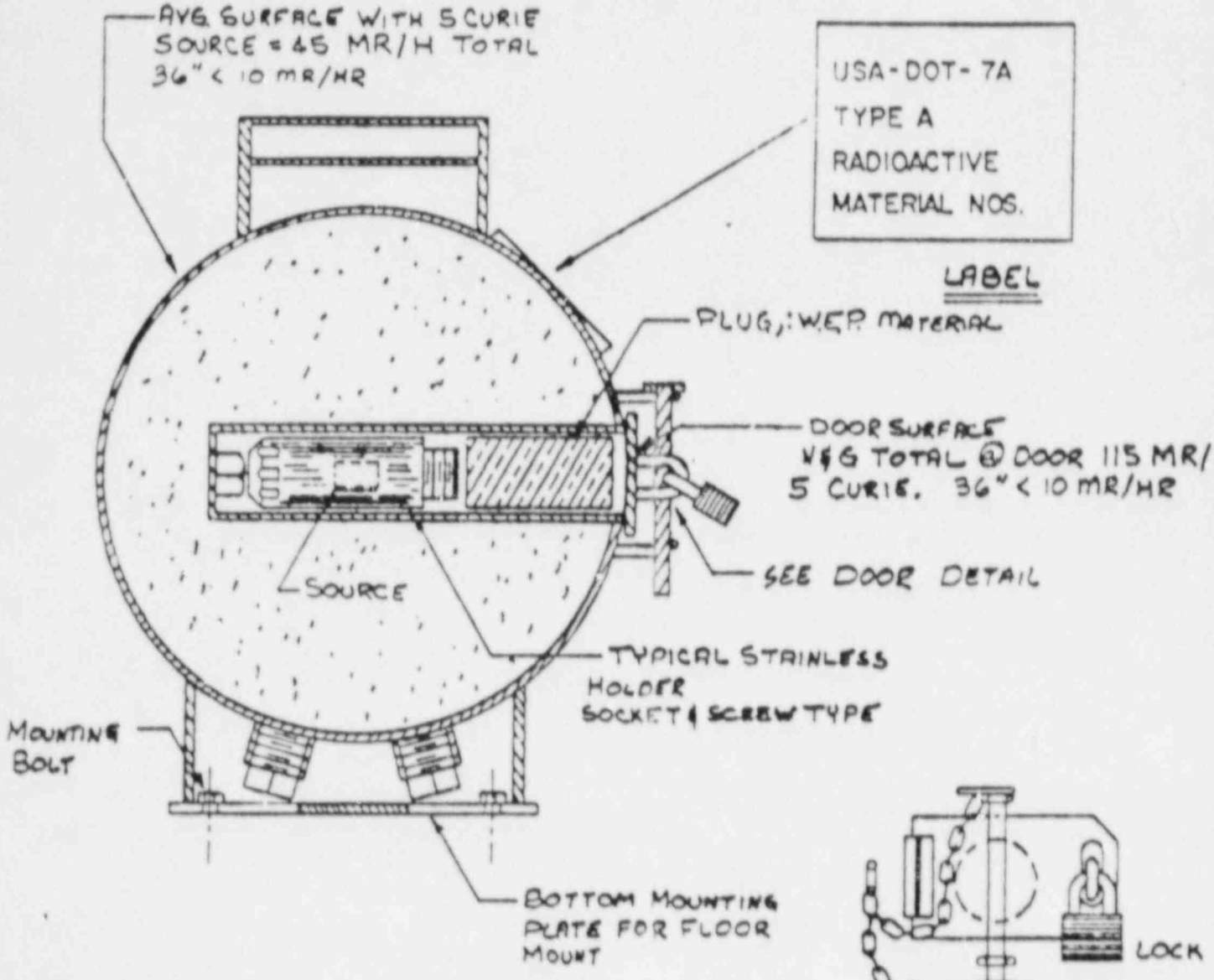
SOURCE LOADING TOOL ASSEMBLY
SOURCE HOLDER – 3 curie AmBe 241



SOURCE HOLDER ASSEMBLY
3 curie AmBe SOURCE



REVISIONS			
LTR.	DESCRIPTION	DATE	APPROVED



MATERIAL

SHIELDED MATERIAL
W.E.P. STEEL ENCASED

FINISH

COLOR-RED
WEIGHT-100 lbs.

S. I. E, INC.
Fort Worth, Texas

3 or 5 Curies AmBe
Neutron Storage Shield
14" Diameter Spherical

APPENDIX A

Annual Inspection Checklist

Well Logging Location _____ Date _____ Time _____

Logging Supervisor _____ Inspector _____

Radioisotope(s) _____ Activity (mCi) _____

Sealed Source Serial Nos. _____

Survey Meter Model No. _____ Serial No. _____ Calibration Due Date _____

	Yes	No
1. Was the logging supervisor wearing a film or TLD badge?		
2. Were other individuals working within the restricted area wearing film badges or dosimeters?		
3. Was the restricted area properly controlled to prevent unauthorized entry?		
4. Did the logging supervisor have a calibrated and properly operating survey meter and evidence of its latest calibration?		
5. Were the lastest survey records as required by paragraphs 39.67(b), (c), and (e) of 10 CFR Part 39 available?		
6. Were the shipping papers for transportation of radioactive material available and properly completed?		
7. Was the utilization log properly filled out?		
8. Did the logging supervisor have sufficient knowledge of safety rules? (Ascertained by oral questions.)		
9. Was the logging supervisor working with defective equipment?		
10. Were radioactive isotopes stored properly and kept secure to prevent unauthorized removal?		
11. Was the storage area posted with "CAUTION (or DANGER) RADIOACTIVE MATERIAL" signs?		

	Yes	No
12. Did the logging supervisor possess a copy of the applicant's operating and emergency procedures?		
13. If operating in an NRC state under reciprocity, was a copy of the Agreement State license available?		
14. Were there any incidents which may have required initiation of emergency procedures?		
15. Were the emergency procedures properly followed?		
16. If necessary in the emergency, were surveys as required by paragraphs 39.67(d) and 39.69(c) conducted and recorded?		
17. Were there any items of noncompliance other than those listed on this form? (If any, explain in remarks.)		

Remarks _____

APPENDIX B

Full Name: _____

Date: _____

RADIATION SAFETY EXAMINATION FOR IN HOUSE USE TO EVALUATE WELL LOGGERS

1. Radiation is present in the atmosphere at all times and cannot be be detected by man's senses. True? False?

2. _____ is the time required for the activity of a radioactive isotope to decrease (radioactive decay) to half of its initial value.

3. A _____ is a unit of measurement of radioactivity representing 37 Billion disintegrations per second.

4. A _____ is one/thousandth of a Curie.

5. Rem is the unit of measurement expressing radiation exposure dose to _____.

6. The most important considerations for protection from radiation are _____, _____, and _____.

7. According to the inverse square law, if the distance from a source of radiation is twice as far away as before, the intensity is one-fourth as great. True? False?

8. _____ is the thickness of shielding material necessary to reduce the intensity of x-ray or gamma ray to one half of its initial value.

9. A commonly used type of shielding material is _____.

10. Neutron sources are shielded by parafin or other material with a high hydrogen content. True? False?

11. Radioactive materials contained in sealed sources commonly used for well logging operations are _____ (for neutron logging) and _____ (for density logging).

12. Radioactive materials commonly used for tracer studies are _____ and _____.

13. A "logging supervisor" is an individual who _____ _____.

14. A "logging assistant" is an individual who _____ _____.

15. To qualify as a logging supervisor, an individual must have satisfactorily completed training requirements being: approved radiation safety training course for well loggers of at least _____ hours; read and received instruction in applicable _____ and our Operating and Emergency Procedures; and completed _____ months on-the-job training.

16. Regulations require that logging supervisors be inspected _____ at a temporary job site to evaluate job performance.

17. Only radioactive materials specifically authorized by our _____ can be used in our well logging operations.

18. The _____ is responsible for the over-all radiation safety program.

19. NRC regulations specific for well logging operations are found in 10 CFR Part _____.

20. Our radiation safety program is governed by conditions of our radioactive material _____, our _____ _____ manual, and appropriate _____.

21. Three ways to monitor personnel for radiation exposure are _____, _____, and _____.

22. In our operations, we use _____ for personnel monitoring, and they must be worn during all operations which involve possible exposure to radiation.

23. TLD badges must be exchanged at least quarterly. True? False?

24. According to regulations, the total allowable radiation dose to the whole body is _____ rems in one year; _____ rems in one quarter.

25. In the "bank account" formula 5(N-18) for determining available exposure, N represents the individual's age. True? False?

26. A 30 year old man has a "bank account" of _____ rems, minus prior exposure, if any.

27. A _____ bunker is recommended for storage of radioactive materials.

28. Signs reading "_____" must be posted on all four sides of the radiation storage bunker.

29. The radiation level which distinguishes a restricted area from a non-restricted ares is _____ mR/hr.

30. How often do regulations require that a physical inventory and inspection of licensed materials be made? _____

31. Leak testing of sealed sources is required once each year. True? False?

32. How often must a survey meter used for well logging be calibrated? _____

33. Geiger-Meuller type survey meters are the most efficient of the three principal types of survey instruments. True? False?

34. On a survey meter, mr/hr means _____.

35. Survey meters used for well logging must measure as high as _____ mR/hr.

36. Survey meters used for well logging must read _____ and _____ radiation.

37. Loading and unloading of source holder assembly must only be done with an approved _____.

38. During efforts to recover a sealed source lodged in the well, _____ must be continually monitored.

39. _____ tool detector may be energized for monitoring for contamination at job site.

40. When it is determined that a sealed source has been ruptured, the RSO must immediately notify _____.

41. Three items of equipment that must be visually checked for defects labeling, and working condition prior to use are _____, _____, and _____.

42. NRC regulations require licensees to transport radioactive materials in compliance with _____ regulations.

43. Well logging sources cannot be transported unless they are in a transport container that meets DOT _____ specifications.

44. Before transporting radioactive materials a radiation survey must be made of each position occupied by personnel and the _____ of the vehicle.

45. The radiation level in the passenger compartment of a vehicle transporting radioactive materials cannot exceed _____ mR/hr.

46. When transporting radioactive materials, _____ must be properly completed, signed and within reach of the driver.

47. The transport index is determined by the survey meter reading of the highest radiation level at a distance of _____ from the exterior of the transport container.

48. A Radiation Yellow III label on the source container indicates that the transport index is more than _____ but less than _____.

49. Vehicles transporting radioactive materials which require a Radiation Yellow III label must be placarded on both sides, the front and the back with placard reading _____.

50. In the event of an emergency involving radioactive materials employees must notify the _____ immediately.