RADIATION PROTECTION PROGRAM

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Preface

This Radiation Protection Program has been written to cover multiple procedures and situation. Some referenced uses of radioactive sources and the procedures associated with them may not be currently applicable to the activities at Sensor Concepts & Applications, Inc. (SCA). The scale of this program is to be prepared for changes in the growth and scope of the use of radioactive sources at SCA.

Radiation Protection Program

SCA is committed to a Radiation Protection Program (RPP) of the highest quality. Likewise SCA hereby commits to full and complete compliance with all relevant requirements in the Code of Maryland Regulations (COMAR) 26.12.01.01 "Regulations for the Control of Ionizing Radiation." This Radiation Protection Program is designed to control operations conducted at SCA and off site locations that may result in the potential exposure of SCA personnel, members of the general public and/or the environment to ionizing radiation. SCA's commitment to the RPP is based on the fundamental principle that levels of radioactivity to be used, and exposures to all sources of ionizing radiation, are to be maintained **As Low As Reasonably Achievable (ALARA)**.

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1.0 Organizational Outline for Radiation Protection

Superior, consistent performance in radiological control is achieved when: qualified personnel follow proven procedures, management actively monitors the workplace, and radiation safety personnel audit activities to assess the quality of work from a compliance and performance standpoint. Regular review and informed interest by senior management is required to achieve a superior Radiation Protection Program.

1.1 Designation Description

Radiation (Radiological) Worker:
These individuals will conduct activities using radioactive materials and work with radiation producing devices under the direction of an Authorized User. Radiation Worker responsibilities are outlined in Section 1.2.1.

Authorized User:
This specification of Radiation Worker will oversee operations and assist other Radiation Workers in the radiological aspects of the job or task. An appointed Authorized User (AU) will assume the duties of the Radiation Safety Officer (RSO) upon direction by the RSO. It is the responsibility of the AU to directly oversee personnel and operations as to ensure compliance with radiological control policies and procedures. AUs will be approved by the Radiation Safety Committee.

Radiation Safety Officer:
The Radiation Safety Officer (RSO) will be responsible for overseeing the Radiation Protection Program and the requirements of the radioactive materials and radiation machine facility licenses. The responsibilities of the RSO are outlined in Section 1.2.2.

Assistant Radiation Safety Officer:
The Assistant Radiation Safety Officer (ARSO) assists the RSO in the management of the Radiation Protection Program.

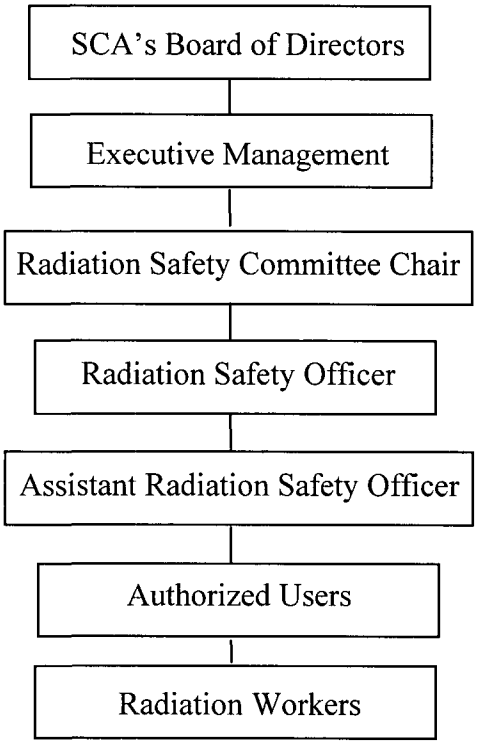
Radiation Safety Committee:
The Radiation Safety Committee (RSC) is a body consisting of the RSO, ARSO, Executive Manager and persons trained and experienced in the safe use of radioactive materials and radiation producing devices. The RSC is responsible for working with Executive Management and the RSO in implementing and managing the Radiation Protection Program.

Executive Management:
Executive Management is the individual at the senior management level who is responsible for the oversight of the SCA's radiation safety program and has the ultimate responsibility for the licenses and the activities associated with the

license. Executive Management has an important role in implementing and managing the radiation safety program and reports to SCA's Board of Directors.

1.2 Organization Chart

The following organizational chart depicts the control hierarchy of the Radiation Protection Program:



1.2.1 Radiation (Radiological) Workers

1. Radiation Workers will be familiar with this Radiation Protection Program and all relevant SCA procedures. As a rule, the following responsibilities will be met by all Radiation Workers:
2. Keep exposures to ionizing radiation As Low As Reasonably Achievable (ALARA).
3. Conduct a whole body survey prior to exiting a restricted area where unsealed radioactive material was used or whenever contamination is suspected.
4. Wear the proper personal protective equipment (PPE) when working with or handling unsealed radioactive materials. PPE will not be worn outside of controlled areas.
5. There will be no eating, drinking, smoking, chewing gum, eating utensils or application of cosmetics in areas under radiological control. No evidence of the aforementioned activities will be discarded into trash receptacles in controlled areas.
6. Maintain good personal hygiene. Wash hands and wrists thoroughly after exiting an area under radiological control.

7. Use double gloves when working with radioactive materials if there is an abrasion of the skin below the wrist.
8. Survey the work area for radioactive contamination upon completion of work involving unsealed radioactive material in unsealed form. Contaminated areas must be decontaminated immediately.
9. All radioactive samples, contaminated equipment and waste containers will be appropriately labeled.
10. The RSO or designee will be immediately notified of any personal contamination, internal exposure or a major spill involving radioactive materials.
11. Report all findings during contamination surveys in units of radioactivity (e.g. DPM or microcuries).
12. Report all evidence of non-compliance to the RSO, ARSO, RSC or State of Maryland

1.2.2 Radiation Safety Officer

The Radiation Safety Officer (RSO) is charged with the implementation, maintenance, oversight and periodic modification of the Radiation Protection Program. The RSO's duties and responsibilities also include ensuring radiological safety and compliance with State of Maryland, Nuclear Regulatory Commission (NRC) and Department of Transportation (DOT) regulations and the conditions of the license. In support of this requirement the RSO will:

1. Maintain surveillance of overall activities involving radioactive material and use of radiation producing devices, including monitoring and surveying of all areas in which radioactive material or radiation producing devices are used.
2. Ensure compliance with rules and regulations, license conditions, and the conditions of project approvals authorized by the Radiation Safety Committee.
3. Monitor and maintain absolute and other special filter systems associated with the use, storage, or disposal of radioactive material.
4. Provide necessary information on all aspects of radiation protection to personnel at all levels of responsibility.
5. Oversee proper delivery, receipt, and conduct radiation surveys of all shipments of radioactive material arriving at or leaving from the facility, as well as packaging and labeling of all radioactive materials leaving the institution.
6. Distribute and process personnel radiation monitoring equipment, determine the need for and evaluate personnel radiation monitoring, review exposure records for trends and high exposures, notify individuals and their supervisors of radiation exposures approaching maximum permissible amounts, and recommend appropriate remedial action.
7. Conduct training programs and otherwise instruct personnel in the proper procedures for the use of radioactive material and radiation producing

devices prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.

8. Supervise and coordinate any radioactive waste disposal program, which may include effluent monitoring. Maintain waste storage and disposal records.
9. Store radioactive materials not currently in use, including waste.
10. Perform or arrange for leak tests on all sealed sources and calibration of radiation survey instruments.
11. Maintain an inventory of all radioisotopes and limit the quantity of radionuclides to the amounts authorized by SCA's Radioactive Materials license.
12. Immediately terminate any activity that is found to be a threat to public health and safety or property.
13. Supervise decontamination and recovery operations.
14. Maintain other records not specifically designated above.
15. Hold periodic meetings with, and provide reports to, the Radiation Safety Committee and Executive Management.

1.2.3 Assistant Radiation Safety Officer

The ARSO shall support the RSO in his or her daily duties to ensure compliance with all local, state, federal, and license specific requirements or commitments. The ARSO shall adhere to all procedural guidelines and requirements for program maintenance found in this Radiation Protection Program.

1.2.4 Radiation Safety Committee

The Radiation Safety Committee (RSC) is responsible for the oversight of SCA's Radiation Protection Program. In fulfillment of this role, the RSC promulgates policies, rules and procedures for the safe use of radioactive material and radiation producing devices. The RSC has the authority to grant, deny, or withdraw permission for the use of radioactive materials and or radiation producing devices. It is the intent of SCA that no use of radioactive materials or radiation producing devices precedes without the knowledge and approval of the RSC. The committee will consist of: the President of SCA (Executive Management representative), the RSO, ASRO, and an Administrative representative. The Radiation Safety Committee size and composition shall be large enough to represent the spectrum of radiation users at SCA. Members shall have been trained and have experience as radiation workers including the safe handling of radioactive materials and the use of radiation producing devices. A written record of all meetings will be maintained by the Chairperson.

Specific duties and responsibilities of the RSC include:

1. Review the training and experience of the proposed Authorized Users and the Radiation Safety Officer (RSO) to determine that their qualifications are sufficient to enable them to perform their duties safely and in accordance with the regulations and the license.

2. Review and approve or deny all requests for authorization to use radioactive material, maintaining consistency with the regulations, the license and the As Low As Reasonably Achievable (ALARA) philosophy.
3. Prescribe special conditions that will be required during a proposed method of use of radioactive material or radiation producing devices such as requirements for personal monitoring, physical examinations of users and special monitoring procedures.
4. Review annually, the RSO's summary report of the occupational radiation exposure records of all personnel.
5. Establish programs to ensure that all persons whose duties may require them to work in or frequent areas where radioactive materials or radiation producing devices are used are appropriately trained.
6. Review annually the RSO's summary report of the entire radiation safety program to determine that all activities are being conducted safely, in accordance with regulations and the conditions of the license, and are consistent with the ALARA program and philosophy. The review must include an examination of records, reports from the RSO, results of program audits, written safety procedures and the adequacy of the management control system.
7. Recommend remedial action to correct deficiencies identified in the radiation safety program.
8. Maintain written minutes of all Committee meetings, including members in attendance and members absent, discussions, actions, recommendations, and decisions
9. Conduct periodic audits, in conjunction with the RSO, of the radiation protection program. Review findings of annual audits and act upon recommendations.

1.2.5 Executive Management

Effective radiation safety program management is vital to achieving safe and compliant operations. SCA believes that consistent compliance with applicable regulations provides reasonable assurance that licensed activities will be conducted safely. SCA also recognizes that effective management will result in increased safety and compliance.

"Management" refers to the processes for conducting and controlling the radiation safety program and to the individuals who are responsible for those processes and have authority to provide necessary resources to ensure safety and to achieve regulatory compliance.

To ensure adequate management involvement, a duly authorized executive management representative must acknowledge management's commitments and responsibility for the following:

1. Radiation safety, security and control of radioactive materials, and compliance with regulations;

2. Completeness and accuracy of radiation safety records and all information provided to the State of Maryland;
3. Knowledge about the contents of licenses and applications;
4. Compliance with current State of Maryland, NRC and Department of Transportation (DOT) regulations and SCA's operating and emergency procedures;
5. Commitment to provide adequate resources (including space, equipment, personnel, time, and contractors) to the radiation protection program to ensure that public and workers are protected from radiation hazards and compliance with regulations is maintained;
6. Selection and assignment of qualified individuals to serve on the Radiation Safety Committee and to serve as the Radiation Safety Officer for licensed activities; and
7. Prohibition against discrimination of employees engaged in protected activities.

2.0 Training Requirements

Individuals working in or frequenting restricted areas must meet the following applicable training requirements. These training requirements shall be continually reviewed and revised in order to provide function-specific and need-specific training. Therefore these requirements may be modified. Training shall be conducted by the Radiation Safety Officer, or someone of similar training and experience, in accordance with outlines reviewed and approved by the Radiation Safety Committee.

2.1 Frequency of Training

As a rule, Radiation Safety training will be required:

1. Before assuming duties with, or work in the vicinity of, radioactive materials or radiation producing devices.
2. Whenever there is a significant change in duties, regulations, or the terms of the license.
3. Annually (refresher training).

2.2 Types of Training

In order to meet function specific training requirements, the following types of training will be offered, at a minimum:

1. General Employee Radiation Training (GERT), Initial
2. Radiation Worker Training, Initial
3. GERT, Refresher
4. Radiation Worker Training, Refresher

An examination is required for Radiation Worker training completion with a minimum passing grade of seventy percent.

2.3 Topics

The topics that are covered in any training will be designed to meet function-specific training needs. The following topics are samples of material that may be covered during training.

2.3.1 General Information

A. General Awareness
   1. Signs and labels
   2. Notice to Employees
   3. License Scope
   4. Emergency response
   5. Restricted access, Facility requirements

B. Radiation Safety
   1. Radiation versus Contamination
   2. Internal versus External exposure
   3. Biological effects of radiation
   4. ALARA philosophy
   5. Use of time, distance, and shielding to minimize exposure

C. Regulatory requirements
   1. Organization of Radiation Safety Program
   2. Material control and accountability
   3. Personnel dosimetry
   4. Radiation safety program audits
   5. Materials Transfer and disposal
   6. Recordkeeping requirements
   7. Surveys: frequency, type and responsibilities
   8. Postings
   9. Labeling of containers
   10. Handling and reporting of incidents or events
   11. Licensing and inspection by the Maryland Department of the Environment
   12. Need for complete and accurate information
   13. Employee protection
   14. Deliberate misconduct, disciplinary actions

2.3.2 License-Specific Program Elements

A. Authorized Users and Radiation Workers
B. Ordering and receiving radioisotopes
C. Applicable regulations and License conditions
D. Areas where radioactive material is used or stored, Restricted Areas
E. Areas where radiation producing devices are used, Exclusion Zones
F. Potential hazards associated with radioactive material or radiation producing devices in each area where the individuals will work
G. Radiation safety procedures

H. SCA Rules and Procedures
I. Each individual's obligation to report unsafe conditions to the RSO
J. Appropriate response to spills, emergencies or other unsafe conditions
K. A worker's right to be informed of occupational radiation exposure, if applicable
L. Locations where SCA has posted or made available: notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including applications and applicable correspondence), as required by State regulations
M. Emergency procedures:
    1. RSO name and telephone number
    2. Immediate steps to prevent or control spread of contamination
    3. Spill response instructions
N. Dosimetry
    1. Whole body
    2. Extremities
    3. Lost or replacement badges and dose assessment
    4. Records
O. Survey meters and direct read dosimetry
    1. Use and care
    2. Calibration frequency
    3. Use of check sources
P. Procedures for receiving packages containing radioactive materials
    1. Normal business hours
    2. Off-hours restriction
    3. Notification of user and RSO
    4. Security issues
    5. Exposure levels
    6. License possession limits
    7. Receipt of damaged or unauthorized packages
R. Procedures for opening and examining packages
    1. Package condition, leakage and contamination
    2. Monitoring packages
    3. Monitoring packing materials
    4. Personal Protective Equipment.
    5. Transferring material to users
S. Sealed Sources
    1. Leak test requirements
    2. Inventory requirements
    3. Exempt quantities
    4. Records
T. Other topics, as applicable
U. Question and answer period

2.3.3 Use of Radioisotopes

A. Control procedures for obtaining permission to use radioactive materials at SCA
B. Procedure limitations and requirements
C. Safety precautions and what equipment to use
D. Limitations and conditions relative to handling unsealed licensed material (shielding, engineering control requirements, etc.)
E. Routine survey and monitoring procedures to be followed for contamination control
F. Emergency procedures concerning spills, fires, release of material, and/or accidental contamination of personnel
G. Decontamination procedures to use and whom to contact in case of an emergency
H. Instructions concerning transfer of licensed materials between areas
I. Requirements for storage, labeling of containers, and identification of areas where licensed materials are used
J. Personnel monitoring devices to use, where to obtain them, and exchange procedures and exposure results
K. Waste disposal procedures to follow, limitations for disposal of liquid or solid wastes, and procedures to use for waste storage.
L. Records to be maintained on use and disposal of licensed materials

3.0 Radiation Monitoring Instruments

Radiation detection instrumentation will be available in sufficient types and quantities as to support the scope of SCA operations involving radioactive materials and/or radiation producing devices.

SCA currently maintains the following list of portable radiation detection instrumentation. This list is subject to change based on operations and the recommendations of the Radiation Safety Committee. Portable instruments will be calibrated at yearly intervals by a licensed calibration vendor. At a minimum, portable survey instrumentation will be readily available for use within all locations using penetrating sources of radiation (> 250 keV). The RSC will validate the appropriateness of the number and type of available instrumentation during the procedure review process.

PRESENT INSTRUMENT INVENTORY

INSTRUMENT MAKE	MODEL	SERIAL NUMBER
Ion Chamber Survey Meter	451P-RYR	0025
Ion Chamber Survey Meter	451P-RYR	0734
Ion Chamber Survey Meter	451P-RYR	1230
Ion Chamber Survey Meter	451P-DE-SI	6231
GM pancake probe	489-110D	125493
Neutron probe	RP-N	105990
Readout Meter for probes	190N	106199

3.1 Calibration of Dose or Exposure Rate Instruments

SCA will employ a fully licensed vendor to perform all dose rate calibrations. Currently, Fluke Electronics Corporation, 6045 Cochran Rd., Cleveland, OH 44139 or Ludlum Measurements, Inc., 501 Oak St., Sweetwater, TX performs this service. SCA has not requesting license authority to perform such calibrations.

3.2 Calibration Records

Calibration records, for all survey instruments, will be provided by a licensed vendor and maintained by SCA Radiation Safety staff. The RSO maintains an electronic computer database of all radiation monitoring instruments that require annual calibration. The RSO receives calibration certificates from the licensed vendor and enters the date of calibration into this database. The licensed vendor also sends a reminder notification to the RSO that an instrument is due for calibration. The RSO then contacts the Authorized User to have the instrument sent for calibration. The Authorized User will be provided with a back-up survey instrument when his/her assigned instrument is sent for calibration.

3.2.1 Frequency of Calibration

SCA is committed to an annual calibration schedule. In addition, special calibrations will be performed at any time there is reason to believe that the operating characteristics of a metering device have been changed, by repair or alteration, or whenever system performance is observed to have changed significantly. Routine instrument maintenance will be performed as recommended by the manufacturer.

4.0 Material Receipt and Accountability

The Radiation Safety Officer, or designee, will approve all orders for radioactive material and will ensure that the requested material, quantities, manufacturer, and model are authorized by the SCA license and that the possession limits are not exceeded. All packages are to be delivered during normal operating hours. No after hours, weekend or holiday deliveries will be accepted. All carriers should be instructed to deliver radioactive packages directly to the RSO.

Table 1 DOT Labels

PACKAGE	CONTENTS	SURVEY TYPE	SURVEY TIME
Labeled (White I, Yellow II, Yellow III)	Gas or Special Form greater than Type A quantities	Radiation Level	As soon as practicable, but not later than 3 hours after receipt
Labeled (White I, Yellow II, Yellow III)	Not Gas Nor Special Form greater than Type A quantities	Contamination & Radiation Level	As soon as practicable, but not later than 3hours after

			receipt
Labeled (White I, Yellow II, Yellow III)	Gas or Special Form Less than Type A quantities	None	None
Labeled (White I, Yellow II, Yellow III)	Gas or Special Form greater than Type A quantities	Contamination	As soon as practicable, but not later than 3 hours after receipt
Not Labeled	Licensed Materials	None	None

4.1 Instructions for Source Material Receipt

4.1.1 Shipping and Receiving Personnel

During normal working hours, immediately upon receipt of any package of licensed material, each package must be visually inspected for any signs of shipping damage such as crushed or punctured containers or signs of dampness. Any obvious damage must be reported to the RSO or his/her designee, immediately. Do not touch any package suspected of leaking. Request the person delivering the package to remain until monitored by the RSO, or his/her designee.

Outside of normal working hours (e.g., nights, weekends, and holidays), deliveries should be refused.

Since certain packages of licensed material will have detectable external radiation, they should be sent immediately to a designated storage area, where they will be checked for contamination and external radiation level as soon as practical. They should not be allowed to remain in the receiving area any longer than necessary, as they may be a source of exposure for receiving personnel. If the instructions are not clear, or if there are questions regarding receiving packages containing radioactive material, please contact the Radiation Safety Officer.

4.2 Procedure for Opening Packages Containing Sources

For packages received under this license, authorized individuals shall implement procedures for opening each package, as follows:

1. Wear gloves to prevent hand contamination.
2. Visually inspect the package for any sign of damage (e.g. crushed, punctured). If damage is noted, stop and notify the RSO.
3. Check DOT White I, Yellow II, or Yellow III label or packing slip for activity of contents, to ensure shipment does not exceed license possession limits.
4. Monitor the external surfaces of a labeled package according to specifications in the Table 1 in 4.0.
5. Open the outer package (following supplier's directions if provided) and remove packing slip. Open inner package to verify contents (compare

requisition, packing slip and label on the pig or other container). Check integrity of the final source container (e.g., inspecting for breakage of seals or vials, loss of liquid, discoloration of packaging material, high count rate on smear). Again, check that the shipment does not exceed license possession limits. If you find anything other than expected, stop and notify the RSO.

6. Place the source in the secure radioactive materials storage area.
7. Survey the packing material and packages for contamination before discarding. If contamination is found, treat as radioactive waste. If no contamination is found, remove or obliterate the radiation labels prior to discarding in the regular trash.
8. Maintain records of receipt and package survey results.
9. Notify the RSO and the final carrier when removable radioactive surface contamination or external radiation levels exceed the packaged specified limits.

4.3 Materials Shipping Policy

Licensed material shall not be transferred or shipped from one location to another without the approval of the RSO. Such transfers/shipments must be packaged and labeled in accordance with DOT, NRC, or U.S. Postal Service Regulations, whichever is applicable. In addition the receiving organization must be licensed for the material and willing to accept the liability associated with receipt and possession of the material.

5.0 Occupational and Public Doses

5.1 Dose Limits for Individual Members of the Public

SCA does not allow access to its facilities by members of the general public. In addition, SCA's use of source materials or radiation producing devices is restricted to controlled areas. SCA operations will be conducted so that doses to individual members of the public will be within the regulatory limits, 0.1 Rem in a year.

5.2 Occupational Exposure Control

Occupational exposures at SCA will be maintained within the parameters outlined in Table 2. ALARA limits are established as a goal for occupational exposures. All Radiation Workers should minimize the potential for radiation exposure by following prudent external and internal radiation protection principles. Radiation Workers will follow administrative controls designed to limit radiation exposures. Engineering controls should be used whenever practicable. Personal Protective Equipment (PPE) should be used to limit potential radiation exposures. The principal exposure concern at SCA is related to the internalization of radioactive materials. Internalization occurs when radioactive materials enter the body via a route of entry. The primary routes of entry are:

1) Inhalation
2) Absorption
3) Ingestion

4) Injection or puncture

The procedures and policies in this RPP have been designed to mitigate the effective uptake of radioactive materials via one of these primary routes of entry.

Table 2 Occupational Dose Limits

Occupationally Exposed Adults	Annual Limit	ALARA Limit
Total Effective Dose Equivalent (TEDE)	5 Rem	0.5 Rem
Total Organ Dose Equivalent (TODE) (except lens of the eye)	50 Rem	5 Rem
Eye (Lens) Dose Equivalent (LDE)	15 Rem	1.5 Rem
Declared Pregnant Woman	0.5 Rem to embryo/fetus	0.05 Rem to embryo/fetus

Table Notes:
1. The "total effective dose equivalent" (TEDE) is defined as the sum of the "deep-dose equivalent" (for external exposures) and the "committed effective dose equivalent"(for internal exposures).
2. The "total organ dose equivalent" (TODE) applies to the sum of the "deep-dose equivalent" and the "committed dose equivalent" to any individual organ or tissue.
3. In order to avoid confusion with the acronym for effective dose equivalent (EDE), the abbreviation LDE is also used to represent the eye (lens) dose equivalent.

5.3 Declared Pregnant Workers

Declaration of pregnancy is optional and is at the sole decision of the Radiation Worker. Declared Pregnant Women must issue their declaration in writing to the RSO and include the estimated date of inception. Upon declaration, the worker's dose limitations will be as represented in Table 2 and:

1. All Declared Pregnant Women (DPW) will receive general information relative to radiation and its potential effect on the fetus.
2. DPWs will be given specific information and instruction regarding their specific work responsibilities and corresponding radiation safety issues.
3. The RSO, or designee, will schedule an appointment with all DPWs to discuss the information in 1 and to determine an appropriate monitoring schedule.

6.0 Personnel Monitoring

External exposure monitoring (whole body) will be required for any Radiation Worker working with energetic radioactive materials (e.g. > 250keV) or in close proximity to x-ray sources and expected to receive more than 125 millirem of exposure during any quarterly reporting period. Personal monitoring will be required for any Radiation Worker using more than one millicurie of energetic

material (e.g. > 250 keV) in any single operation. Landauer Dosimetry, or another licensed vendor, will be the dosimetry service provider.

6.1 Proper Dosimeter Wear

Body dosimeters should be worn on the part of the body between the neck and waist, the area most likely to be exposed to the source of radiation. Wear the dosimeter so that the front faces toward the source of radiation.

Wear a ring dosimeter so that the label is facing out from the side of the hand most likely to receive an exposure. In most cases, this means that the label will face out from the palm side of the hand. Rings are hand-specific. The inner label will contain either the initials URE (right hand) or ULE (left hand). Ring dosimeters should be worn under gloves. Care must be taken not to dispose of the ring in the trash when gloves are removed.

6.2 Dosimeter Care

Dosimeters s should not be taken home or worn for non-work exposures such as a dentist's office.

Someone else's dosimeter should never be worn or loaned to another person. It is a legal requirement that doses be tracked for the worker to whom the dosimeter is assigned.

When not in use store dosimeters, along with their control, in a safe location away from sun, heat, sources of radiation or potential damage. Protect dosimeters from impact, puncture, or compression.

Do not wear the dosimeter during or after receiving medical treatments involving radiopharmaceuticals.

6.3 Dosimeter Exchange

Dosimeters are exchanged quarterly. Each user is responsible for seeing that the current dosimeter is exchanged on schedule. Delay in processing may invalidate the results (dosimeters expire after a given time), and increases the chance of dosimeters being lost or damaged.

Any unusual exposures, such as exposure to dosimeter during baggage x-ray, must be reported at the time of exchange.

The RSO assigns dosimeters, distributes them, collects them at the end of the monitoring period for processing, and receives dosimetry reports.

The RSO will receive new dosimeters a few days before each new quarter. Exposed dosimeters will be collected and new dosimeters will be distributed on or near the date of each new wear period. Offsite employees will receive new dosimeters in the mail and be provided with a postage paid return mailer.

If an employee is unable to locate their dosimeter for the exchange then they must provide the RSO with details of their activities during the monitoring period.

6.4 Lost or Damaged Dosimeters

If a dosimeter is lot notify the RSO immediately for a replacement and stop working near radioactive sources until a replacement dosimeter is issued.

If the dosimetry service provider is unable to process a damaged dosimeter, or if a dosimeter is lost or expired, an estimate of exposure will be made by the RSO after reviewing employees activities.

6.5 Exposure Records

All exposure records are maintained indefinitely. An employee may request a copy of their record upon written request. Any anomalies in monthly reports will be reviewed by the RSO and discussed with the employee.

7.0 Safe Use of Radionuclides

Each area where radioactive material is used or stored must establish procedures for the use of radioactive materials. Within these procedures, specific instructions are to be provided to the Radiation Worker regarding the safe completion of that procedure by the Authorized User.

General instructions that should be applied at all times when working with radioactive materials include:

1. Wear a laboratory coat or other protective clothing at all times in areas where un-sealed licensed materials are used.
2. Wear disposable gloves at all times when handling un-sealed licensed materials.
3. After each procedure or before leaving the area where unsealed licensed materials have been used or are present, monitor hands, shoes, and clothing for contamination in a low-background area.
4. Do not eat, drink, smoke or apply cosmetics in any area where licensed material is stored or used.
5. Do not store food, drink or personal effects in areas where licensed material is stored or used.
6. Wear personnel monitoring devices, if required, at all times while in areas where licensed materials are used or stored.
7. Secure all licensed material when it is not under the constant surveillance and immediate control of the user(s).

8.0 Safe Use of Radiation Producing Systems/Devices

Every radiation generating equipment shall possess warning devices that operate when, and only when, radiation is being produced. Awareness of these warning devices must be noticeable inside the exclusion zone. All safety features shall be present and verified operational at the beginning of each day of operation.

General instructions that should be applied at all times when working with radioactive materials include:

1. Avoid exposure to the primary beam
2. Verify external visual warnings
    a. Amber warning lights shall turn on prior to powering the x-ray source for a minimum of 10 seconds and will remain on until the x-ray source is powered down.
    b. Red lights shall turn on when x-rays are being produced and off when x-rays are not being produced.
    c. Each red x-ray-on light shall have a corresponding sign that reads "X-RAY ON".
3. External Audible Warnings
    a. There shall be an external audible warning horn for radiation generating equipment. The horn shall produce an audible indicator when radiation is being produced.
4. Safety Interlocks
    a. Each radiation generating equipment shall have safety interlock on a circuit which allows it to operate independently of all other safety interlocks.
    b. All safety interlocks shall operate within specifications.
    c. When a safety interlock system has stopped equipment operation, it shall only be possible to resume operation of the equipment by manually resetting controls at the position where the safety interlock has terminated operation and, lastly, at the operator control console.
5. Warning Signs
    a. The use of warning or caution signs is required to provide a warning to an employee, visitor, or contractor. The placement of signs and the geometric dimensions of the radiation symbol and colors are proscribed by State and or Federal regulations.
    b. Radiation Area signs will be posted at all entrances to any area where an individual could receive a dose equivalent in any one hour in excess of 5 millirem at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
    c. High Radiation Area signs will be posted at all entrances to any area where an individual could receive a dose equivalent in any one hour in excess of 100 millirem at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
    d. All signs will be posted in a conspicuous place
6. Never leave radiation generating equipment unattended unless the system has been but in a state where it cannot produce external radiation.

9.0 Emergency Procedures

Any anomaly that violates SCA's Radiation Protection Plan or procedures at a level that is not deemed to be an emergency shall be considered an incident.

Radiological emergencies or incidents may occur with any equipment using radiation or from contaminated materials. These incidents may involve inadvertent exposure for numerous reasons. Any operational situation may result in radionuclide releases with actual, potential, or perceived harm or consequences to human health and the environment.

9.1 Inadvertent Exposure from Radiation Generating Devices

If it has been determined that an occurrence which is likely to result in any non radiation worker being exposed to ionizing radiation in excess of 50 microrem in an hour above background has occurred then the Authorized User shall execute the following tasks:

1. Terminate the source of that exposure immediately and every exposed individual shall be removed from the Exclusion Zone safely.
2. Inform individuals inadvertently exposed of the exposure by the local RSO or his designee and provided them with easy to understand information about the amount of dose received and the consequences of further exposure.
3. Contact SCA's Radiation Safety Officer and informed him of the incident within twenty four hours.
4. Review the events that led to this exposure and adjust operation procedures as required to mitigate the problem safely.

If an accident involving exposure to radiation in excess of 100 millirem above background per incident occurs then the Authorized User shall execute the following tasks:

1. Immediately shut down the radiation generating equipment.
2. Rescue/Evacuate all personnel to a safe area.
3. Sound the alarm if appropriate, for example if there is a fire.
4. Call for help. Get Emergency medical aid as required.
5. Exit the area and if there is continuing exposure secure the area.
6. Contact the RSO regarding the incident.
7. Conduct a review of the events that led to this exposure and adjust the operation procedures to resume safe operations.

9.2 Radiation Accident Involving Source Material

In emergency or accident situations involving all licensed radioactive materials, the following steps should be taken:

1. Persons in the immediate area not contaminated in the incident should be asked to leave the area. Establish a restricted area boundary, limiting access to the area to authorized personnel only.
2. The restricted area must be kept under constant, direct supervision by an Authorized User or the Radiation Safety Officer until area is deemed safe for occupancy.
3. The Authorized User directly supervising the use of material involved in the accident should be notified immediately. In the case of spills, assessment of the accident should be made to determine if accident is minor or major and the proper procedures for which should be followed.

9.3 Accidental Ingestion or Inhalation of Source Material

Radioactive materials can be taken up internally when volatile or other airborne radioactive materials are inhaled and when radioactive materials are absorbed through skin or ingested. Currently SCA has not licensed radioactive sources that are in a physical state that is ingestible, inhalable or absorbable through the skin or like to become so as a result of a fire. However, if there is evidence of dispersible material and suspect that an uptake has occurred then the following steps should be taken:

1. Persons suspected of ingesting, inhaling or absorbing licensed radioactive source material a bioassay is required.
    a. This bioassay may be in the form of thyroid counting or urine bioassay.

9.4 Missing or Damaged Source

Licensed radioactive sources must be under the control of an authorized user at all times. When not in use these sources are to be dept in a secure storage area. If a source is damaged or found missing it must be reported to the RSO within 24 hours.

10.0 Surveys and Monitoring

Areas under radiological control will be surveyed to evaluate radiation levels, characterize workplace conditions and to identify potential radiological hazards. Radiological instruments shall be used only to measure the radiation for which their calibrations are valid.

Before allowing an individual to perform surveys, the RSO will ensure that said individual has sufficient training and experience to perform surveys independently.

11.0 Leak Test Procedures

SCA will use Suntrac Services, Inc, or another licensed vendor, to analyze all leak tests. The RSO conducts the required physical inventory and leak testing. All beta/gamma and neutron sealed sources (greater than 100 microcuries) will be tested for leakage and inventoried at intervals not to exceed six months. All sealed sources (greater than 10 microcuries) designed for the purpose of emitting alpha particles will be tested at intervals not to exceed three months. Ni-63 foil sources (greater than 100 microcuries) will be tested at intervals not to exceed six months. Results are maintained in an electronic computer database and in paper copy (the original leak check certificate received from the licensed vendor). The electronic computer database flags those sealed sources due for leak-testing. In addition, the outside vendor that performs the leak test analysis also sends the RSO a reminder notice when sealed sources are due for leak testing. The RSO has the responsibility for maintaining a comprehensive inventory of all licensed radioactive materials. Please reference RPP section 1.2.2. Inventories of all sealed sources are maintained in an electronic computer database by the RSO. The inventory lists the Authorized Users, nuclide, half-life, decay, location and

description. The databases also track the licensed possession limits. All new sealed sources are ordered, received and delivered by the RSO. The RSO will enter the new source into the electronic inventory database. Any transfer of a sealed source must have the written approval of the RSO.

12.0 Transportation

SCA will comply with all local, state and federal regulations regarding the transportation of radioactive materials.

13.0 Radiation Protection Program Maintenance

This program shall be reviewed for implementation and content no less than annually. The results of these audits shall be maintained on file for review and inspection.

Audits are conducted, in part, to fulfill the requirements of SCA's radioactive material license and for an annual review of the content and implementation of the SCA Radiation Protection Program. It should also identify program weaknesses and allow SCA to take early corrective actions (before any Maryland Radiological Health Program inspection). During an audit, the auditor needs to keep in mind not only the requirements of Maryland's Radiological Health Program's regulations, but also SCA's commitments in its applications and other correspondence with regulators. The auditor should also evaluate whether SCA is maintaining exposures to workers and the general public As Low As is Reasonably Achievable (ALARA) and, if not, make suggestions for improvement. The RSO or designee will conduct annual audits. This individual will be selected based on his/her training and experience and the focus of the audit as directed by the RSC. Therefore training and experience may vary depending on the needs of the radiation safety program. Records of these audits will be maintained for 3 years after the audit and will include date of the audit, name(s) of person(s) who conducted the audit, persons contacted by the auditor, areas audited, audit findings, corrective actions, and follow-up. Minimum qualifications include at least five years experience as a Radiation Safety Officer or Authorized User of radioactive materials, and at least five years experience in auditing radiation safety related procedures, systems and records. The sample form (Appendix A), or other appropriate document, can be used to document the annual audit of the Radiation Protection Program. Guidance follows on completing each section of the form (3.1). In the "remarks" portion of the form, note any deficiencies that were identified and the corrective actions taken (or to be taken).

13.1 Audit Scope

13.1.1 Section 1, Audit History

Enter the date of the last audit, whether any deficiencies were identified, and whether actions were taken to correct the deficiencies.

13.1.2 Section 2, Organization and Scope of Program

Give a brief description of the organizational structure, noting any changes in personnel. Describe the scope of licensed activities. Check whether the Radiation Safety Officer (RSO) is the person identified in the license and fulfills the duties specified in the license.

13.1.3 Section 3, Training, Retraining, and Instructions to Workers

Ensure that workers have received the training required by the RPP. Be sure that, before being permitted to use source material, the user has received training and has a copy of the SCA safe use and emergency procedures. Note whether refresher training is conducted in accordance with RPP commitments. Ensure that each worker has access to a copy of SCA's current procedures and policies, and by interview and/or observation of selected workers that he/she can implement them.

13.1.4 Section 4, Audits

Verify that audits fulfill the State requirements, are conducted in accordance with SCA's commitments, and are properly documented.

13.1.5 Section 5, Facilities

Verify that SCA's facilities are as described in license documents.

13.1.6 Section 6, Materials

Verify that the RSO authorizes the quantities and types of source material that SCA possesses.

13.1.7 Section 7, Leak Tests

Verify that all sealed sources are tested for leakage at the prescribed frequency and in accordance with any SCA's commitments. Records of results should be maintained.

13.1.8 Section 8, Inventories

Verify that inventories are conducted at least once every 6 months to account for all sources and stock material; physical inventory records should be maintained.

13.1.9 Section 9, Radiation Surveys

Verify that SCA has appropriate, operable and calibrated survey instruments available, that the instruments are calibrated (at the required frequency) in accordance with license conditions and in accordance with State regulations. Calibration records must be retained for 3 years after the record is made. Check that radiation levels in areas adjacent to use are within regulatory limits. Records of surveys must be retained for 3 years after the record is made.

13.1.10 Section 10, Receipt and Transfer of Radioactive Material

Verify that packages containing source material, received from others, are received, opened, and surveyed in accordance with written procedures. Ensure that transfers are performed in accordance with State regulations. Records of

surveys, receipt, and transfer must be maintained in accordance with State regulations.

13.1.11 Section 11, Transportation

Determine compliance with Department of Transportation (DOT) requirements. Verify that radioactive packages are prepared, marked, and labeled in accordance with 49 CFR Parts 172 and 173 requirements. Verify that shipping papers are properly prepared, that they contain all needed information, and that they are readily accessible during transport (49 CFR 172.200, 201, 202, 203, 204 and 177.718).

13.1.12 Section 12, Personnel Radiation Protection

Evaluate SCA's determination that unmonitored personnel are not likely to receive more than 10 percent of the allowable limits. Alternately, if personnel dosimetry is provided and required, verify that it complies with State requirements and SCA's commitments. Review personnel monitoring records; compare exposures of individuals doing similar work; determine reasons for significant differences in exposures. If any worker declared her pregnancy in writing, evaluate SCA's compliance with COMAR 26.12.01.01 Section D.208 and CFR 20.1208. Check whether records are maintained as required.

13.1.13 Section 13, Posting and Labeling

Check for compliance with the posting and labeling requirements.

13.1.14 Section 14, Bulletins and Information Notices

Check to determine if the RSO is receiving bulletins, information notices, etc. Check whether SCA took appropriate action in response to Maryland Radiological Health Program mailings.

13.1.15 Section 15, Special License Conditions or Issues

Verify compliance with any special conditions on SCA's license. If SCA has started any unusual or new aspects of work, review and evaluate compliance with regulatory requirements.

13.1.16 Section 16, Continuation of Report Items

This section is self-explanatory.

13.1.17 Section 17, Problems or Deficiencies Noted; Recommendations

This section is self-explanatory.

13.1.18 Section 18, Evaluation of Other Factors

Evaluate management's involvement with the Radiation Protection Program, whether the RSO has sufficient time to perform his/her duties, and whether SCA has sufficient staff to handle the workload and maintain compliance with regulatory requirements.