

MIDCO, INC.

OPERATING AND EMERGENCY  
PROCEDURES MANUAL

PREPARED BY:

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WHENEVER THIS MANUAL REFERENCES THE STATE OR FEDERAL  
REGULATORY AGENCY, 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

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WHENEVER REFERENCE IS MADE TO THE RADIATION SAFETY OFFICER,  
IT IS ONE AND THE SAME AS THE RADIATION PROTECTION OFFICER.

## MIDCO, INC.

### OPERATING & EMERGENCY PROCEDURES MANUAL

#### OPENING STATEMENT:

This manual outlines procedures pertaining to the use and handling of radioactive materials in well logging applications. It is the intent of Midco, Inc. 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 reasonable achievable.

A safety committee will be formed to regularly review Midco, Inc.'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 Midco, Inc. to minimize safety problems and noncompliance problems, to minimize hazards to employees, and to insure 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 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 attached 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.

For convenience sake, the term "company" will indicate Midco, Inc.'s licensed facilities. The following pages will give specific procedures.

# OPERATING AND EMERGENCY PROCEDURES MANUAL

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## I. MANAGEMENT RESPONSIBILITY

A. The Radiation Safety Officer (R.S.O.) is responsible for the over-all radiation procedures and training function. These duties consist of:

1. Making sure all facilities are inspected monthly to determine the contamination levels, if any.
2. Maintaining proper files for the protection of the employees and the review of regulatory agents.
3. Providing an effective and ongoing training program for all employees who handle radioactive materials.
4. To insure that all waste procedures are implemented.
5. To insure that all transportation of radioactive material is done in compliance with D.O.T. regulations (49 CFR).
6. To insure that job site surveys and vehicle surveys are completed within specified time.
7. Providing monthly checks on all radiation handlers to insure proper compliance with all State and Federal regulations.
8. Maintaining a personnel monitoring device.
9. Maintaining records to insure that no excessive exposures are received by employees (not to exceed 1.25 Rems per calendar quarter or no more than 5.0 Rems per calendar year.)
10. To insure that survey meters are calibrated every six months.
11. To insure that leak/wipe tests of sealed sources are performed every six months. (If licensed for radioactive source.)
12. The Radiation Safety Officer is committed to make every effort to comply with State and Federal regulations for control of radiation and to report any deficiency or area of non-compliance to the radiation safety committee.

B. Management Records - Master Radiation Files will be maintained at the facility by the R.S.O. Some of the records contained in these files are:

1. Radiation License Information
  - (a) License and Amendments
  - (b) Procedures Manual
  - (c) State/Federal Rules and Regulations
2. Personnel Exposure Records
  - (a) Reports from dosimetry service
  - (b) Employee termination exposure report letters
3. Survey Records
  - (a) Survey meter calibration certificates
  - (b) Monthly facility surveys
  - (c) Monthly bunker surveys
  - (d) Monthly vehicle surveys
  - (e) Job site surveys

4. Source Information (If licensed for radioactive source.)
  - (a) Source inventory
  - (b) Source utilization log
  - (c) Receipts of purchase and disposal
  - (d) Leak/wipe test reports
  - (e) Physical inspection of source assembly, container, & tools.
5. Tracer Material Use (If licensed for I-131 and Ir-192)
  - (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
3. Post - Notice of where license, procedures manual, and regulations can be found

D. Training of Personnel

1. No company employee will be allowed to use or supervise the use of radioactive materials until he has first:
  - (a) Successfully completed a State or Federally approved radiation safety training course.
  - (b) Read and received instruction in the applicable State or Federal rules and regulations.
  - (c) Read and received instruction in the company's operating and emergency procedures and demonstrated an understanding thereof.
  - (d) Demonstrated competence to use radioactive materials, related handling tools and radiation survey instruments which will be employed in his assignment.
2. Employees may assist in operations using radioactive materials under the direct supervision of someone qualified under section D-1, if said assistant has:
  - (a) Read or received instruction in the company's operating and emergency procedures and demonstrated an understanding thereof.
  - (b) Demonstrated competence to use the radioactive materials, related handling tools and radiation survey instruments which will be employed in his assignment.
3. Records of qualifications, certificates of training, etc., indicating that the above requirements have been met will be maintained in the radiation files for inspection.

## 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 Radiation Safety Officer 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 Radiation Safety Officer, or his designated representative, at the end of the control period for the badge.
5. TLD badge reports will be kept up-to-date by the Radiation Safety Officer. These reports will become a part of each employee's personnel record by means of an individual exposure report which will be maintained on a quarterly basis by the R.S.O. 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 used shall be sensitive to gamma radiation.
2. One or more operable radiation survey meters 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. (Ref: Figure #6) A record of each survey will be kept in the company's survey file.
4. A calibration check shall be performed on each radiation survey meter 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. The calibration will be performed by a State or Federally approved survey meter calibration service company. A written record of this calibration will be kept by the R.S.O. in the company's survey file.

5. A survey must be made and recorded for each operation using sealed radiation sources. (Ref: Figure #6)

C. 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 Radiation Safety Officer or other authorized user.
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. (SIT-1), Webster, Texas  
G.E. Smith & Associates, Pasadena, TX (Leak TEst Kit #2)  
Nuclear Sources & Services, Inc., Houston, Texas (LT-1)  
Gulf Nuclear, Houston, Texas (LTK-1)  
Eberline Instruments, Santa Fe, New Mexico  
or Any other State or Federally approved company providing this service.

3. After the 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 retained for review by regulatory agents.

D. Bioassay Procedures for Handlers of Iodine 131 Tracers:

1. The U.S. Nuclear Regulatory Commission sets requirements for bioassay in Regulatory Guide 8.20, which are also required by Agreement States, providing for bioassays to be performed whenever an individual handles more than 50 millicuries of liquid Iodine at any one time in a field application (open air) such as our operations.
2. In our operations we will not handle units of Iodine 131 containing more than 40 millicuries, and we do not expect that an individual will use more than 50 mCi at any one time, however, if so, we will follow these procedures:
  - (a) As soon as possible after the tracer job the individual shall be taken to an area away from the radioactive material storage facility where the minimum background influence can be obtained. Background reading will be recorded.
  - (b) Using a currently calibrated survey meter with a remote probe with a beta window, we will place the probe directly on the surface of the skin at the base of the neck where the thyroid gland is located.
  - (c) If there are any counts measurable greater than background reading, the individual will be sent to a facility that has at least a 1x1 sodium iodide detector. Most likely this would be a radiology lab with counting equipment capable of determining the thyroid burden in microcurie amounts.
  - (d) If the thyroid burden exceeds 0.04 microcuries of I-131, an investigation of the operations will be made to determine if the exposed individual is following correct handling procedures. The Radiation Safety Officer will reiterate to all employees the importance of safe handling procedures, and the factors of time distance and shielding for reducing exposure.
  - (e) If the thyroid burden exceeds 0.14 microcuries of I-131, the individual will be prevented from any further handling of the isotope until the thyroid burden is below 0.14 microcuries.
  - (f) A repeat bioassay shall be taken within one week of the previous measurement in order to confirm the effectiveness of the corrective actions, and bioassays will be repeated weekly until the thyroid burden falls below 0.04 microcuries.
3. Reports of bioassays will be placed with our personnel exposure records in our radiation files and will be furnished to the individual and to the agencies governing radiation as per NRC and State regulations.



### III. PROCEDURES FOR RECEIVING RADIOACTIVE ISOTOPES

- 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 will 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 D.O.T. compliance. The package will not be accepted unless it meets the following criteria:
1. Box must reflect that it meets USA DOT 7-A specifications.
  2. Box must reflect the manufacturer's test seal, giving crush characteristics in pounds per square inch.
  3. Box must have proper triangular labels, properly filled out, giving isotope, curie quantity and transport index.
  4. Packing slip and supplier's label must be attached to box.
- B. Packages of radioactive tracer materials are monitored prior to shipment by the supplier. They generally bear a Yellow III label, which indicates a maximum of 200 mr/hr at surface and 10 mr/hr at three feet. Occasionally the package will bear a Yellow II label, which indicates a maximum of 50 mr/hr at surface and 1 mr/hr at three feet. The package must be monitored with a low level currently calibrated survey meter as soon as practicable after receipt to insure the radiation level does not exceed the above limits, as set out in D.O.T. regulations (49 CFR 172.403).
- C. Monitoring must be in accordance with procedures set out in NRC regulations (10 CFR 20.205). If there is any evidence of radioactive contamination, the Radiation Safety Officer shall 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 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 use at 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.

#### IV. GENERAL RULES FOR TRANSPORTATION OF RADIOACTIVE ISOTOPES

- A. A licensed radiation handler will log the quantity of radioactive material, Iodine 131 or Iridium 192, to be used with date, isotope, survey (mr/hr), chemical base, destination, and signature.  
(Ref: Figure #2 - RA Material Use Log)
- B. This material will be placed in a designated area in the vehicle under lock and key, or in an appropriately designed transportation box meeting D.O.T. 7-A requirements, or may be shipped in the original shipping container received from supplier if no alteration in packaging has been made.
- C. Proper surveys will then be made of the transportation vehicle to insure against excessive exposure (not to exceed 2 mr/hr) using a currently calibrated survey meter.
- D. Each transportation vehicle will have a locked transportation area for radioactive materials designated by the R.S.O. 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 any company vehicle.
- E. All vehicles transporting radioactive materials will have a placard on four sides that bears the proper labelling according to D.O.T. specifications of the word "RADIOACTIVE." The placard is approximately 11" x 11" square in dimension. It has black lettering on a safety yellow and white background.
- F. Appropriate shipping papers will be on board the vehicle within reach of the driver and will be completed in accordance with 49 CFR - Subpart C - Parts 172.200 thru 172.204.



## V. STORAGE FACILITIES AND PROCEDURES

### A. Storing and Securing

1. For temporary storage, the materials will be placed in a secure area that is properly marked with appropriate signs around the perimeter. This storage area will be locked at all times except when removing or returning material. Materials, when not in use, will remain in the storage area properly locked and secured.
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 authorized personnel will be allowed in the storage area, and they must be wearing a film badge.

### B. Vehicle Storage

1. The radioactive material containers will be located in the rear of the vehicle, chained and locked in place and will remain locked at all times except when handling the materials.
2. The material should be carried in an approved D.O.T. 7-A container, at the furthest point possible away from the driver or passengers.

### C. Posting Restricted Areas, Vehicles and Labelling Containers

1. Posting restricted areas and storage areas where the levels are expected to achieve 2 mr per hour will be labelled with signs stating "Caution - Radiation Area" or "Caution Radioactive Materials." These signs will bear the radiation symbol and be magenta and safety yellow in color. The signs will be conspicuous and obvious from all directions. In the event that the levels exceed 5 mr/hr, then a sign stating "Caution -- High Radiation Area," magenta and safety yellow in color will be conspicuously posted.
2. All vehicles transporting or containing radioactive materials will bear a placard on four sides with the proper labelling of the word "RADIOACTIVE." (See Section IV-E) It is clearly understood that this placard will not be displayed if the vehicle is not carrying or storing radioactive materials.
3. All containers carrying or storing or used for transporting radioactive materials will bear a tag with the identification of the radioactive material, the quantity of the radioactive material and the date that the radioactive material was that particular quantity. The tag will also state "Caution -- Radioactive Material."

## VI. GENERAL PROCEDURES FOR HANDLING RADIOACTIVE ISOTOPES ON LOCATION

- A. There will be no loading of ejectors "logging tool" in the logging compartment of the logging vehicle. All loading and handling procedures will be made outside at the rear of the logging vehicle. No smoking, eating or drinking is permitted during loading or handling procedures. Complete "before" portion of Job Site Survey (Figure #6).
- B. The appropriate equipment will be on hand and used by company employees during loading of logging tool. The procedures listed below must be carried out in numerical sequence.
  - 1. A certified calibrated survey meter, disposable napkins, disposable rubber gloves, disposable plastic syringes and current TLD badge will be within the working area visible to employees' line of sight during the entire operation.
  - 2. An approved handler will be the only individual involved in loading logging tool with isotope.
  - \* 3. Handler must establish a restricted area of not less than 30 feet from the work area, which all personnel must observe during loading procedures. Only company personnel will be allowed within the perimeter. These employees must be wearing a duly approved monitoring device.
  - 4. The handler loading the logging tool must be wearing disposable rubber gloves during the complete loading operation.
  - 5. All implements used in handling and transferring radioactive isotopes must not be handled without protection of disposable rubber gloves. All implements and materials must be confined to a properly labeled hot box and kept in the appropriate place on the logging vehicle so designated by the R.S.O.
  - 6. All transferring and loading of logging tool ejectors will be made over absorbent napkins. No pipetting will be done by mouth.
  - 7. Upon completion of the loading operation, absorbent napkins, rubber gloves and all 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.
  - 8. Upon completion of the loading operation, a survey will be made with an approved surveying device to determine if any radioactive materials were spilled.
  - 9. If any radioactive materials were spilled, implement the decontamination procedures so outlined in this manual.
  - 10. At the completion of the logging operation, the remainder of the isotope will be injected into the well being logged. This will insure the proper disposal of the remaining isotope. "After" portion of Job Site Survey (Figure #6) must be completed.

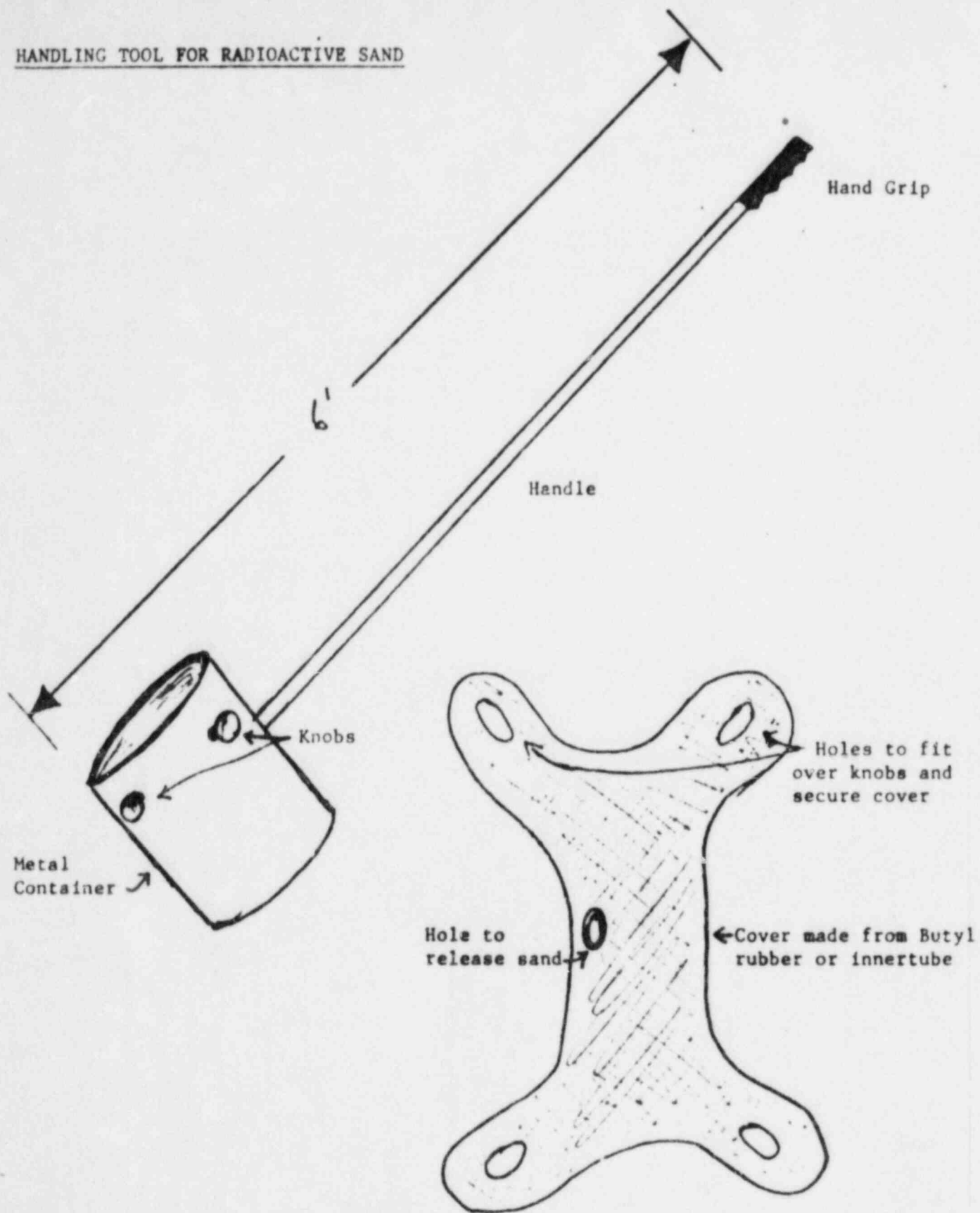
C. Radioactive isotopes baked on sand are used in small quantities as a tagging agent to determine the point of fluid entry in the well bore. Tagging procedures using radioactive sand will vary somewhat depending on the company performing the hydraulic frac operation because of blender design. Ultimately 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 employees' line of sight during the entire tagging operation.
2. "Before" portion of Job Site Survey (Figure #6) must be completed.
3. Employee must be wearing disposable rubber gloves, disposable face mask, and duly approved TLD badge while handling the radioactive sand.
4. The employee handling the sand will use great caution to make sure that the dust by-product of the radioactive sand will not contaminate the area. He will have the wind at his back to insure that the dust does not contaminate his clothing, and he will not allow anyone to be downwind of the tagging operation.
5. The handler will put the radioactive sand into the blender on the well stimulation service company's vehicle. The sand should be sprinkled as close to the fluid face as possible in order to reduce the dust factor. (Remote handling tool should be used.)
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 so outlined in this manual.
8. "After" portion of Job Site Survey (Figure #6) must be completed.
9. Any remaining unused radioactive sand will be returned to the facility in accordance with transportation rules set out in Section IV, and placed in the storage container at our licensed facility for temporary storage until it can be returned to the supplier for waste disposal.

D. Procedures 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-B, 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 this loading operation.

HANDLING TOOL FOR RADIOACTIVE SAND



## VII. WASTE DISPOSAL PROCEDURES FOR ISOTOPES

- 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:  
4230 S.W. 134th Street, Oklahoma City, OK and  
any other licensed facility for our company.
  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 judgment must be rendered by a qualified employee in the definition of a spill before emergency procedures should be implemented. 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 decontamination procedures outlined in this manual.
  - 3. If the spill is on the skin, flush thoroughly with large quantities of fresh water and use an industrial soap, if available. Repeat this cleaning three times, checking the contaminated area after each washing with a survey meter to insure thorough cleaning of the area. If Iodine 131 is the isotope involved, use a potassium base solution (10% per volume located in decontamination kit).
  - 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. Wash minor wounds immediately under running water while spreading the edges of the gash.
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. Check hands ALWAYS before eating, drinking, or smoking. Cleanse carefully of contamination (scrub with soap and water), and check again.

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, by steam cleaning. A 15% hydrochloric acid solution may be used to remove contamination from the surface of non-porous materials. Other chemicals may be had 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 amount is internal.
  - c. The wash water shall be treated as radioactive waste. If wash water is discharged into a sanitary sewage system, the dilution of the activity by the sewage must be such that the tolerance established for such disposal by the N.R.C. and agreement States are not exceeded. Since we do not have the capability of assaying the wash water for the concentration of contaminant in microcuries per milliliter, we must use the amount of tracer material actually used on the job and the average daily water consumption at the facility in determining that we are not exceeding tolerances. If the wash water is discharged into a septic tank, then the surface of the fluid in the

septic tank shall be surveyed after each such decontamination operation, and if any activity above background is noted, the tank shall be posted with a radiation warning sign alerting everyone concerned of the possible hazard. If standard decontamination efforts are unsuccessful, the procedures to be followed shall depend on the value and ownership of the items involved, the degree of contaminations, and the half-life of the contamination activity. 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 (which measures 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 and if the radiation measures less than 2.0 MR/hr at three inches from the surface.
  4. Should any additional information not contained herein be needed, the R.S.O should be consulted.
- d. More persistent activities remaining on injection apparatus, customers equipment, etc. are steam cleaned or chemically treated for contamination.
- e. The user 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. The user in charge shall personally supervise its safe disposition either by staying on the job until the contamination is removed or transporting the equipment to the base where it may be stored awaiting further decontamination efforts.



X. SOURCE HANDLING PROCEDURES

- A. Only company employees who are licensed radiation personnel and who have been trained in handling sealed sources shall perform or directly supervise operations utilizing a sealed radioactive source.
- B. The source assembly will be transported to and from location in full compliance with Department of Transportation regulations (49 CFR). The source assembly will be carried in a transportation container that meets D.O.T. 7-A requirements and which is fastened to an integral part of the vehicle and located at the furthest point possible away from the driver or passengers. Shipping papers, as outlined in 49 CFR Subpart C - Parts 172.200 thru 172.204, will be carried in the cab of the vehicle.
- C. When the source is removed from the storage bunker, it will be logged out on the Source Utilization Log (Ref: Figure #9) and a survey made using a low level survey meter approximately 6 inches from the source container. This log will be kept in the master file for review by regulatory agents.
- D. At no time will a source be handled by hand. All loading or unloading will be done with the aid of a source loading tool or other approved handling tool.
- E. All employees involved in operations using a source will wear a personnel monitoring device (TLD badge). A certified calibrated low level survey meter will be available during all operations using a source.
- F. At the well location, and prior to beginning operations utilizing the source, operator will complete "Before" portion of the Job Site Survey (Ref: Figure #6).
- G. Using the remote handling tool, the source assembly is removed from the transport container. The source assembly is attached to the logging tool and placed inside the well.
- H. When logging procedures have been completed, the tool is returned to the surface, the source shield is replaced, and the source assembly is removed and placed back into the transport container. A vehicle survey is then taken to check for contamination and proper transportation index. "After" portion of the Job Site Survey is completed before leaving location to show there is no ground contamination.
- I. Upon return to facility, source assembly will be surveyed and logged in on the Source Utilization Log (See C above), source assembly will then be returned to the storage bunker using the source handling tool, and locked.

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

- A. In the event a tool containing a sealed source of radioactive material is stuck in an oil or gas well, the following procedures should be followed to insure maximum safety:
1. Remain in contact with the well operator and offer advice and recommendations regarding safe fishing (retrieval) procedures and make the well operator aware of the possibility that fishing procedures might damage the source capsule.
  2. During the retrieval operations, our logging supervisor will 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, logger will remove the source housing assembly from the logging 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, we will immediately notify the State or Federal regulatory agency governing radiation. (Emergency telephone number on cover page of this manual.)
  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.
- B. If it becomes apparent that the source cannot be retrieved and will have to be abandoned downhole, we 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 to follow for safe abandonment of a source downhole:
1. After notifying the regulatory agencies, the logging supervisor 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 and model and curie quantity).
- B. Under no circumstances will any employee of licensee remove a source from a source holder or assembly.
- C. 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 procedure 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.

- D. Sealed sources will be returned to the manufacturer for disposal, or transferred to a commercial waste disposal service. Receipt from manufacturer or waste disposal service will be placed in the radiation files as record of disposal.

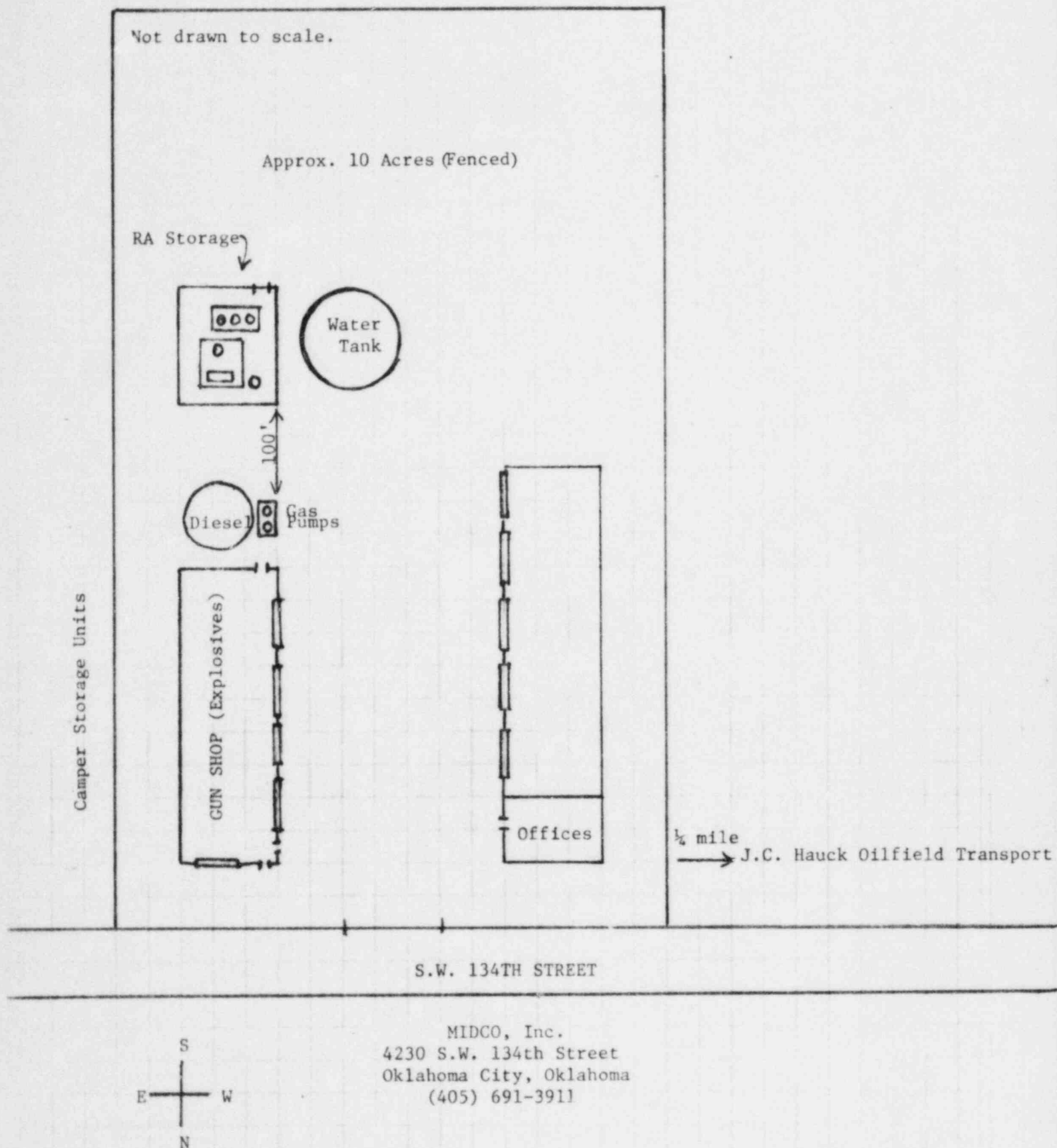
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\* Survey reading made on receipt.





## FACILITY DRAWING

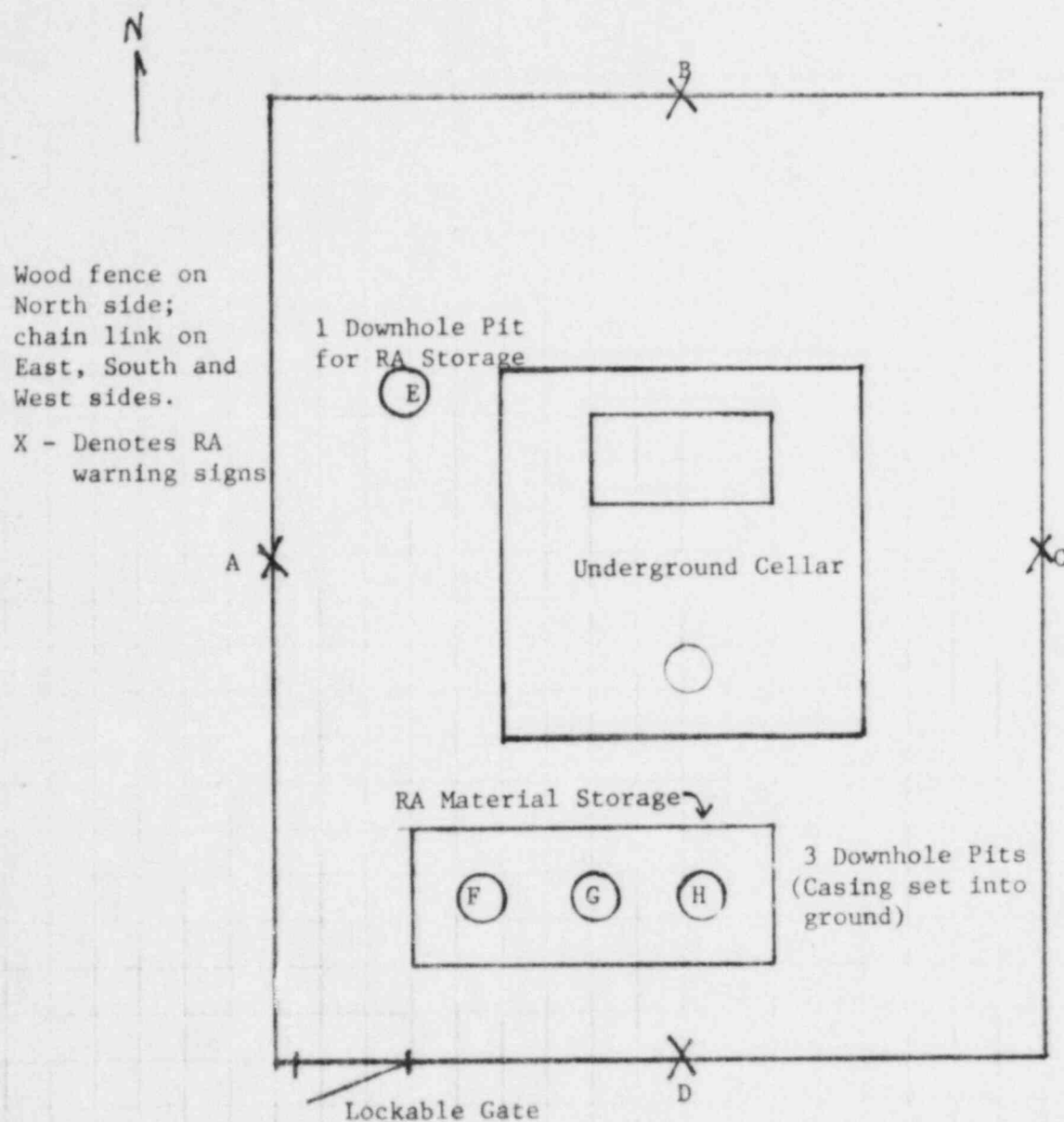


60325



## MONTHLY R/A BUNKER SURVEY

MIDCO, Inc.  
4230 S.W. 134th Street  
Oklahoma City, Oklahoma



SURVEYS		
A		MR/HR
B		MR/HR
C		MR/HR
D		MR/HR
E		MR/HR
F		MR/HR
G		MR/HR
H		MR/HR

## SURVEY METER INFO:

Make: \_\_\_\_\_

Model: \_\_\_\_\_

Serial No.: \_\_\_\_\_

Date of Calibration: \_\_\_\_\_

SURVEYED BY: \_\_\_\_\_

DATE: \_\_\_\_\_



# RADIOACTIVE MATERIAL UTILIZATION SURVEY

DATE \_\_\_\_\_

WELL IDENTIFICATION

LOCATION

FIELD \_\_\_\_\_  
NAME \_\_\_\_\_ NUMBERS \_\_\_\_\_

COUNTY \_\_\_\_\_

STATE \_\_\_\_\_

## SURVEY METER IDENTIFICATION:

MODEL NUMBER \_\_\_\_\_

MANUFACTURER \_\_\_\_\_

SERIAL NUMBER \_\_\_\_\_

Date of Calibration \_\_\_\_\_

## RADIOACTIVE MATERIAL

TRACER MATERIALS: INVOICE NUMBER \_\_\_\_\_ (Attach Supplier's Invoice)

RADIOISOTOPE USED \_\_\_\_\_

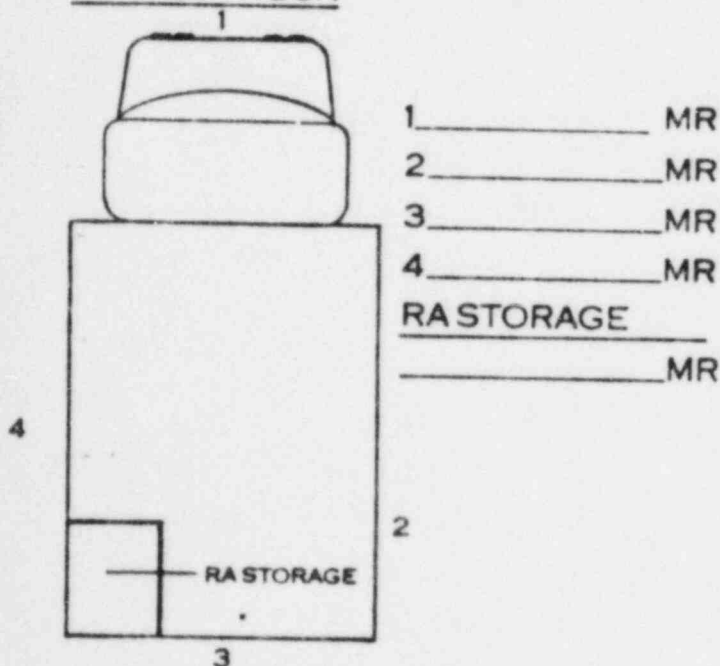
TYPE OF USE \_\_\_\_\_

VOLUME \_\_\_\_\_

Waste Disposal \_\_\_\_\_

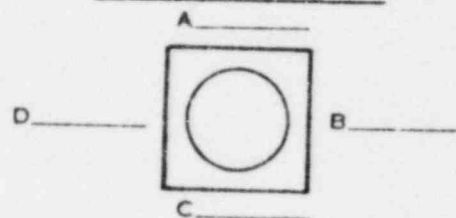
SEALED SOURCES: Radioisotope Used \_\_\_\_\_ Activity \_\_\_\_\_

### \* SURVEY TRUCK

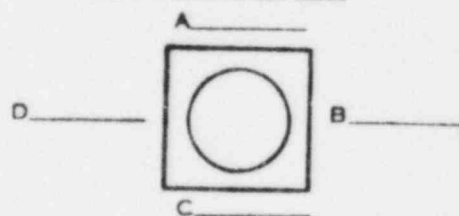


### WELL HEAD

BEFORE - MR/HR



AFTER - MR/HR



LICENSED PERSON SIGN HERE: \_\_\_\_\_

\*May be used for Monthly Vehicle Surveys.

EMERGENCY PROCEDURES REPORT

1. Customer: \_\_\_\_\_  
\_\_\_\_\_
2. Customer's Supervisor: \_\_\_\_\_
3. Radiation Safety Officer: \_\_\_\_\_
4. Cause of Emergency: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Source of Isotope: \_\_\_\_\_
6. Quantity of Isotope (curies) believed to have been spilled: \_\_\_\_\_  
\_\_\_\_\_
7. Safety Precautions immediately enacted: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
8. Were there any suspected overexposures and if so, who:
  1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
  4. \_\_\_\_\_
  5. \_\_\_\_\_
  6. \_\_\_\_\_

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

10. On the sketch of the job site, mark the location of the exact spill:

11. Make an isodose chart if the level of the spill is greater than 10 mr @ 1 foot.

a. one foot: \_\_\_\_\_

b. three feet: \_\_\_\_\_

c. six feet: \_\_\_\_\_

12. Check the air space for contamination: \_\_\_\_\_

13. Results of wipe tests after clean up emergency procedures are undertaken:

Position #1: \_\_\_\_\_ (dpm)

Position #2: \_\_\_\_\_ (dpm)

Position #3: \_\_\_\_\_ (dpm)

14. Suggestions to future prevention of this accident: \_\_\_\_\_

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 to be from a notebook or a standard sheet of stationery.

## RADIOACTIVE SOURCE INVENTORY AND INSPECTION

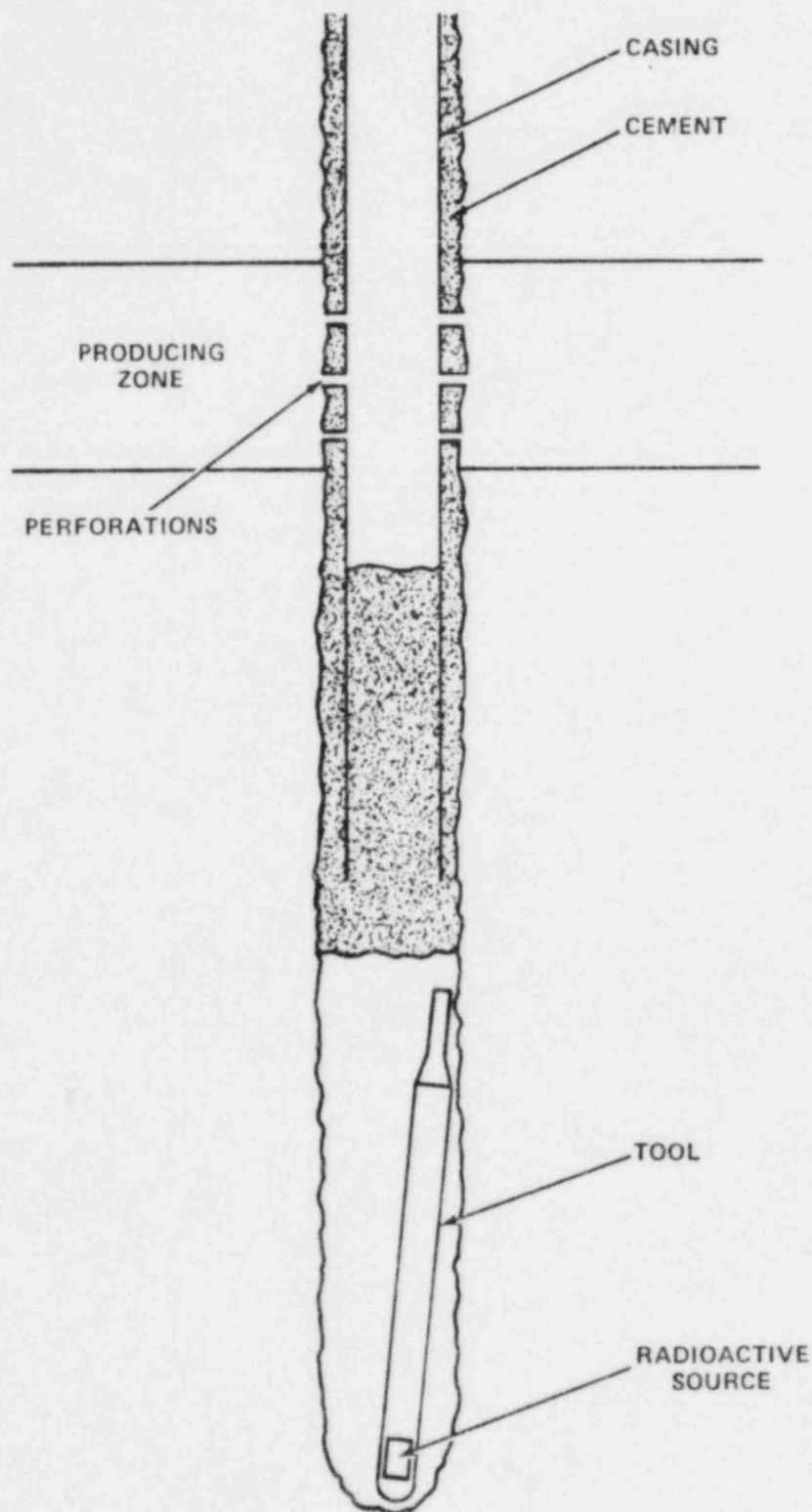
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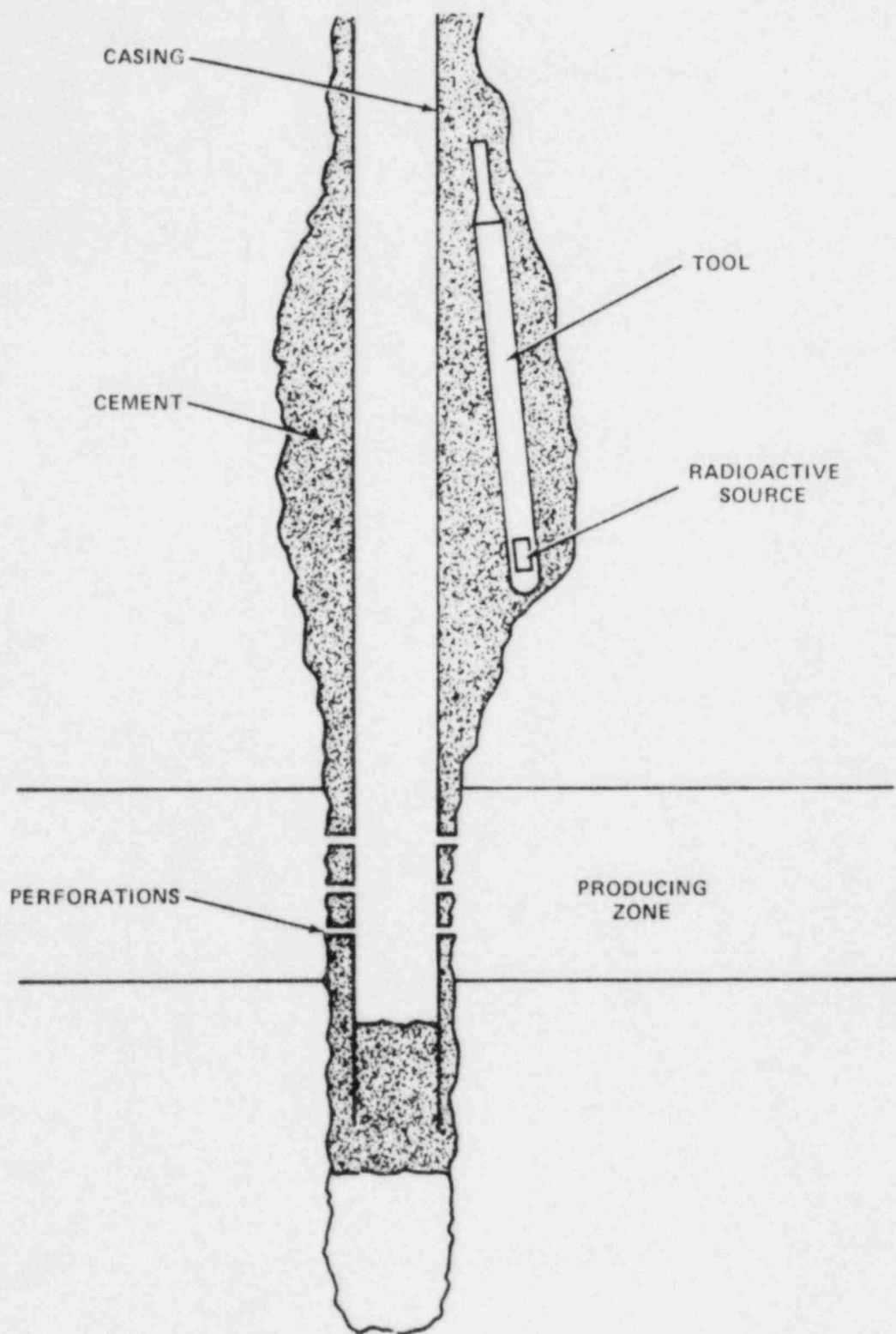
\*Visual inspection of physical condition and proper labeling.

BY:

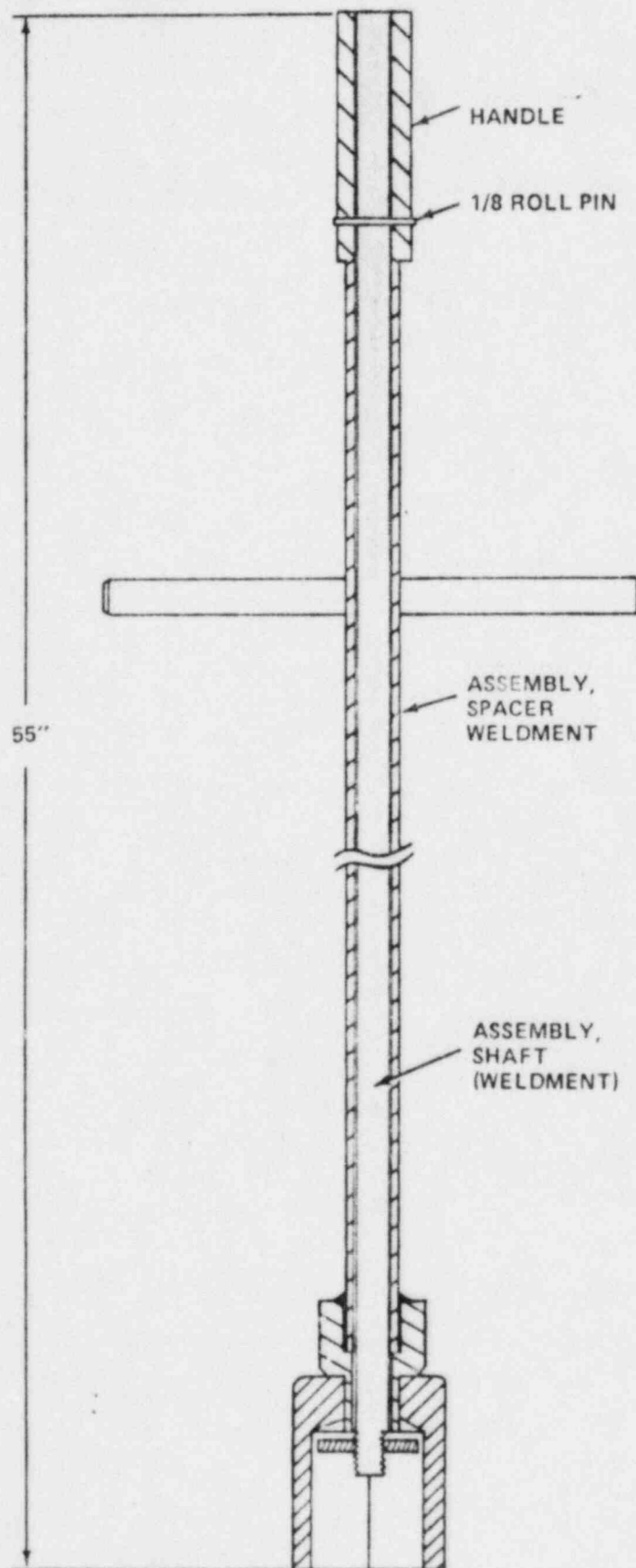






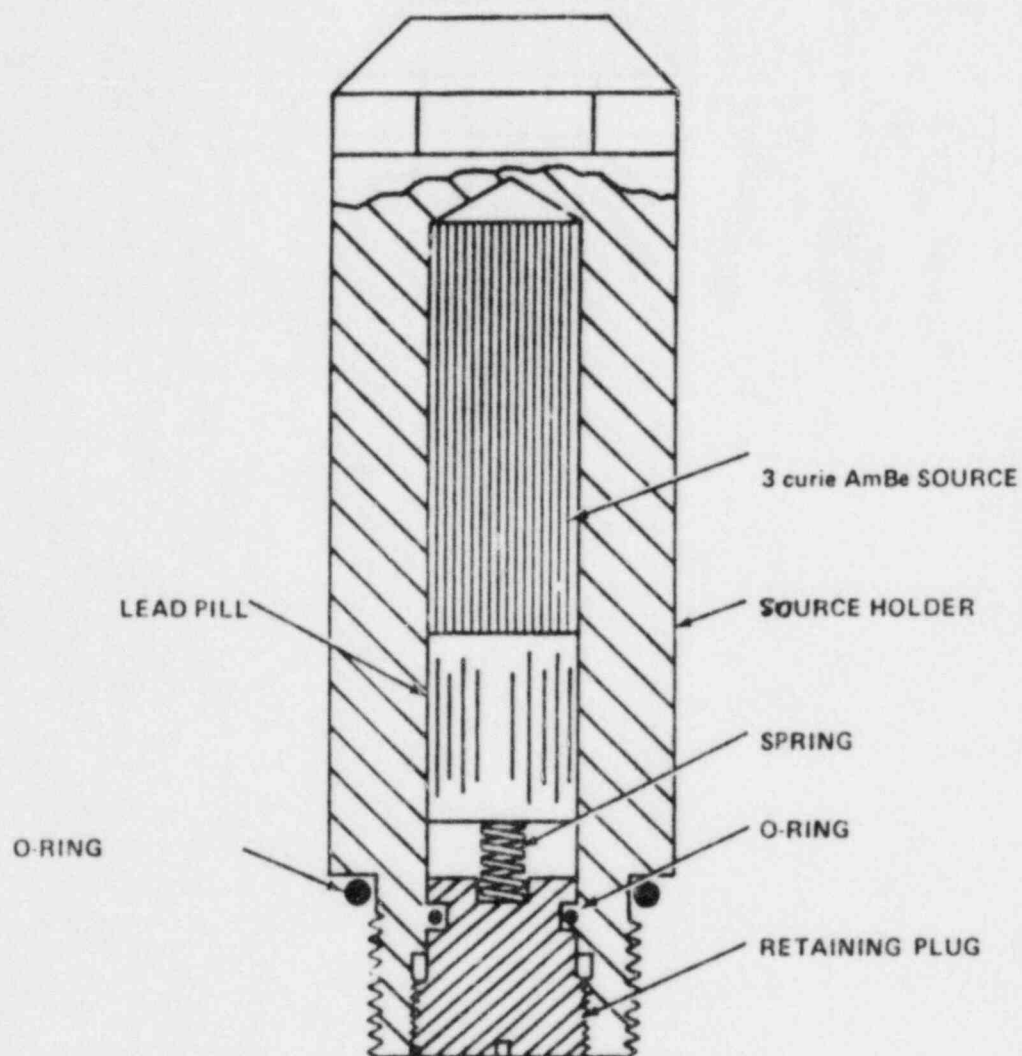


SOURCE LOADING TOOL ASSEMBLY  
SOURCE HOLDER - 3 curie AmBe 241

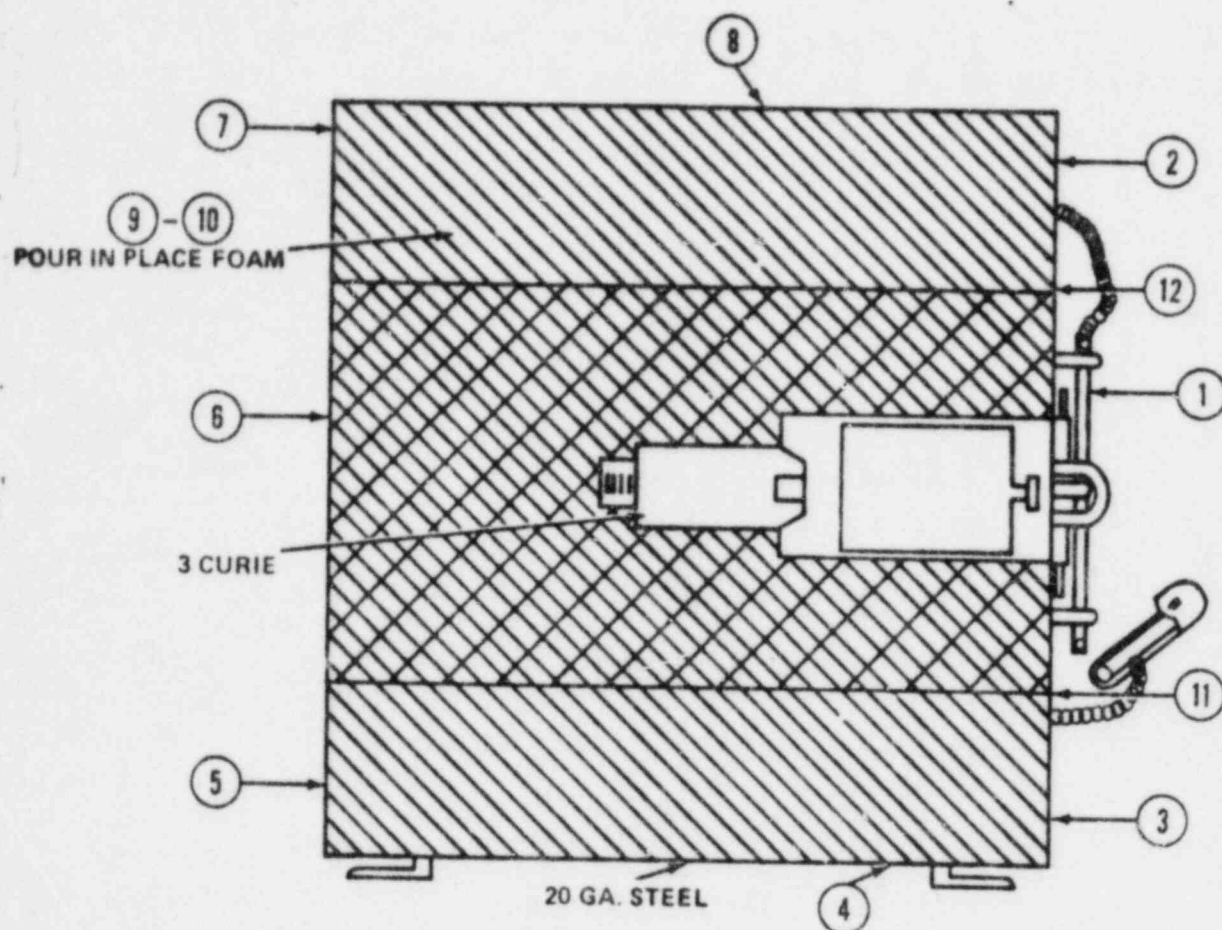


60325

SOURCE HOLDER ASSEMBLY  
3 curie AmBe SOURCE



3 curie AmBe 241 SHIELD  
D.O.T. - 7A



NO.	NEUTRONS	GAMMA
1	40 MR/HR	1.0 MR/HR
2	20 MR/HR	1.0 MR/HR
3	40 MR/HR	1.0 MR/HR
4	48 MR/HR	2.0 MR/HR
5	32 MR/HR	1.2 MR/HR
6	44 MR/HR	1.8 MR/HR
7	32 MR/HR	1.3 MR/HR
8	48 MR/HR	2.0 MR/HR
9	48 MR/HR	2.0 MR/HR
10	48 MR/HR	2.0 MR/HR
11	48 MR/HR	2.0 MR/HR
12	48 MR/HR	1.8 MR/HR

60325