

NEW YORK STATE DEPARTMENT OF HEALTH
BUREAU OF ENVIRONMENTAL RADIATION PROTECTION
RADIATION GUIDE 10.18

***GUIDE FOR THE PREPARATION OF APPLICATIONS FOR
THE USE OF SEALED SOURCES OF
RADIOACTIVE MATERIALS IN
CATEGORY II, III AND IV IRRADIATORS***

**RADIATION GUIDE 1.10
USE OF RADIOACTIVE SOURCES IN CATEGORY II, III, AND IV
IRRADIATORS**

I. Introduction

The purpose of this guide is to assist you in applying for a license to possess and operate irradiators which utilize radioactive sources, other than self-shielded dry source storage irradiators. If you intend to construct an irradiator facility, you should not begin construction prior to your submission of a completed application and the required fee, and the department's acceptance of the application. Any activities undertaken prior to issuance of a license are entirely at the risk of the applicant, and will not influence issuance of a license.

You should also be aware that radiation sources to be stored or used in an aqueous environment must be as nondispersible and insoluble as possible, and cesium 137 chloride is, therefore, not acceptable. Some of the information requested in this guide may not be relevant to your facility (e.g., information on irradiator pools) and need not be submitted in that case.

This guide is to be used with Application Form DOH-370. Complete items 1-4, on the form itself; and submit the information for other items on supplementary pages. The application and all supplementary materials must be submitted in duplicate in an 8 1/2 X 11 inch format.

You must also prepare and submit a complete description of a proposed irradiator facility. If you are applying for renewal of a license for an existing facility, you may reference previously submitted descriptive material if there have been no changes. However, it is expected that most licensees will need to resubmit a description in order to provide the level of detail required by this guide.

One copy of the application, with all attachments, should be retained by the applicant, since the license will require as a condition that the licensee follow the statements and representations set forth in the application and any supplement to it. The original and one copy should be mailed to the following address:

New York State Department of Health
Bureau of Environmental Radiation Protection
2 University Place, Room 375
Albany, New York 12203

Telephone: (518) 458-6485

II. Contents of an Application

The following paragraphs explain the information required in response to the items on Form DOH-370.

Item 1 **Enter** the name and corporate address of the company and the telephone number of a contact person for licensing issues.

Item 2 **List** all addresses and locations where radioactive material will be used or stored if other than that in Item 1. A post office box number should not be stated as the address for a place of use. These addresses and locations will become part of the license conditions, if the license application is approved, and the addresses or locations at which radioactive materials or radioactive wastes are located or stored may **not** be changed without obtaining a license amendment.

Item 3 **Indicate** whether the application is for a new license, an amendment to an existing license, or a renewal of an existing license.

Item 4 **Radiation Safety Officer (RSO)**

- A. **Submit** the name, training and experience of the person who will be responsible for day-to-day conduct of the radiation protection program (the RSO).

The proposed RSO should have formal training in health physics and radiation protection, sufficient to enable him or her to administer the radiation protection program for a facility of this type. If the proposed candidate lacks such formal training, you should contact this office.

In addition to formal training, the candidate should have at least a year's experience working at an irradiator similar to the one in question, and be familiar with the operations of the irradiator and radiation safety considerations.

Submit the training and experience of your proposed RSO.

- B. **Responsibility for Radiation Safety**

Describe the management structure for the irradiator facility, and the responsibility and authority of the RSO and other management personnel who have radiation safety responsibilities and authority.

Your response should **stipulate** that the RSO will have independent authority to stop operations that he or she considers unsafe, and to conduct necessary tests and measurements. It should also **stipulate** that the RSO reports directly to the facility manager, and will have adequate time and resources to fulfill all RSO responsibilities, including the following:

- The RSO, or a person qualified and authorized to act in his/her absence, will be on-call at all times when the irradiator is in operation.
- The RSO will oversee the acquisition of irradiator sources, and their receipt and storage.
- The RSO will maintain an inventory by make, model and serial number, of all sources obtained under the license, showing their location (e.g., position in source rack) and documenting disposal.
- The RSO will ensure compliance with regulations and the conditions of the license, and will maintain detailed operating and emergency procedures and oversee emergency response.
- The RSO will ensure that all checks, tests, calibrations and surveys are performed in a timely and accurate manner.
- The RSO will oversee the management of the personnel monitoring program and review all exposure records. Unusual or high exposures will be promptly investigated and corrective action taken.
- The RSO will evaluate the radiation safety program annually, oversee the irradiator operator evaluations described below in "Personnel Training," and report to management on any changes or improvements needed.
- The RSO will oversee the management of the training program, and will ensure that all persons receive required training and instructions and are tested to confirm understanding of the training given.
- The RSO will update operating and emergency procedures as needed, and at least annually; and will ensure that all staff are instructed in any changes and demonstrate understanding of the changes.
- The RSO will investigate all test and survey data that fall outside of acceptance limits, all incidents and abnormal occurrences and all errors or inappropriate actions by staff, and recommend corrective actions to facility management.
- The RSO will ensure that all reportable events are promptly reported to the department.

Confirm that the RSO will have these authorities and duties.

Item 5 **List** all individuals who will use or directly supervise the use of radioactive material. Give the title or position of each person.

A. **Individuals with Operational or Safety Responsibilities**

Personnel Training

You must describe the training to be provided to irradiator operators, to other persons who will be allowed unescorted access to controlled areas, and persons who will be expected to respond to alarms and summon assistance. This training must be provided before a person assumes duties under the license.

1. **Confirm** that training for operators will include:
 - fundamentals of radiation safety applicable to irradiators
 - pertinent regulations
 - operation of the irradiator and associated equipment
 - operating and emergency procedures the individual will be expected to perform
 - case histories of accidents, and avoidance of accidents
 - passing a written test based primarily on operating and emergency procedures and covering knowledge needed for safe operation

 - OJT or simulator training
 - passing a practical test on performance of operating and emergency procedures
 - annual evaluation of each operator's performance, and provision of refresher training
 - annual written test on refresher topics
 - annual drills on emergency response

Also, **confirm** that classroom training in the above topics will be approximately 40 hours, and that on-the-job training under the supervision of an experienced operator will consist of at least one month of full-time training. You must also **describe** the minimum training and experience of the personnel who will provide this training.

2. **Confirm** that training for those who will be permitted unescorted access to controlled areas will include:
 - radiation safety precautions to be observed
 - tasks they may be expected to perform
 - proper response to alarms, signs and warning devices
 - oral testing on the above
 - annual refresher training for (employees)

You should also **describe** the training and experience of the personnel who will provide this training.

3. **Confirm** that training for those who will be expected to respond to alarms or summon assistance will include:
 - proper response procedures to be followed
 - "dry runs" of response plans
 - testing on the above
 - annual refresher training for (employees)

You should also **describe** the training and experience of the personnel who will

provide this training.

B. Training & Experience of Other Personnel

If licensee personnel are to leak test dry-storage radiation sources, or to load or unload sources, you must **submit** the qualifications (training and experience) of the individuals whom you wish to perform these tasks. The procedures to be used should be included in the outline or summary of procedures submitted in response to _____.

Item 6.

Radioactive Material

For each type of radioactive material to be used, **submit**:

1. The radionuclide to be possessed (e.g., cobalt-60).
2. The manufacturer's name and specific model number of each sealed source to be used in the irradiator.
3. The maximum amount of radioactive material in any one sealed source, expressed in curies.
4. The maximum total amount of radioactive material to be possessed at any one time, expressed in curies. The maximum amount should include a margin to allow for source reloading and exchange. Please specify the maximum loading and the margin allowance separately.
5. A copy of the certificate of registration (sealed source and device registration sheets) issued by NRC or an Agreement State for each model of sealed source to be possessed..

The sources proposed must be doubly encapsulated in a material resistant to general corrosion and to localized corrosion, such as 316L stainless steel, if the sources are to be used in an irradiator pool.

Also, in prototype testing of the sealed source, it must have been leak tested and found leak free after each of the following tests:

- a. Temperature. The test source must be held at -40°C for 20 minutes, 600°C for one hour, and then subjected to a thermal shock test with a temperature drop from 600°C to 20°C within 15 seconds.
- b. Pressure. The test source must be twice subjected for at least five minutes to an external pressure (absolute) of two million newtons per square meter.
- c. Impact. A 2 kilogram steel weight, 2.5 centimeters in diameter, must be dropped from a height of 1 meter onto the test source.

- d. Vibration. The test source must be subjected three times for 10 minutes each to vibrations sweeping from 25 hertz to 500 hertz with a peak amplitude of five times the acceleration of gravity. In addition, the test source must be vibrated for 30 minutes at each resonant frequency found.
- e. Puncture. A 50 gram weight and pin (0.3 centimeter pin diameter) must be dropped from a height of 1 meter onto the test source.
- f. Bend. If a length of the source is more than 15 times larger than the minimum cross-sectional dimension, the test source must be subjected to a force of 2000 newtons at its center, equidistant from two support cylinders, the distance between which is 10 times the minimum cross-sectional dimension of the source.

Confirm that the source prototype underwent these tests successfully.

Item 7 **Purpose(s) For Which Radioactive Materials Will Be Used**

Specify the purpose(s) for which the irradiator will be used, and the products to be irradiated.

If flammable or explosive materials, or any other products that could create a hazardous condition, are proposed to be irradiated, you must **submit** a demonstration that procedures will be in place to prevent a hazardous condition from occurring. If anything intended for human consumption (e.g., produce, prepared food, spice, etc.) is to be irradiated, you must **first** apply for and obtain approval from the New York State Department of Agriculture and Markets.

Items 8

Item 10 (a) **Instruments - Submit a list of all radiation detection instrumentation available.**

Portable instruments used for surveys must be a type that will not saturate in high radiation fields and read zero.

Analytical instruments must have suitable accuracy, reproducibility and sensitivity for the intended uses..

Appendix A to this guide contains a form that may be used to describe the instruments.

Complete this form and return with application.

Item 10 (b) **Calibration of Instruments** - If survey meter calibrations are performed at your facility, you must submit your procedures. **Appendix B** to this Guide contains a model

procedure. **State** that you will follow the model procedure or submit a copy of the Appendix with your changes indicated in **red** ink.

If your survey meters are sent out for calibration, submit a statement that calibrations will be performed by persons licensed to perform this service by the U.S. Nuclear Regulatory Commission or an Agreement State and that a copy of this license will be kept on file with the calibration certificates for our inspection.

(b) Quantitative Measuring Instruments - Instruments that will be used for quantitative measurements to determine compliance with Department regulations (e.g., leak-test measurements, effluent monitoring) should be calibrated at annual intervals. A description of the procedure for calibration of such instruments should be submitted and should include:

- (1) the manufacturer and model number of the source(s);
- (2) the nuclide and quantity of radioactive material in the source(s);
- (3) the accuracy of the source(s);
- (4) the step-by-step procedures for calibration, including associated radiation protection procedures; and
- (5) the name(s) and pertinent experience of person(s) who will perform the calibrations.

(c) Pool water conductivity meters must be calibrated annually. **Confirm** that this will be done.

Item 11 Facilities and Equipment

A. General Description

Provide a general description of the irradiator building and the site on which it is, or will be, located. Also, provide a general description of the irradiator itself and its operating features. Include diagrams and sketches to illustrate the descriptions, and to show locations of safety-related features and equipment such as access barriers and controls, alarms, radiation monitors, postings (Very high radiation area), roof plugs or other movable shielding, and pool access barriers. For existing facilities, please include photographs to augment the description.

For planned facilities, provide a schedule for construction so that in-progress inspections could be performed at the Department's discretion.

You should also provide sketches and photographs of properties adjacent to the irradiator site, and describe their current use and zoning.

B. Access Control and Safeguards for Irradiator Room(s)

Your access control and safeguards system must include the following:

1. A door or other physical barrier to each entrance that prevents entry if sources are unshielded.
2. It must be impossible to unshield the sources if a barrier is open.
3. Sources must return promptly to the shielded position if a door or barrier is opened.
4. Each barrier/door must have a lock operated by the same key used to unshield the sources (see item I, "Controls for Source Movement," below).
5. Each entrance must have an independent backup access control that will detect entry while the sources are unshielded, and will cause the sources to return to the shielded position. It must also activate a visible and audible alarm that will alert any person entering the room while sources are unshielded, and alert at least one other person on site who is trained in how to respond to the alarm.
6. There must be a radiation monitor in the irradiator room that is integrated with access door locks to prevent room access when radiation levels are high, indicating unshielded sources, and it must not be located in the direct radiation beam. Attempted entry when levels are high must activate the alarm described in paragraph 5. above.
7. Each irradiator room must have conspicuous, visible and audible alarms that are activated by the source control before sources move from the shielded position. The alarms must activate with enough lead time for people to leave the room before the sources are unshielded.
8. Each irradiator room must have a clearly visible, and readily accessible, control that will allow a person in the room to return the sources to their shielded position.
9. Each irradiator room must have a control that prevents the sources from moving from the shielded position, unless the control has been activated and the door/barrier to the room has been closed within a preset time after activation of the control. Reopening the door must result in the need to re-activate the control before sources can be unshielded.
10. If an irradiator room has roof plugs or other movable shielding, it must not be possible to operate the irradiator unless the shielding is in its intended position.
11. Underwater irradiators must have a personnel access barrier around the pool which must be locked to prevent access when the irradiator is unattended, and has an intrusion alarm to detect entry when the barrier is locked. Activation of the alarm must alert an individual (on- or off-site) who is prepared to respond or summon assistance.

12. Each entrance to an irradiator room, and each entrance to the area within the personnel access barrier of an underwater irradiator, must have a sign bearing the radiation symbol, and the words "Caution (or danger) radioactive material," and a sign stating "Very high radiation area."

Submit a complete description of your access control and safeguards system.

C. **Shielding**

Describe the composition of the shielding walls and the thickness of each, on a diagram showing wall configuration and any penetrations in shield walls.

If any accessible areas outside the shield are expected to have a dose exceeding 2 mrem in an hour, identify these areas and explain how access to them will be controlled. Also explain how compliance with the 100 mrem per year limit for non-occupational exposure (exposure to the general public) will be ensured.

You must also assess the expected dose rate over an irradiator pool, and ensure that it does not exceed 2 millirem per hour at 30 centimeters over the edge of the pool with the sources fully shielded. The dose rate from dry-storage sources should not exceed 2 millirem per hour at 1 meter or 20 millirem per hour at 5 centimeters, with the sources shielded.

If you are requesting possession of more than 5 million curies of activity in an irradiator, you must also **evaluate** the effects of heating on the shielding walls.

Submit a description of your irradiator shielding and explain how it will ensure compliance with regulatory dose limits and ALARA considerations.

D. **Fire Protection**

Except for underwater irradiators, you must provide heat and smoke detectors in or near each irradiator room, that will activate an audible alarm and alert a person trained to summon assistance promptly.

The sources must automatically return to the shielded position if a fire is detected, and the irradiator room(s) must be equipped with a fire extinguishing system that will extinguish a fire without the need for entry of personnel into the room. The system must have a shut-off valve to control flooding into uncontrolled areas.

Describe your fire protection system.

E. **Other Radiation Monitors**

In addition to the radiation monitors described above, you must provide a loose source monitor for irradiators where product moves, or is moved, past the sources. This monitor must be located so that it will detect a source being carried with product toward

an exit. It must activate an audible alarm, cause the product to stop moving and alert a person trained to summon aid.

For a pool irradiator, you must also monitor pool water for contamination. If this is done by using a monitor on the pool water circulating system, the detection of above-normal radiation levels must activate an alarm. The alarm set point must be as low as practical while avoiding false alarms, and the detector(s) must be located where any contamination is likely to accumulate.

Describe the location and type of these and all other required radiation monitors, using diagrams and sketches as appropriate. Also indicate your alarm set-points or explain how these will be established.

For the loose source monitor, you must also **demonstrate** that the location, sensitivity and set point are such that the product carrier will stop before a fugitive source could cause a radiation overexposure to any person.

F. Irradiator Pool

Facilities with irradiator pools must have:

1. a water-tight stainless steel liner, or a liner metallurgically compatible with other pool components, and constructed with a low likelihood of leakage and with a surface easily decontaminated;
2. the means to safely store sources in the event of pool repairs or maintenance;
3. no outlets more than 0.5 meter below normal low water level;
4. no intakes more than 0.5 meter below normal low water level that do not have siphon breakers;
5. means to replenish pool water losses;
6. a clearly visible means to indicate if pool water is below the normal low water level, or above the normal high water level;
7. a purification system designed to maintain pool water at a conductivity of 20 microsiemens per centimeter or less, and of a clarity that sources are clearly visible;
8. a physical barrier (railing or cover) to prevent personnel from accidentally falling into the pool during normal operations; and
9. no long-handled tools or poles where the dose rate on the handling areas of the tools exceeds 2 millirems per hour.

Describe the irradiator pool lining. Also **confirm** that all requirements stated above will

be met and **describe** how this will be ensured.

G. Source Rack Protection

If product moves on a conveyor or carrier system, the source rack and the mechanism that moves the rack, must be protected by a barrier or guides to prevent product or product carriers from contacting the rack or mechanism.

Describe the source rack protection to be provided, including diagrams or sketches if these would help to illustrate the safeguards.

H. Power Loss Safeguards

In the event of loss of electric power:

1. after 10 seconds, sources must automatically return to the shielded position in new irradiators;
2. the lock on the door of the irradiator room(s) must **not** be deactivated by the power loss ; and
3. administrative controls must be in place to ensure that no person will enter the area of the irradiator where sources are located without using an operable and calibrated radiation survey meter that will not saturate in a high radiation field.

Describe how loss of electric power will affect unshielded sources and how they will be safely returned to the shielded position, and **confirm** that loss of power will not deactivate door locks. Also **confirm** that administrative controls relative to the use of a survey meter during a power loss will be effectively enforced.

For new irradiators, also **describe** the system for automatic return of sources to the shielded position in the event of power failure.

I. Controls for Source Movement

1. The mechanism that moves sources or causes them to become unshielded, must require a key to actuate, and this must be the same key that unlocks the irradiator room door(s).
2. Actuation of the mechanism must cause an audible signal, to warn that the sources are becoming unshielded.
3. The key must **not** be removable while the sources are in the unshielded position.
4. The irradiator control console must have:
 - a. all irradiator controls clearly labeled as to function;

- b. a source position indicator showing whether sources are fully shielded, in transit or unshielded; and
- c. a control that will promptly return sources to the shielded position.

Confirm that your irradiator controls meet, or will meet, all of these requirements.

J. Design Requirements

The following design requirements apply to new irradiators:

1. Shielding walls must comply with generally accepted building code requirements for reinforced concrete.
2. For 5 megacurie irradiators and above: the effect of heating on shielding walls must be evaluated.
3. The foundation design must consider soil characteristics and be adequate to support the weight of the shield walls.
4. The pool must be designed to assure leak resistance, be strong enough to support the weight of pool water and shipping casks, and all metals used must be compatible.
5. The water handling system must provide the required purification, and leaking water must not drain to unrestricted areas without monitoring first.
6. The pool must be designed so that a dropped source-shipping cask would not hit irradiator sources.
7. Sources and Source Handling
 - there must be no crevices on a source, or between a source and holder, that would promote corrosion
 - source rack drops due to power loss must not damage racks
 - rack drops due to cable or support failure must not damage sources
 - rack movement design must assure a low likelihood of a stuck source
 - means must be supplied to free a stuck rack with minimal risk of exposure to personnel
8. The design of the fire protection system must ensure sensitive detection and efficient suppression of fire, and the system must be protected from mechanical and radiation damage.
9. The source rack return design must ensure full shielding of sources automatically if power is lost for more than 10 seconds.
10. If building an irradiator in seismic areas, appropriate design standards, such as

ACI 318-89, Chapter 21, must be met.

11. Electrical wiring and electrical equipment must be selected to minimize failure due to radiation exposure.

Confirm that these requirements will be met, and briefly describe how.

K. Construction Monitoring & Acceptance Testing

The following monitoring and acceptance testing must be performed as indicated below, and completed before sources are loaded:

1. Shielding - construction must be monitored to verify compliance with design requirements.
2. Foundation - construction must be monitored to verify compliance with design requirements.
3. Pool integrity - construction must be monitored to verify compliance with design requirements and the specific pool requirements in item F of "Facilities and Equipment" above. This must include a test of pool integrity.
4. Water Handling System - you must verify proper performance of the purification system, conductivity meter and water level indicators.
5. Radiation Monitors - you must verify proper operation of all monitors and all associated alarms, interlocks and mechanical responses.
6. Source rack - you must verify proper operation, including rack lowering due to simulated loss of power. Source rack protection requirements of item G of "Facilities and Equipment" above (including all limit switches and interlocks function) must also be tested for proper operation.
7. Access Control - you must verify proper performance of the completed system (including all alarms, controls and interlocks).
8. Fire Protection - you must verify that fire detection and suppression systems perform as intended, by actual testing; including testing of the mechanism to cause the source rack to become fully shielded automatically.
9. Source Return - you must verify that source racks return to the fully shielded position without offsite power (using backup power, gravity, etc.).
10. Computer Systems - you must verify that all essential systems that are computer controlled (such as access control) will function properly if offsite power is lost.
11. Computer Security - you must verify that security features in the computer system will prevent operators from defeating access controls or other essential safety systems,

when they are required to be operable.

12. Electrical Wiring and Electrical Equipment - you must verify that installed systems meet design specifications for radiation resistance.

L. Initial survey after source loading

After sources are loaded, and prior to routine operations, you must perform a thorough survey to confirm that the irradiator shielding performs as predicted in item C. above.

The license will initially be issued to allow for construction and testing, but routine operations will not be authorized until the results of this initial survey are submitted to this office for review.

Confirm that a detailed survey of the installation, with all sources in the exposed position, will be performed by a qualified expert and submitted to this office for review. The survey, and supporting information on irradiator workload, must demonstrate compliance with regulatory limits for occupational and non-occupational exposure in all areas around the irradiator room and the facility itself. Special attention should be given to areas around shield penetrations, and to the effects of sky-shine; and the area above an irradiator pool must be surveyed to confirm the limit in item C. above. Surveys around shielded dry-storage sources must also confirm that item C. limits are met.

The survey report must specify the location of all measurements, and any assumptions made.

Item 14 **Personnel Monitoring**

1. Irradiator operators must wear either a film badge or a TLD while operating an irradiator, and while in an irradiation room or other controlled area. The film badge or TLD processor must be accredited by NVLAP for energy photons in the ranges 0.03 to 10 rem, and 10 to 500 rad. Each badge or TLD must be assigned to and worn by only one person and must be processed at least monthly.
2. Other individuals who will be permitted unescorted access to the irradiation room(s) and other controlled areas, must wear a film badge or TLD during such access.
3. Visitors may be provided with pocket dosimeters that are checked for response to radiation at least annually and are accurate to within plus or minus 30 percent. Any single individual allowed to enter an irradiation room or other controlled area must wear a dosimeter which may be a pocket dosimeter. For groups of individuals, only two members of the group must be provided with dosimeters.

Confirm that your personnel monitoring program meets, or will meet these criteria.

Item 16

Radiation Safety Program

- A. You must have written operating procedures, covering the following activities:
1. Entering an irradiator room after an irradiation. These must require the operator to enter using a survey meter that has been checked for proper operation with a check source prior to entry, to ensure that sources are shielded. Any readings above normal must require the room to be secured until the cause is determined by the RSO; and must require that all irradiated products, equipment used and personnel involved, be checked for contamination at once.
 2. Leaving an irradiator room prior to irradiation. These must require the operator to visually inspect the room to verify that no one else is present, and to activate a timed control switch that permits source actuation only if the room door is locked within a pre-set time interval.
 3. Entering an irradiator room after a power failure. These must require a qualified operator or the RSO to survey the room to ensure normal radiation levels, using a survey meter checked as in 1. above, before any other entry.
 4. Operation of all irradiator systems, including key control and staffing. Key control procedures must specify that only one key will be in use at any one time; only qualified operators, the RSO or facility management may possess it; and the key must be attached to a portable radiation survey meter by a chain or cable. Staffing procedures must specify that, for moving product irradiators, a qualified operator and one other person trained to respond to incidents and alarms will be on-site during irradiation. Procedures for static

product irradiators must specify that a person trained to respond to incidents and alarms will be on-site during irradiation.

5. Use of personnel monitoring devices, including what dosimeters are to be worn by what personnel, when and where in the facility they must be worn, placement on the body and storage when not in use.
6. Performance of radiation surveys, including the instruments to be used, areas to be surveyed, the frequency of periodic surveys, and what events (such as source changes or source repositioning, or building modifications) require special surveys.
7. Monitoring pool water, pool sediments from vacuuming, resins and other potentially contaminated media before release (does not apply to dry storage irradiators). Procedures must specify that any contamination will be below regulatory limits, and that resins will be surveyed in a low background area and released only if background levels are not exceeded.
8. Leak-testing dry storage sources, including procedures for doing wipe tests (not on the source itself) and for counting the wipes.
9. Inspection and maintenance checks. These procedures must cover the checks required in item B. below and include criteria for acceptability, and actions to be taken if results are unacceptable.
10. Loading, unloading and repositioning sources.

You should **submit** an outline or summary of procedures 1 - 9, so that you will not have to amend the license if details change.

If you intend to load, unload and reposition sources you should **submit** a description of all radiation protection precautions to be observed, the names of the individuals who will perform the work and their training and experience, and your system for recording the location of each source (by serial number) placed in the source rack.

B. Written Emergency Procedures

You must have written procedures for emergencies and untoward events, that instruct staff whom to notify, immediate actions to take, any prohibited actions and records to keep. You should **describe** procedures for responding to the following:

1. Sources stuck in a shielded or unshielded position.
2. Apparent over-exposures.

3. Alarms for loose source on product, or for pool water contamination.

4. Detection of leaking sources, pool contamination, or other contamination.
5. Water problems (pool water too low, too high or escaping)
6. Loss of offsite power.
7. Alarms indicating unauthorized entry.
8. Fires or explosions in an irradiator room.
9. Natural disasters.
10. Jamming of the automatic product transport system.

C. Inspection and Maintenance Checks

Confirm the following will be checked at weekly intervals for acceptable performance:

1. Function of access control system and alarms.
2. Function of console source position indicator.
3. Function of pool water contamination monitor.
4. Function of loose source monitor.
5. Function of console source return control.
6. Patency of pool water circulation system and leak-tightness.
7. Operability of heat and smoke detectors.
8. Operability of extinguishers (without activation).
9. Operability of pool water makeup system.
10. Operability of pool water level indicators.
11. Condition of system for raising and lowering sources and evidence of wear.
12. Condition of barrier to protect source rack and rack movement mechanism.

13. Patency of pool (no excessive water loss).
14. Wiring, electrical and monitoring equipment condition and operability.
15. Conductivity of pool water (maintained below 20 microsiemens per cm).

Also **confirm** that any problems found during weekly checks (or at any other time) will be corrected without delay.

D. Ensuring Source Integrity

Please **confirm** that:

1. Sources will not be installed or put into service unless they are received with a certificate documenting an acceptable leak test within 6 (six) months of receipt; or they are tested for leakage upon receipt.
2. Dry-storage sources will be subsequently tested for leakage at intervals not to exceed 6 (six) months.
3. Pool water will be checked for contamination each day of operation or once a week, whichever is more frequent.
4. If pool water is checked by analysis of a sample, results will be evaluated within 24 hours.
5. If pool water is checked by a monitor on the circulating system any activity above normal background will activate an alarm.
6. Apparent source leakage will be reported to the department immediately by telephone.
7. Apparent source leakage will cause prompt checks of personnel, equipment, product, etc. for contamination.

E. Records and Reports

You must retain records of the radiation safety program for either three years or the duration of the license, and you must report certain events to the Department if they occur.

1. Records - the following records must be maintained for the periods indicated:
 - a) Records of personnel training, testing and annual evaluation must be kept for 3 years
 - b) Records of RSO program reviews and operator evaluations (see item 7.B.) must be kept for 3 years
 - c) Personnel monitoring records must be kept until the license is terminated

by the Department

- d) Records must also be kept of:
 - Surveys (3 years)
 - Meter calibrations (3 years)
 - Leak Tests (3 years)
 - Inspection & Maintenance checks (3 years)
 - Major malfunctions, defects, incidents and operating problems (3 years)
 - Receipt, transfer and disposal of sources (life of license)
 - Verifications of design requirements, construction monitoring and acceptance testing (life of license)
 - Events related to eventual decommissioning (life of license)

Confirm that these records will be maintained for the periods indicated.

- 2. **Reports** - the following events must be reported to the Department by telephone within 24 hours, followed by a written report within 30 days:
 - a) a stuck source
 - b) a fire or explosion
 - c) damage to source racks
 - d) failure of the cable or drive mechanism for source racks
 - e) failure of the access control system
 - f) fugitive source alarm activation
 - g) detection of contamination
 - h) structural damage to a pool component
 - i) abnormal water loss or leakage from a pool
 - j) pool water conductivity exceeding 100 microsiemens per cm

Confirm that these events will be reported as required (if any occur), and that written reports will contain the information called for in section 38.29(a) of Code Rule 38.

F. **Annual Audit of the Radiation Safety Program**

Section 38.17(c) of Code Rule 38 requires that an audit of the conduct of your radiation safety program, and of the RSO's performance be conducted annually.

You should **describe** who will conduct these audits, the general content of the audits, how the results will be reviewed and how recommendations will be implemented.

G. **Financial Assurance**

Section 38.7 of Code Rule 38 requires that financial assurance for decommissioning be provided in the amount of \$75,000.

Please review this code section and **submit** one of the financial assurance instruments described. A guide for surety bonds is enclosed with this guide - if another mechanism

will be used please contact this office for additional guidance.

Item 17 **Waste Management**

You should **describe** how you will minimize and manage the radioactive waste generated from your operations.

This description must include a commitment to dispose of unneeded irradiator sources as soon as possible.

Item 18 **Certificate** - The application should be signed by the President, or any Chief Executive Officer. Identify the title of the office held by the individual who signs the application.

Enter the name and telephone number (including area code) of the individual who knows your proposed radioactive materials program and can answer questions about the application. This should be a staff member and **not** a consultant.

III. **AMENDMENTS TO LICENSES**

Licensees are required to conduct their programs in accordance with statements, representations and procedures contained in the license application and supporting documents. The license **must** therefore be amended if the licensee plans to make any changes in the facilities, equipment (including type of monitoring and survey instruments), procedures, authorized users or radiation safety officer, or radioactive material to be used.

A request for amendment can be submitted in the form of a letter explaining the desired changes, and including any needed drawings, certificates, manufacturers specifications, etc. It is advisable to call this office first, so that the information to be submitted can be discussed in advance.

Urgent requests should be clearly marked "urgent" in red ink, at the top of the first page of any communication. These will be given priority.

LIST OF APPENDICES

<u>Appendix</u>	<u>Subject</u>
A	Instrumentation
B	Model Procedure for Calibrating Survey Instruments

APPENDIX A
INSTRUMENTATION

1. Survey meters

- a. Manufacturer's name _____
Manufacturer's model number _____
Number of instruments available _____
Minimum range _____ mR/hr to _____ mR/hr
- b. Manufacturer's name _____
Manufacturer's model number _____
Number of instruments available _____
Minimum range _____ mR/hr to _____ mR/hr
Minimum range _____ mR/hr to _____ mR/hr

2. Other instruments used for quantitative measurement procedures (e.g., liquid scintillation counter, well counter, velometer)

<u>Type of Instrument</u>	<u>Manufacturer's Name</u>	<u>Model No.</u>
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APPENDIX B

MODEL PROCEDURE FOR CALIBRATING SURVEY INSTRUMENTS

Radiation survey meters must be calibrated with a radioactive source. Electronic calibrations alone are not acceptable. Survey meters must be calibrated at least annually and after servicing. (Battery changes are not considered "servicing.")

Model Procedure

1. The source must be approximately a point source.
2. Either the apparent source activity or the exposure rate at a given distance must be traceable by documented measurements to a standard certified within 5 percent accuracy by the National Bureau of Standards.
3. A source that has approximately the same photon energy as the environment in which the calibrated device will be employed should be used for the calibration.
4. The source should be of sufficient strength to give an exposure rate of about 30 mR/hr at 100 cm. Minimum activities of typical sources are 85 millicuries of cesium-137, 21 millicuries of cobalt-60, and 34 millicuries of radium-226.
5. The inverse square law and the radioactive decay law must be used to correct for change in exposure rate due to changes in distance or source decay.
6. A record must be made of each survey meter calibration.
7. A single point on a survey meter scale may be considered satisfactorily calibrated if the indicated exposure rate differs from the calculated exposure rate by less than 10 percent. Deviations of up to 20% may be acceptable if the correction factors for all scales are attached to the meter.
8. The following three kinds of scales are frequently used on survey meters:
 - a. Meters on which the user selects a linear scale must be calibrated at no less than two points on each scale. The points should be at approximately 1/3 and 2/3 of full scale.
 - b. Meters that have a multi-decade logarithmic scale must be calibrated at no less than one point on each decade and no less than two points on one of the decades. Those points should be at approximately 1/3 and 2/3 of scale.
 - c. Meters that have an automatically ranging digital display device for indicating rates must be calibrated at no less than one point on each decade and at no less than two points on one of the decades. Those points should be approximately 1/3 and 2/3 of the decade.

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9. Readings above 1,000 mR/hr need not be calibrated. However, such scales should be checked for operation and approximately correct response.
10. At the time of calibration, the apparent exposure rate from a built-in or owner-supplied check source should be determined and recorded.
11. The report of a survey meter calibration should indicate the procedure used and the data obtained. The description of the calibration will include:
 - a. The owner or user of the equipment.
 - b. A description of the instrument that includes manufacturer, model number, serial number, and type of detector.
 - c. A description of the calibration source, including exposure rate at a specified distance on a specified date.
 - d. For each calibration point, the calculated exposure rate, the indicated exposure rate, the deduced correction factor (the calculated exposure rate divided by the indicated exposure rate), and the scale selected on the instrument.
 - e. The reading indicated with the instrument in the "battery check" mode (if available on the instrument).
 - f. The angle between the radiation flux field and detector (for external cylindrical GM or ionization-type detectors, this will usually be "parallel" or "perpendicular" indicating photons traveling either parallel with or perpendicular to the central axis of the detector. For instruments with internal detectors, this should be the angle between the flux field and a specified surface of the instrument.
 - g. For detectors with removable shielding, an indication of whether the shielding was in place or removed during the calibration procedure.
 - h. The apparent exposure rate from the check source.
 - i. The name of the person who performed the calibration and the date on which the calibration was performed.
12. The following information should be attached to the instrument as a calibration sticker or tag:
 - a. The source that was used to calibrate the instrument.
 - b. The proper deflection in the battery check mode (unless this is clearly indicated on the instrument).

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- c. For each scale or decade, one of the following is appropriate:
 - 1) the average correction factor:
 - 2) a graph or graphs from which the correction factor for each scale or decade may be deduced; or
 - 3) an indication that the scale was checked for function but not calibrated, or an indication that the scale was inoperative.
- d. The angle between the radiation flux and the detector during the calibration.
- e. The apparent exposure rate from the check source.

NOTE: One-word reminders or symbols that are explained on the Survey Meter Calibration report may be used on the calibration sticker.

On the following page is a form you may want to use.

Name: _____ Date: _____