

**GUIDE FOR THE PREPARATION OF APPLICATIONS FOR THE
USE OF RADIOACTIVE MATERIALS IN WELL-LOGGING OPERATIONS**

Kansas Department of Health and Environment
Bureau of Environmental Health
Radiation Control Program
1000 SW Jackson, Suite 330
Topeka, Kansas 66612-1365

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PREFACE

The purpose of this guide is to assist applicants in the preparation of applications for radioactive material licenses or amendments thereto to receive, possess and use radioactive materials for well-logging operations.

The Nuclear Energy Development and Radiation Control Act of 1963 charges the Kansas State Department of Health and Environment with, among other things, responsibility for regulating the receipt, possession, and use of radioactive materials. The Department is authorized to establish by rule, regulations or order such standards and instructions to govern the possession and use of radioactive material as it may deem necessary or desirable to protect health or to minimize danger to life or property.

In the performance of its regulatory functions, the Department has promulgated the Kansas Radiation Protection Regulations. The following parts are pertinent to the subject of this guide:

1. Part 1, "General."
2. Part 3, "Licensing of Sources of Radiation."
3. Part 4, "Standards for Protection Against Radiation."
4. Part 10, "Notices, Instructions and Reports to Workers, Inspections."

These four parts were in effect as of May 1, 1986, and are printed in a regulation booklet entitled "Kansas Radiation Protection Regulations." Current copies of the Department regulations may be obtained from the Kansas Department of Health and Environment, Bureau of Environmental Health, Radiation Control Program, 1000 SW Jackson Suite 330, Topeka, KS 66612-1365.

General requirements for issuance of a specific license are contained in Part 3. An application submitted in accordance to these requirements will be evaluated against the regulations of Part 4 - "Standards for Protection Against Radiation." Part 10 includes information as to the rights of workers involved in the use of radioactive materials or radiation producing devices. Part 1 contains definitions of terms used in the other regulations.

The information contained herein is intended to provide illustrative guidance and should not be considered a substitute for the applicant's careful evaluation of the proposed use of radioactive materials, or for assuring that the application correctly and adequately describes the radiation safeguards and procedures to be followed.

Information not specifically discussed herein should be included with the application if the applicant considers it to be an important part of the radiation safety program. Where an application is incomplete, it may be necessary for the Department to request additional information so as to provide reasonable assurance that the applicant has established an adequate radiation safety program. Exchanges of correspondence between the Department and applicant delay final action on the application. This may be avoided by a thorough study of Department regulations and this guide prior to the filing of an application.

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INTRODUCTION

If for any reason you feel confident that an application can be submitted without following this guide, please remember that any necessary information that is not submitted will delay completion of the review of your application.

The purpose of this document is to describe the type and extent of information that the Kansas Radiation Control Program staff needs to evaluate an application for the use of radioactive materials in oil, gas, and mineral well-logging operations. The issuance of this type of license is provided for under Regulation 28-35-179a and 28-35-180a of the Kansas Radiation Protection Regulations. The applicant should carefully study the regulations and this guide and submit all information requested. The well-logging operations covered by this guide are the use of the electronic well-logging containing sealed sources and the use of radioactive materials to conduct tracer studies. This guide is not intended for use in the preparation of applications for use of millicurie tracers in secondary recovery operations or for use of special nuclear material in well-logging operations.

The following Kansas Radiation Protection Regulations apply to well-logging operations and should be used in conjunction with this guide. The applicant should carefully study the regulations. This guide does not substitute for understanding the requirements of the regulations.

Part 1, "General"

Part 3, "Licensing of Sources of Radiation"

Part 4, "Standards for Protection Against Radiation"

Part 10, "Notices, Instructions and Reports to Workers, Inspections"

Please note that this guide is intended only for general guidance in preparation of the license application and should not be considered as a substitute for the applicant's safety evaluation of the proposed use of radioactive material. The applicant must ensure that the application correctly and adequately describes the radiation safety measures and procedures to be followed in order to provide adequate protection.

AS LOW AS REASONABLY ACHIEVABLE

The applicant should, in addition to complying with the requirements set forth in the Kansas Radiation Protection Regulations, make every reasonable effort to maintain radiation exposures, and radioactive material effluents to unrestricted areas, As Low As Reasonably Achievable (ALARA). Applicants should give consideration to the ALARA philosophy in the development of operating procedures and in the training of personnel using radioactive material.

Some of the items that should be considered to help maintain radiation exposures as low as reasonably achievable are discussed below. The discussion is not intended to be all inclusive, but should be used as a guide in establishing an operating philosophy for maintaining occupational radiation exposures as low as reasonably achievable.

The most important single item is the routine use of survey meters to ensure that radioactive sources have been returned to the storage container after each log operation. The necessity of performing adequate surveys should be emphasized during initial classroom training, on-the-job training, and refresher training of personnel.

The habit of taking advantage of available shielding at temporary job sites also contributes to maintaining low occupational exposures. Again, this practice can and should be addressed during initial training, on-the-job training, and refresher training.

In addition to the practices mentioned above, taking advantage of the full length of the handling devices, using as long a handling tool as practicable and properly storing radioactive material as soon as possible after use can all contribute to maintaining occupational exposures as low as reasonable achievable.

In addition to providing for items as those listed above, the necessity of using the safety equipment that is provided should be emphasized during initial training of radiation workers.

Management can also contribute to maintaining low occupational exposures by spreading the workload among personnel so that the same person does not always receive the assignment that involves the highest exposure. Management should review personnel monitoring records to identify those individuals who have exposures higher than the average and to try to establish and correct the cause.

FILING AN APPLICATION

A license application for radioactive material should be submitted on Form RH-1, "Application for Radioactive Material License." Since the space on Form RH-1 is usually not sufficient to contain all of the required information, additional sheets should be appended. Each separate sheet or document submitted with the application should be clearly identified by a heading indicating the appropriate item number.

The application should be completed in duplicate. The original should be mailed to the Kansas Department of Health and Environment, Bureau of Environmental Health, Radiation Control Program, 1000 SW Jackson Suite 330, Topeka, KS 66612-1365. Since the license will require, as a condition, the licensee follow the statements and representations set forth in the application and any supplements to it, one copy of the application with all attachments should be retained by the applicant. In addition, Regulation 28-35-332a of the Kansas Radiation Protection Regulations requires that this information be posted or otherwise made available to employees of the licensee.

Upon completion, the application Form RH-1 must be signed and dated by an official representative of the applicant, e.g., President, Department or Division Head, or other person authorized to sign official documents to certify that the application contains information that is true and correct to the best of the applicant's knowledge and belief. Applications that are unsigned will be returned for proper signature.

CONTENTS OF APPLICATION

The following discussion deals with specific items on the application forms. Any section of the application which is not applicable should be so designated. Materials submitted on a separate attachment should be clearly identified.

The information should pertain to the specific activities for which authorization is requested and should be as complete and detailed as possible. Submissions of incomplete information will result in delays because of the correspondence necessary to obtain supplemental information. The submitted information must be sufficient to allow the Department to determine that the proposed equipment, facilities, procedures, and controls are adequate to protect health and minimize danger to life and property.

If applying for amendment to existing license, information previously submitted may be referenced.

Application for a Radioactive Materials License

Item 1. (a) NAME AND STREET ADDRESS OF APPLICANT

Enter the name of the firm applying for the license, the mailing address and telephone number.

Item 1. (b) STREET ADDRESS(ES) AT WHICH RADIOACTIVE MATERIAL WILL BE USED

If the mailing address in Item 1 (a) is a P.O. Box or if different from the location where radioactive material will be primarily stored, then list the street address where the radioactive material will be primarily stored and/or used. Since well-logging operations involve travel away from a home base, indicate that materials will also be used at temporary job sites.

Item 2. DEPARTMENT TO USE RADIOACTIVE MATERIAL

Department or section within company which will use radioactive material (if applicable).

Item 3. PREVIOUS LICENSE NUMBER(S)

Indicate if this is a renewal, amendment, or a new license application. If a renewal or amendment, please indicate the appropriate Kansas License Number.

Item 4. INDIVIDUAL USER(S)

As indicated in the application, give name and titles of individuals who will use or supervise the use of radioactive materials.

Item 5. RADIATION PROTECTION OFFICER

A qualified individual should be designated the responsibility for radiation protection. The individual designated as Radiation Protection or Safety Officer (RSO) is normally an individual user, supervisor, or other individual who will maintain the license and have overall responsibility for the radiation protection program. The applicant should detail the named individual's duties and responsibilities. The RSO is expected to coordinate the safe use of the radioactive material and to ensure compliance with the requirements of the Kansas Radiation Protection Regulations.

Typical duties of the RSO should include the following:

- (a) To ensure that radioactive materials that are possessed or used by the applicant are limited to those materials specified in the license.

- (b) To ensure that the radioactive materials are used only by those individuals authorized by the license.
- (c) To ensure that all users wear personnel monitoring equipment, such as film badges or thermoluminescence dosimeters (TLD). If certain trace studies are performed, the RSO should insure that bioassays are performed on individuals using large quantities of material.
- (d) To ensure that radioactive material is properly secured against unauthorized removal at all times.
- (e) To supervise leak testing of sealed sources and instrument calibrations.
- (f) To develop operating and emergency procedures and to assist in personnel training and orientation in these procedures.
- (g) To conduct a periodic physical inventory to account for all sources of radiation.
- (h) To conduct a program of inspection and maintenance of equipment and containers to assure proper labeling and physical condition.
- (i) To serve as a point of contact and give assistance in case of emergency (well-logging tool damage, theft of radioactive materials, fire, etc.) and to ensure that proper authorities, (for example, local police and Department personnel) are notified promptly in case of an accident or other incident that may involve the release of radioactive material.
- (j) To ensure that the terms and conditions of the license, such as periodic leak tests, are met and that the required records, etc., are periodically reviewed for compliance with Kansas Radiation Protection Regulations, applicant license conditions and applicant submittals to the Department.
- (k) To conduct radiation safety inspections of licensed activities periodically to ensure compliance with the regulations, license conditions and company operating procedures.

The individuals who will use or supervise the use of radioactive materials should be listed, and the qualifications and training of these individuals along with a brief resume of their experience with radioactive materials and formal training should be entered under items 8 and 9 of this application. This should include a copy of a certificate of training for individuals who have attended an authorized training course on radiation principles and safety, if applicable.

Item 6. (a) RADIOACTIVE MATERIAL

(Examples)

1. Americium 241/Beryllium
 2. Cesium 137
 3. Iodine 131
 4. Iridium 192
- (b) Chemical and/or physical form and maximum quantity of each chemical and/or physical form you wish to possess at one time.

(Example)

1. Sealed source (XYZ Company, Model 2, 2 curies per source.) 4 sources total.
2. Sealed source (XYZ Company, Model 1, 125 millicuries per source), 2 sources total.
3. NaI (Sodium iodide) (100 millicuries total)
4. Tagged sand (100 millicuries total)

Item 7. DESCRIBE PURPOSE FOR WHICH RADIOACTIVE MATERIAL WILL BE USED

1. To be used for neutron logging at oil and gas wells.
2. To be used for density logging of oil and gas wells.
- 3&4. To be used for tracer studies in oil and gas wells.

Item 8. TRAINING AND EXPERIENCE OF EACH INDIVIDUAL(S) NAMED IN ITEM 4: and

Item 9. EXPERIENCE WITH RADIATION

A resume of the training and experience of each person who will supervise the use of radioactive material, who will use radioactive material without supervision, or who will have responsibilities for radiation safety should be submitted. User qualifications should include instructions in radiation safety practices appropriate for activities to be performed, and in company requirements, manuals and standard operating procedures, and radiation regulations, and on-the-job experience actually handling comparable materials. Descriptions of on-the-job training should include the degree of independent use, the types and quantities of materials handled, the company or other employer where the experience was gained, and the length of time over which the training occurred.

In addition, the qualifications of the Radiation Safety Officer should include familiarity with Kansas Radiation Protection Regulations and company requirements and procedures, general training in basic radionuclide handling techniques and safety practices, and on-the-job experience actually handling comparable materials. Descriptions of on-the-job experience should include aspects such as the degree of independent use of radioactive materials, the types and quantities of radioactive materials handled, the types of surveys and other radiation safety duties performed, the name and address of the company or other employer where the experience was gained, and the length of time over which the experience was obtained.

Provide any documentation supporting each individual's training and experience. This should include but not be limited to copies of certifications from approved training or certification programs, and/or corporate training records detailing the type and extent of training and experience.

Item 10. RADIATION DETECTION INSTRUMENTS

A radiation survey instrument is advised for all oil well-logging operations. Each radiation survey instrument should be calibrated at intervals not to exceed one year and after each instrument servicing. E.G., a calibration should be performed if there is reason to suspect damage to the instrument as a result of an accident (vehicle accident or dropping of meter).

Instrumentation and survey methods used during tracer studies should be sufficiently sensitive to detect the radioisotopes being monitored. A thin-end window (less than 2 mg/cm²) GM detector should be used for beta-emitting radioisotope tracer contamination surveys.

The applicant should specify for each type of radiation detection instrument available to the program: The manufacturer's name and model numbers, the number of instruments available, the type of radiation detected (alpha, beta, gamma, and/or neutron), and the sensitivity range in milliroentgens per hour or counts per minute. For instruments to be used for surveys, the instrument should have a capability of measuring a minimum of 0.1 milliroentgens per hour.

The applicant should submit details if the use of a logging tool as a survey instrument is proposed, including the radiation detected and the sensitivity range.

List any other radiation detection instruments available which are not routinely used for health physics surveys or monitoring.

Item 11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE

Instrument calibration provisions should be detailed in the application. The applicant should state the calibration frequency, and describe the methods and procedures for calibration of survey and monitoring instruments as well as any other instruments and systems used in the radiation protection program such as measuring instruments used for assay, bioassay and/or sealed-source leak-test samples.

In instrument calibration will be performed by an organization other than the applicant, the name of the organization and the calibration frequency should be included in the application.

If the applicant wishes to calibrate instruments, the following information should be submitted:

- (a) The type (radioisotope, manufacturer and model number) and activity of the source to be used and the manufacturer and model number of the device.
- (b) The specific procedures to be used for calibration, including radiation safety procedures to be followed for use of the source. These procedures should include sample calculations to demonstrate an understanding of how to establish the exposure rate at a given distance and sample calculations to demonstrate an understanding of how to correct for source decay.
- (c) The name and pertinent experience of each individual who will perform instrument calibration.

Item 12. FILM BADGES, DOSIMETERS, AND BIOASSAY PROCEDURES USED

The types of personnel monitoring employed should be adequately described. Please specify the type of radiation detected by the film badges and in addition, indicate what company supplies the film badge service. State at what intervals the film badges will be exchanged and where personnel attach the badges to their clothing.

Film badges, TLD or equivalent personnel monitoring devices are recommended for well-logging operations. Use of these devices with monthly evaluations is an acceptable practice.

If the use of pocket dosimeters is proposed, the applicant should provide the name of the manufacturer, type, model number and range (mR), and frequency of reading and recording.

During tracer studies, bioassays (thyroid checks, urinalysis, etc.) may be required when individuals work with multi-millicurie quantities of iodine-131, depending on the type of work, equipment used, and procedures followed. For example, if an individual handles 50 millicuries of iodine-131 per week in noncontained form, thyroid checks should be made. Such criteria to be used in determining the need for bioassays and the type of

bioassays that will be performed should be described. If a commercial bioassay service is to be used, the name and address of the firm should be provided.

Item 13. FACILITIES AND EQUIPMENT

The applicant should describe the facilities to be used to ensure security and safe storage of materials. Sources of radiation must be stored in a manner which will minimize danger from explosion and/or fire. This provision is considered necessary to reduce the probability of damage to sources of radiation stored in the proximity of explosives frequently used in well-logging operations, and in the event of fire. U.S. Department of Transportation regulations prohibit the storage and transportation of radioactive materials with Class A and other specified explosives.

In describing available facilities, the applicant should submit the information requested in the following; subitem (a) for sealed source programs, and/or subitem (b) for tracer studies programs.

(a) Sealed Source Programs

Storage and other facilities. The description of field office, site or vehicular storage containers and facilities should include drawings or sketches. The design dimension, thickness or shielding, type of shielding materials (concrete, steel, lead, etc.), and means for securing sources from unauthorized removal should be described. The expected radiation levels at the surface of containers and accessible areas of storage facilities should be given. Laboratories or field office facilities that are to be maintained as restricted areas for survey instrument and logging tool calibration and repairs should be described.

(b) Tracer Operations

1. Facilities and equipment for sample preparation. If tracer samples are not to be purchased in ready-to-use form, laboratory or field office facilities that are to be maintained as controlled areas for sample preparation should be described. Sketches are helpful. Hoods, sinks, trays with absorbent materials, remote handling tools, rubber gloves, etc., that will be available at these laboratory sites should also be described.
2. Storage provisions. The description of storage facilities should include drawings or sketches of the rooms, buildings, pits, - etc., showing shielding materials (concrete, steel, lead, earth, etc.), and means for securing materials from unauthorized removal.

Storage facilities should be designed and materials positioned so that radiation levels do not normally exceed 2 milliroentgens per hour at 18 inches from the exterior surface of the storage facility in order to meet the criteria for an uncontrolled area.

In addition to the permanent storage facility, please provide a detailed description of the precautions that will be taken for storage of material at temporary jobsites. This should include the following:

- (a) A detail of the storage vault or container that is provided on transporting vehicles, including dimensions and shielding information.
- (b) Posting of temporary storage facilities.
- (c) Precautions that will be taken to prevent unauthorized removal of radioactive material from temporary storage facilities.
- (d) Precautions that will be taken during transport. Transport containers shall be physically secured to the transporting vehicle to prevent accidental loss, tampering, or unauthorized removal.

Item 14. RADIATION PROTECTION PROGRAM

Contamination Surveys

Please describe in detail the procedure used for determining if contamination is present on the logging tool after the completion of each log. The logging tool and well site should be surveyed for contamination when logging tools are removed from the hole and after the source has been removed from the logging tool. The survey may be performed with a survey meter or by energizing the logging tool after the source has been removed. Methods and instruments used in surface contamination surveys should be sufficiently sensitive to detect the nuclides being monitored. Records of contamination surveys shall be maintained for inspection by the Department.

The Kansas Radiation Protection Regulations do not specify limits for surface contamination. Each applicant may propose and justify the levels of removable surface contamination that will be allowable before decontamination must be performed. These limits should be based on the need to avoid transfer of significant amounts of contamination to uncontrolled areas and to maintain exposures as low as is reasonably achievable. Emergency instructions should be established in case contamination is detected. Decontamination procedures should be provided by the applicant.

Radiation Area Surveys

Please indicate in detail the methods and occasions for conducting radiation surveys. Detail the procedures employed to assure that personnel exposure is kept to a minimum during source handling. (Refer to Appendices A and/or B of this guide.)

Indicate in detail the procedure employed to assure that the source has been returned to its storage container after use for a log. In addition, indicate what records are maintained for this survey. Please submit the format used for these records.

Describe the procedure, the frequency of the procedure, and the instrument used for performing surveys for the purpose of determining radiation levels at the storage location and what quantities of radioactive material are used. Specify what records will be maintained.

Environmental Surveys

Environmental surveys are not applicable with the use of sealed radioactive sources.

Environmental surveys are required if radioactive tracer materials are used. In the event of a spill or a well-head ejection of radioactive material, detailed procedures should be on hand for clean-up, decontamination, and environmental and follow-up surveys. The applicant should submit these procedures with or as a part of their Health Physics Program.

Leak Tests

A leak test of sealed radioactive sources used for well-logging is required at six (6) month intervals. If the tests will be performed using a commercial "kit", the name of the kit manufacturer or distributor and the kit model designation must be given. If the applicant intends to perform in-house leak tests without the use of an approved commercial leak-test kit, the following information must be submitted:

- (a) The name and qualifications of each individual who will perform the leak tests.
- (b) Procedures and materials to be used in collecting test samples.
- (c) The type, manufacturer's name, model number, and radiation detection and measurement characteristics of the instrument to be used for assaying the test samples. Determination and periodic verification of the counting efficiency of the instrument should be included in the measurement characteristics of the instrument.
- (d) Instrument calibration procedures, including the name of the manufacturer and model number of each standard source to be used, the step-by-step calibration procedures to be followed, and the name, experience, and training of each individual who will perform the calibrations. In providing information about the standard sources used in the calibrations, applicants should provide information concerning the accuracy of each source used. Each source should be, as a minimum, $\pm 5\%$ of the stated value and traceable

to a primary standard, such as that maintained by the National Institute of Standards and Technology.

- (e) The method, include a sample calculation, used to convert instrument readings to units of activity, e.g., microcuries.

Health Physics Program

The applicant should describe the radiation protection program that will be implemented to ensure safe use of radioactive materials. The applicant should submit a copy of the operating and emergency procedures that individuals will follow in the use of radioactive material. Appendix A describes the elements of an acceptable radiation protective program for the use of sealed sources. Similarly, Appendix B describes the elements of an acceptable radiation protection program for tracer use of radioactive materials.

Item 15. WASTE DISPOSAL

The applicant should describe the procedures for disposing of radioactive material.

- (a) Sealed Sources

Sealed sources containing radioactive material should be returned to the manufacturer or transferred to another licensee authorized to possess the specific quantity and from being transferred. Please note that the loss and subsequent abandonment of a radioactive source down-hole constitutes disposal, and must be indicated in disposal records.

- (b) Tracer Operations

Wastes from tracer operations such as unused materials, contaminated tissues, gloves, tools, clothing, containers, etc., should be disposed of in accordance with the Kansas Radiation Protection Regulations.

Short, half-life materials may be stored to allow decay to background radiation levels. Containment and security during storage should be provided.

A commonly used method of disposal is transfer to a commercial firm licensed to receive radioactive wastes.

Spills should be cleaned up and, if possible, injected into the well. Any wash water used to clean up or decontaminate equipment should be treated as radioactive waste.

If wash water is discharged into a sanitary sewerage system, the dilution of the activity by the sewerage must be such that the limit established for such disposal by Regulation 28-35-232a Appendix A of the Kansas Radiation Protection Regulations is not exceeded. If you do not have the capability of assaying the wash water for the concentration of contaminant in microcuries per milliliter, the amount of tracer material actually used on the job and the water consumption must be used to determine that limits are not exceed.

If the wash water is discharged into a holding tank, then the surface of the fluid in the holding 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.

Whatever methods of waste disposal are used, records reflecting the final disposition of all radioactive materials must be maintained for inspection by the Department.

Item 16. CERTIFICATE

THE APPLICATION MUST BE SIGNED AND DATED

The application must be signed and dated by an official representative of the applicant, e.g., President, Department or Division Head, or other person authorized to sign official documents to certify that the application contains information that is true and correct to the best of the applicant's knowledge and belief. Applications that are unsigned will be returned for proper signature.

Submit ONLY the Original To:

Kansas Department of Health and Environment
Bureau of Environmental Health
Radiation Control Program
1000 SW Jackson Suite 330
Topeka, KS 66612-1365

APPENDIX A

RADIATION PROTECTION PROGRAM - SEALED SOURCES

Procedures should be established to ensure compliance with the provisions of the Kansas Radiation Protection Regulations, Part 10, "Notices, Instructions and Reports to Workers, Inspections," and Part 4, "Standards for Protection Against Radiation." The procedures should be specific and adequate to provide protection against potential radiation hazards associated with the use of sealed sources in well-logging activities. As a minimum each of the following elements should be described in the application.

1. Survey Program

Kansas Radiation Protection Regulations require that the surveys be made to determine if radiation hazards exist during the use of radioactive material. A survey means an evaluation of the radiation hazards incident to the use, release, disposal, or presence of radioactive materials. When appropriate, this evaluation includes a physical survey of the location of radiation or concentrations of radioactive materials present.

For operations involving sealed sources, a survey program should include evaluation and/or measurements of gamma and/or neutron radiation levels for both storage and use of sealed sources. Surveys for evaluating the adequacy of shielding, dose, rates during leak testing of sources, the need for personnel dosimeter, or changes in operating procedures may be appropriate. Preparation of shipping labels, posting and establishing restricted areas, limiting work times, locating lost or dropped sources, and monitoring during any down-hole recovery operations are activities that will require surveys.

Leak test wipes should be surveyed with a low-range survey meter for gross contamination to determine safe handling before mailing or otherwise forwarding for assay. Such surveys can be made with a thin-end window G-M (less than 2 mg/cm²) detector held close to a dry smear sample immediately after it is taken in the work area.

2. Periodic Inventory

Each licensee or registrant should conduct a periodic physical inventory to account for all sources of radiation. Records should be maintained for inspection by the Department, and should include the quantities and kinds of sources of radiation, the location where sources of radiation are assigned, the date of the inventory, and the name of the individual conducting the inventory.

3. Utilization Records

Each licensee should maintain current records, which would be kept available for inspection by the Department showing the following information for each source of radiation:

- (a) make, model number, and a serial number of each source of radiation used;
- (b) the identity of the well-logging supervisor or field unit to whom assigned;
and
- (c) locations where used and dates of use.

The word "record" has been used instead of "log" so as not to imply a requirement that a specific log be maintained. Other records normally kept on sources of radiation could be adequate if they contain the information required.

4. Inspection and Maintenance

Each licensee should conduct, at a six-month interval, a program of inspection and maintenance of source holders, logging tools, source handling tools, storage containers, and transport containers to assure proper labeling and physical condition. Records of inspection and maintenance shall be maintained for inspection by the Department.

If any inspection conducted reveals damage to labeling or components critical to radiation safety, the device must be removed from service until repairs have been made.

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, as required by Part 4 of the Kansas Radiation Protection Regulations. This labeling should be on the smallest component transported as a separate piece of equipment.

5. Records Management Program

Provisions for maintenance and management review of utilization records and records of surveys, periodic inventories, personnel exposures, leak tests, and employee training should be established. Job log sheets or other standard forms that facilitate recordkeeping of field operations should be submitted. Procedures for ordering or shipping materials, for notification or responsible persons upon receipt should also be established.

6. Methods for Establishing, Posting, and Controlling Access to Controlled Areas

Procedures for posting and controlling access to work areas that comply with the Kansas Radiation Protection Regulations, Part 4 should be established. When radiation levels exceeding 2 milliroentgens in any one hour are created, methods for controlling access to operational areas should be established. All unnecessary personnel should be restricted from the areas. During each logging operation, the logging supervisor or other designated employee shall maintain direct surveillance of the operation to protect against unauthorized and/or unnecessary entry into a controlled area, as defined in Part 1 of the Kansas Radiation Protection Regulations. A controlled area usually exists for only a relatively short period of time, i.e., during the loading of the tool and insertion into the hole. "Caution - Radiation Area" signs should be posted when radiation levels exceed 5 milliroentgens in any one hour. Physical surveys or established distances from sources may be used to establish radiation areas and need for personnel monitoring in a particular area.

7. Transportation of Radioactive Material

The transport of radioactive materials over public roads by Licensees is subject to the regulations of the Department of Transportation (DOT). Regulation 28-35-195a of the Kansas Radiation Protection Regulations requires that DOT regulations be followed for transport of radioactive materials when transport is intrastate. The DOT regulations cover, among other things, radiation levels at package surfaces (not to exceed 10 mR/hr at one meter from any surface and 200 mR/hr at the surface of containers) contents, construction, and labeling of packages; permissible radiation levels around a vehicle, placarding of vehicles; and accident reporting.

Procedures should be established to assure safe transport and should include at least the following: (a) method for securing radioactive materials in vehicles to prevent shifting or unauthorized removal during transport, (b) a survey program including determination that radiation levels in the passenger compartment do not exceed 2 mR/hr, and (c) placarding vehicles on all four sides with "Radioactive" when "Radioactive Yellow-III" labeled packages are being transported as required by regulations of the Department of Transportation (49 CFR 172.504).

When vehicles are used for temporary storage, the requirements of the Kansas Radiation Protection Regulations, Part 4 are applicable. Security from unauthorized removal, posting with "Caution - Radioactive Material," and radiation levels (verified by surveys) not exceeding DOT limits are acceptable practices.

8. Operating and Emergency Procedures

Written standard operating and emergency procedures for operating personnel should be developed for the specific operations that will be performed. The procedures may be incorporated into check-off type sheets or other forms used onsite to keep records. Copies should be supplied to all employees who are

responsible for job site use of materials. Management should institute review procedures to assure that the established radiation safety program is followed.

Procedures for operations with sealed sources should include at least the following:

- (a) Storage precautions. Each source of radiation must be provided with a storage and/or transport container. The container shall be provided with a lock, or tamper seal for calibration sources, to prevent unauthorized removal of, or exposure to, the source of radiation. Failure to lock transport and storage containers is a common cause of unnecessary exposure to personnel and/or the loss or theft of these sources. Tamper seals may be used instead of locks for calibration sources. The requirement that transport and/or storage containers be locked should reduce risks without imposing undue restrictions.
- (b) Procedures for transporting sources to job and well sites and for storing sources in transit and onsite. Transport containers should be physically secured to the transporting vehicle to prevent accidental loss, tampering or unauthorized removal. Surveys of radiation levels around vehicles and storage sites, securing and positioning sources and containers, inspection of equipment, posting, and records to be kept should be covered.
- (c) Precautionary procedures for loading the logging tool, placing the tool in the well, removing the tool from the well and unloading the source. The use of handling tools, logging tool orientation, establishing, posting, and controlling access to controlled areas; minimum times and distances to be observed during handling of sources; and instructions for dealing with equipment malfunction including lost or dropped sources should be covered.
- (d) The number, type, and length of handling tools. The company must provide and require the use of tools that will assure remote handling of sealed sources other than low-activity calibration sources. Drawings or sketches showing general design and provisions for attaching to or gripping sources should be submitted. **WELL-LOGGING SOURCES MUST NEVER BE HANDLED DIRECTLY BY HAND.**
- (e) Personnel monitoring provisions. Instructions covering the occasions for using of personnel monitoring devices, the location on the body where the devices are to be worn, frequency at which they should be changed, records to be kept, and care of devices should be covered. Any personnel monitoring device, such as film or TLD badges, should be assigned to a specific person; i.e., these devices are not to be worn by different individuals during the period of issuance by the monitoring service company.
- (f) Survey program. The occasions for surveys, frequency and methods, instrument to be used, and records to be kept should be covered.

- (g) Precautionary procedures to be followed to assure the recovery of sealed sources in shallow, uncased holes. The procedures should include the means for preventing possible contamination of potable aquifers during logging operations.
- (h) Procedures to be followed in the event a source is lost down hole. The well-logging company should not perform wireline service operations with a sealed source unless, prior to commencement of the operation, they have a written agreement with the well operator, well owner, drilling contractor, or landowner that in the event a sealed source is lodged down hole, a reasonable effort at recovery will be made. Instructions should cover notification of owners, management, and the Kansas Bureau of Air and Radiation, Radiation Control Program. Prevention of damage to the source during retrieval efforts, monitoring at the surface for the presence of radioactive contamination with a radiation survey instrument or logging tool during logging tool recovery operations, notification of the Bureau immediately by telephone if radioactive contamination is detected at the surface or if the source appears to be damaged, provisions for controlling exposures, personnel monitoring, provisions for permanently sealing the source in place, the setting of a whipstock or other deflection device, and permanently marking the well when the source cannot be recovered should be included.
- (i) Emergency procedures. These instructions should cover procedures to follow in case of vehicle accidents, fire or explosion, ruptured sources, or similar emergency situations. The instructions should describe immediate actions to be taken to prevent further contamination of personnel, equipment, and facilities and evacuation of the area. The instructions should specifically state the names and telephone number of responsible persons to be notified in case of an emergency (owners, management, and the Department). The Kansas Radiation Protection Regulations, Regulation 28-35-229a, contains a number of specific requirements for the occasions and methods for reporting incidents.

9. Sealed Source Leak Testing

Well-logging sealed sources (and any sealed calibration sources) must be tested for leakage and contamination at intervals not to exceed six (6) months. When the supplier does not certify that such tests have been performed within six months, the sources should be used until tested.

The test must be capable of detecting the presence of 0.005 microcurie of removable contamination. The test sample should be taken from the source or from accessible surfaces of the device in which the sealed source is mounted or stored where contamination is likely if the source is leaking. Records of leak test

results must be maintained for inspection by the Department. Leaking sources must be withdrawn from use.

If a test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the Department in accordance with the Kansas Radiation Protection Regulations.

APPENDIX B

RADIATION PROTECTION PROGRAM - TRACER STUDIES

Procedures should be established to ensure compliance with the provisions of the Kansas Radiation Protection Regulations, Part 10, "Notices, Instructions and Reports to Workers, Inspections," and Part 4, "Standards for Protection Against Radiation." The procedures should be specific and adequate to provide protection against potential radiation hazards associated with the use of radioactive materials during tracer studies in well-logging activities. As a minimum, each of the following elements should be described in the application.

1. Survey Program

Kansas Radiation Protection Regulations require that surveys be made to determine if radiation hazards exist during the use of radioactive material. A survey means an evaluation of the radiation hazards incident to the use, release, disposal, or presence of radioactive materials. When appropriate, this evaluation includes a physical survey of the location of radiation or concentration of radioactive materials present.

Radiation surveys must be made and recorded at the jobsite or well-head for each tracer operation. These surveys shall include measurements of radiation levels before and after the operation. Survey records should be maintained for inspection by the Department.

For operations involving tracer use of radioactive material, a survey program should include monitoring, with an appropriate survey meter, of personnel (hands, feet, clothing) and all tools, equipment, and facilities at job sites for contamination and effectiveness of clean up. Such surveys can be made with a thin-end window (less than 2 mg/cm²) GM detector. Procedures should be established to minimize the chance for inadvertent spread of contamination by the contamination survey or other activities to be performed, and to determine which areas require greater attention during decontamination. Reasonable efforts should be made to remove all residual contamination. Acceptable levels of residual contamination should be established.

Short half-life wastes that are stored to allow physical decay to background levels should be surveyed with an appropriate instrument before discarding with normal trash. Any radioactive labeling should be defaced or destroyed before disposal. If this method of disposal is used, records must be maintained to meet the requirements of Regulation 28-35-137 of the Kansas Radiation Protection Regulations.

Operations with tracers may require surveys to evaluate the adequacy of storage facility shielding to determine if restricted areas must be established and posted.

Part 4 of the Kansas Radiation Protection Regulations specifies radiation levels for unrestricted areas. Any accessible external surface of the storage facility or enclosure must meet the requirements for an unrestricted area.

2. Periodic Inventory

Each licensee or registrant should conduct a periodic physical inventory to account for all sources of radiation. Records must be maintained for inspection by the Department, and should include the quantities and kinds of sources of radiation, the location where sources of radiation are assigned, the date of the inventory, and the name of the individual conducting the inventory.

3. Utilization Records

Each licensee should maintain current records, which would be kept available for inspection by the Department, showing the following information for each source of radiation.

- (a) a description of each source of radiation used;
- (b) the identity of the well-logging supervisor or field unit to whom assigned;
- (c) locations where used and dates of use; and
- (d) in case of tracer materials and radioactive markers, the utilization records should indicate the radionuclide and activity used in a particular well.

The word "record" has been used instead of "log" so as not to imply a requirement that a specific log be maintained. Other records normally kept on sources of radiation would appear to be adequate if they contain the information required.

4. Inspection and Maintenance

Each licensee should conduct, at a six month interval, a program of inspection and maintenance of logging tools, source handling tools, storage

containers, transport containers, and injection tools to assure proper labeling and physical condition. Records of inspection and maintenance shall be maintained for inspection by the Department.

If any inspection conducted reveals damage to labeling or components critical to radiation safety, the device must be removed from service until repairs have been made.

5. Records Management Program

Provisions for maintenance and management review of utilization logs and records of surveys, inventories, personnel exposures, leak tests, and employee training should be established. Job log sheets or other standard forms would facilitate keeping records on field operations. Procedures for ordering or shipping materials, for receipt of materials, and for notification of responsible persons upon receipt should also be established. Management control of operations with tracers should include procedures to avoid injection into fresh water zones and to evaluate expected concentrations of radioactivity in water, oil, gas, or air released for uncontrolled use.

6. Methods for Establishing, Posting, and Controlling Access to Controlled Areas

The applicant should establish and describe procedures for posting and controlling access to all work areas including injection sample preparation area and field sites to comply with Kansas Radiation Protection Regulations, Part 4. When radiation levels are created that exceed 2 mR in any one hour the applicant should establish and describe methods for controlling access to all operational areas. All unnecessary personnel should be restricted from the areas. During each logging operation, the logging supervisor or other designated employee should maintain direct surveillance of the operation to protect against unauthorized and/or unnecessary entry into a controlled area, as defined by Part 1 of the Kansas Radiation Protection Regulations. A controlled area usually exists for only a relatively short period of time, i.e., during the tracer sample preparation and injection into the hole. "Caution - Radiation Area" signs should be posted when radiation levels will exceed 5 mR/hr.

7. Transportation of Radioactive Material

The transport of radioactive materials over public roads by licensees is subject to regulations of the Department of Transportation. Regulation 28-35-195 of the Kansas Radiation Protection Regulations requires that DOT regulations be followed for transport of radioactive materials when the transport is intrastate. The DOT regulations cover, among other things,

radiation levels at package surfaces (not to exceed 10 mR/hr at one meter from any surface and 200 mR/hr at the surface of containers); contents, construction, and labeling of packages; placarding of vehicles; and accident reporting.

Procedures established to assure safe transport should include at least the following: (a) methods for securing radioactive materials in vehicles to prevent shifting or unauthorized removal from transport, (b) a survey program including determination that radiation levels in the passenger compartment do not exceed 2 mR/hr, and (c) placarding vehicles on all four sides with "Radioactive" when "Radioactive Yellow-III" labeled packages are being transported as required by regulations of the Department of Transportation (49 CFR 172.504).

When vehicles are used for temporary storage, the requirements in the Kansas Radiation Protection Regulations, Part 4 are applicable. Security for unauthorized removal, posting with "Caution - Radioactive Material," and radiation levels (verified by surveys) not exceeding DOT limits are acceptable practices.

8. Operating and Emergency Procedures

Written standard operating procedures for operating personnel should be developed for the specific operations that will be performed. The procedures may be incorporated into check-off type sheets or other forms used onsite to keep records. Copies should be supplied to all employees who are responsible for job site use of materials and should be submitted as part of the application. Management should institute review procedures to assure that the established radiation safety program is followed.

Instruction covering tracer operations should be specific for each different type of study and should include at least the following:

- (a) Procedures for handling samples, including sample preparation, and injection methods. The instructions should also include methods for establishing, posting, and controlling access to the area; prevention of contamination of site, equipment, and personnel; and tools, protective clothing and equipment to be used in performing the tracer study.
- (b) General safety equipment. Protective gloves and other appropriate protective clothing and equipment shall be used by all personnel handling radioactive tracer material. Precautions shall be taken to avoid ingestion or inhalation of radioactive material. A description of protective clothing (such as rubber gloves, coveralls, respirators, and face shields), auxiliary shielding, absorbent materials, injection equipment, secondary containers, plastic bags for storing contaminated

clothing, tissue, handling tools, etc., that will be available at well sites should be submitted.

- (c) Survey programs. The required frequency and methods of surveys, instruments to be used, records to be kept and contamination limits to be observed should be covered.
- (d) Decontamination procedures. These procedures should cover cleaning up spills, using protective clothing and equipment, and decontaminating personnel and equipment, including acceptable contamination limits.
- (e) Procedures to be used for picking up, receiving, and opening packages containing radioactive material. Provisions should be made such that the requirements of Regulation 28-35-221a of the Kansas Radiation Protection Regulations are met.
- (f) Waste disposal procedures. The disposal methods to be used, surveys to be made, and records to be kept should be included in the procedures.
- (g) Emergency procedures. Procedures to be followed in case of vehicle accidents, fire or explosion, personnel contamination or over-exposures, or similar emergency situations should be explained. These instructions should describe immediate action to be taken to prevent contamination of work areas and personnel, the need for restricting and/or evacuating the area, and procedures for containment of the spills. The instructions should specifically state the names and telephone numbers of responsible persons (owners, management, and the Department) to be notified in case of an emergency. Kansas Radiation Protection Regulations, Regulation 28-35-229a contains a number of specific requirements for the occasions and methods for report incidents.

APPENDIX C

RADIATION PROTECTION PROGRAM SEALED SOURCE LOGS IN GAS STORAGE CAVERNS IN SALT OR SALT PRODUCTION WELLS

Procedures for this use should include:

Type of sources:

1. The use of sealed sources in these facilities should be limited to the smallest, shortest half-life beta gamma sources available. The use of PuBe, RaBe or AmBe neutron sources will not be authorized.
2. The procedures should include a notification of the agency before beginning work in a field, storage or production facility. Such notice should include:
 - (a) Location of the field.
 - (b) Use (storage or salt production).
 - (c) Sealed sources to be used (isotope, size in curies)
 - (d) Procedure to be followed to insure the tool is not lost in cavern.
 - (e) Written condition in the contract with field owner agreeing to the plugging and stabilizing of all connected caverns if a source is lost or abandoned.