



# Irradiator Technology



## Self-Shielded Irradiator Security Inspections

# Irradiator Security Topics

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- **NRC Order to Enhance Security**
- **Concerns with Cesium Chloride**
- **Global Threat Reduction Initiative**
- **Irradiator Increased Controls inspections**
  - **Insights**
  - **Lessons Learned**
- **This Review will Focus On**
  - **Access Controls**
  - **Detection of Unauthorized Access**

# Self-Shielded Irradiators

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- **Following 9/11, the Commission determined that Increased Security of Radioactive Material was Necessary**
- **Increased Control of Sources should be Implemented Through the Issuance of Orders**



# National Research Council

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- **Cesium-137 in the form of cesium chloride presents a greater concern because**
  - It is widely used in significant quantities
  - It is soluble and dispersible
  - There is a lack of disposal options meaning more of these sources will remain in long term storage
- **Recommendation: The U.S. government should take steps to promote the replacement of these sources**

## Other Organizations Have Expressed Reservations With Initiatives That Would Replace Cs-137 Chloride

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- **ACMUI:** Replacement with x-ray units and linear accelerators may be cost prohibitive, there are differences with RBE, throughput may be slower, and replacement not necessary due to enhanced security controls.
- **ASTRO:** Cancer Research could be affected
- **Radiation Research Society:** Alternatives may not be appropriate for all research

# NRC Policy Statement

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- **CsCl sources benefit society: blood irradiation, bio-medical and industrial research, and calibration of instrumentation and dosimetry**
- **Current security controls are adequate**
- **Further design improvements to mitigate or minimize radiological impact can be made**
- **The development of alternative forms and use of Cs-137 are prudent**
- **NRC will continue to monitor the threat environment**

# Global Threat Reduction Initiative

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- **US Department of Energy's National Nuclear Security Administration's Global Threat Reduction Initiative**
- **Federally funded voluntary security enhancements for self-contained irradiators containing Cesium Chloride Sources**
  - **Unwanted source removal (e.g., disposal)**
  - **Enhanced detection (e.g., motion detectors, tampering detection, remote monitoring)**
  - **Delay (e.g., hardening, tie-downs), and**
  - **Response (e.g., equipment, training, etc.)**

# Increased Controls

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- **IC 1 - Control Access**
- **IC 2 - Detect, Assess and Respond**
- **IC 3 – Control Transportation**
- **IC 4 – Portable & Mobile Devices**
- **IC 5 – Records**
- **IC 6 – Information Protection**



# IC 1 Access Control

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- In order to ensure the safe handling, use, and control of licensed material in use and in storage each licensee shall **control access at all times** to radioactive material quantities of concern and devices containing such radioactive material (devices), and limit access to such radioactive material and devices to **only approved individuals who require access to perform their duties.**

# IC 1 Barriers

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- **Must Control Access [With Barriers]**
  - **Physical or Human Barriers**
- **No Explicit Barrier Specifications**
- **No Design Basis**
- **Challenging for inspectors because little guidance is given, and you have to assess the adequacy of barriers**

# IC 1 Barriers

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- **Is drywall adequate?**
- **Is a drop ceiling adequate?**
- **Is a glass window in a door adequate?**
- **If glass is used does it have to have wire mesh or be a special type of glass?**

# IC 1 Barriers

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- **Physical Barriers must be intact.**
- **If you have to break it to gain access, Then it is generally considered OK**
- **If barrier can be easily moved with your hands like a drop ceiling tile or temporary wall, then it is inadequate.**

# Inadequate IC 1 Barrier



# Inadequate IC 1 Barrier

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# Inadequate IC 1 Barrier



# IC 1 Barrier

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- **Example:**
  - **Irradiator : Door is alarmed, room has a drop ceiling, three of the four walls extend to the permanent ceiling.**
- **Is this OK?**



# IC 1 Barrier

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- **No. The Drop Ceiling Does Not Represent an Intact Barrier**
- **Supplemental Q&A: S14**
- **Violation of IC 1 access control.**
- **Isolated Inadequate Barrier (Likely SL IV)**

# IC 1 Barrier

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- **Example Self-Shielded Irradiator Room**
  - Door is alarmed,
  - Room has a drop ceiling
  - Three of the four walls extend to the permanent ceiling.
  - The area above the drop ceiling has a motion detector.
- **Is this OK?**

# IC 1 Barrier

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- **No. IC 1 and IC 2 are separate requirements and each has to be met**
- **The drop ceiling is not considered an adequate barrier, even with an IC 2 motion detector.**
- **Supplemental Q&A: S14**
- **Violation of IC 1 access control.**
- **Isolated Inadequate Barrier (Likely SL IV)**

# Access Control Barrier

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- **Self-Shielded Irradiator Room**
- **Single pane of window glass in door and you can readily see the irradiator from hallway**
- **Door has a magnetic switch alarm and prox card access**
- **The ceiling is made of intact drywall.**

**Is this OK?**

# IC 1 Barrier

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- **It depends. Typically, an intact barrier that must be broken to gain access is an adequate barrier.**
- **However, it is still a judgment call.**  
**Supplemental Q&A No. 14**
  - **Licensees must take into account, and protect against situations where existing alarms, locks, walls, or other barriers could be defeated.**
  - **Key to a Successful Protection System is Integration of People, Procedures, and Equipment**

# IC 1 Barrier & IC 2 Alarm

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- **A irradiator is located on the fourth floor of a University Lab. The lab has windows on the outer corner walls. The windows are not alarmed and one window is open. There is no screen in the window. The RSO explained that because the window is four stories high it does not represent a reasonable point of entry. Therefore, the window does not have to be locked or alarmed.**
- **Is this OK?**

# IC 1 Barrier & IC 2 Alarm

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- Technically, the barrier is NOT continuous and represents a violation.
- Technically, the window represents an access point and should be alarmed when not monitored by humans.
- However, Here Comes the Triple Negative,
  - It would NOT be UNreasonable to Not-Cite this Violation. However, you may want to discuss with your Branch Chief.

# Human IC 1 Barrier

## (Ref. Implementing Guidance)

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- **Access means that an individual could exercise some physical control over the material or device.**
- **Escort means maintaining line of sight with the escorted individual.**
  - **If individual is not within line of site, then the individual is not properly escorted**
  - **Video monitoring is not acceptable as an access control barrier.**



# Inadequate IC 1 Barrier Inattentive Guard

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# IC 1.a Access Control

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- **Only Trustworthy and Reliable Individuals Who Have a Job Related Need May Have Unescorted Access to RAM**
  - Attempt to limit the number of individuals who have access. However, Q&A 39 indicates that if an individual requires access to the room where the device is stored, then they have a job related need.
- **Must Approve Access In Writing**
- **Must Escort Other Individuals**

# Human Barrier Violations at Self-Shielded Irradiator Facilities

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- **Multiple examples have occurred at universities where T&R individuals leave an irradiator room door open for non-T&R staff (i.e., grant unescorted access)**
- **Multiple example have occurred in blood banks where T&R staff have not properly monitored access to self-shielded irradiators**

# Human Barriers

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- **A Self-Shielded irradiator is located in the middle of a blood bank. The licensee claims that they will have a T&R individual controlling access 24 hours per day, seven days per week.**
- **Is this OK?**

# Access Control

**Yes, it is OK. However, Danger Will Robinson**



- **It is very difficult to continuously monitor access.**
- **-Lunch Breaks**
- **-Bathroom breaks**
- **-Sick leave**
- **-Holidays**
- **-Night shift**

## IC 1.c Service Providers

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- **Manufacturing & Distribution (M&D) Service Providers determined to be T&R by an NRC-required background investigation may be granted unescorted access**
  - **Written verification attesting to or certifying the person's T&R shall be obtained from the M&D licensee providing the service.**
- **Non M&D Service providers shall be escorted**
  - **Because they possess specialized knowledge**

# IC 1.c Non M&D Service Providers

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- **Non-M&D Service Providers Can Now Request Orders (E.g., IC 1 and IC 5) IAW NRC Regulatory Information Summary 2007-15**

# IC2 - Monitor, Detect, Assess and Respond

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- **Documented Program to:**
  - **Monitor Access,**
  - **Immediately Detect,**
  - **Assess, and**
  - **Respond to Unauthorized Access**
- **Enhanced monitoring shall be provided during source delivery or shipment of > 100 times the Table 1 values.**



# IC2 - Monitoring

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- **Trained Individuals**
  - Users/Workers/Guards
- **Electronic Means**
  - Motion Detectors, Door/Window Alarms, Vibration
  - Alarms: Local and/or remote
  - Video monitoring
- **Monitoring Must Be Continuous and Effective**
  - Recognize Intrusion Attempt
  - Gather/Provide Data For Assessment

## **IC 2 Immediately Detect**

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- **Detection must be immediate**
  - **Human Escort**
  - **Electronic Alarms Annunciate Locally or at a Nearby Continuously Staffed Alarm Station**
  - **Reliance on Immediate Detection with Video Monitoring By Security Guard may not be adequate**

# IC 2 Assess

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- **Automated Devices**
- **Trained Personnel**
- **Documented Program Should Describe Program and How the Licensee Would Respond to Unauthorized Access**
- **Must**
  - **Evaluate Information Provided By Detection**
  - **Decide What Is Happening**
  - **Decide What to Do**

## IC 2 Immediate Response

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- **The licensee shall respond immediately to any actual or attempted theft, sabotage, or diversion of such radioactive material or of the devices.**
- **The response shall include requesting assistance from a Local Law Enforcement Agency (LLEA).**

# Detection Alarm Test Failures

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- **Multiple IC Inspections have identified non-functioning intrusion alarms**
- **Multiple IC Inspections have identified T&R personnel who have been assigned to control access and detect unauthorized access, but do not fully understand their responsibilities.**
- **Message: Test electronic and human alarm systems during inspections**

# IC 2 Intrusion Detection System: You Make the Call

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- **A blood irradiator is located inside an enclosure, which is located inside a large blood bank. The intrusion alarm generates a local audible alarm which is intended to alert a T&R person of an unauthorized access into the irradiator room.**
- **When the intrusion alarm is tested, it is difficult for the inspector to hear the alarm. The inspector notices that T&R personnel routinely travel upstairs to a lunch room that is outside of the reliable audible alarm monitoring distance.**
- **What should the inspector do? What questions should the inspector ask? Do you have a violation?**

# Inspection Questions

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- **1) During periods of time when there is only one T&R individual present, does that individual ever travel outside of the reliable audible alarm monitoring range (e.g., lunch room), and for how long?**
- **2) Is it possible to increase the volume on the audible alarm, or install flashing lights, or install a pager alarm system?**
- **3) What training have individuals received who are assigned to detect unauthorized access?**

# IC 2 Documented Program Alarm Monitoring

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- **A test of a blood irradiator door alarm at a large hospital showed that a visual alarm was received on a computer screen in the Security Office, and that guards were immediately dispatched to the irradiator.**
- **The inspector noted that the alarm indication was only displayed visually on a computer screen without an audible annunciation, and the computer screen was not positioned in the Officer's immediate viewing area (i.e., the Officer has to turn his head to look at the computer screen).**
- **Is this a deficiency in the ability to immediately detect, assess, and respond to unauthorized access?**



# IC 2 Documented Program

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- **Judgment Call:**
- **IF the guard station is staffed 24 hours per day, and the guards closely monitor the alarm screens, and there are no performance based examples in which the licensee did not immediately respond, THEN it is likely not a violation.**
- **However, this definitely represents an opportunity for improvement. Typically, audible alarms can easily be activated to accompany a visual alarm indicated on the computer screen.**

## IC 2.c Dependable Means to Transmit Information

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- Licensee has an irradiator in a research lab. The door is alarmed, and the alarm signal is carried over a single telephone wire. There is no cellular backup, or redundant alarm system.
- Is this OK.

# IC 2.c Dependable Means to Transmit Information

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- **No. Inspection Procedure TI 2800/038 instructs inspectors to verify that the licensee has at all times a dependable means to transmit information...**
- **If a single line is used, it should fail in an alarm condition.**
- **If it does not fail in an alarm condition, then the licensee should employ redundancy**
  - **Cellular Backup**
  - **Video Monitoring**
- **Bring All Potential Violations of IC 2.c Back to Office for further review**

# LLEA Response Plan

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- **Example:**
  - **Licensee moves irradiator to new hospital wing, but does not update LLEA response plan.**
- **Is this OK?**

# Pre-Arranged Response Plan Update

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- **No. Violation of IC 2.b:  
Failure to update pre-arranged plan.**
- **NRC Enf. Policy, Section 6.12.d.6**

## **IC 2.d&e: Report & Document**

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- **Report All Actual or Attempted Theft, Sabotage or Diversion of RAM**
  - **NRC Operations Center 301-816-5100**
  - **Agreement State**
- **Document**
  - **All Unauthorized Access**
  - **Necessary Corrective Actions**

## IC 2 Enhanced Monitoring

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- **Enhanced monitoring shall be provided during source delivery or shipment for Source Activity that > 100 X Table 1.**
- **Examples include:**
  - **Additional Monitoring Personnel**
  - **Increased Video Surveillance**

## IC 3.b Transportation

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- **Prior to Shipping > 100 x Table 1**
  - **Notify NRC in Writing 90 days prior to shipment**
  - **NRC Will Issue Order to Implement Additional Security Measures (ASMs) for Transportation of RAM QC**
- **Future > 100 x Table 1 Shipment, NRC Notifications Not Necessary as Long as Licensee Implements ASMs**



## IC 3.c Shipments > 100 X Table 1

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- **If a licensee employs an M&D licensee and the M&D licensee takes possession at the licensee's location of use and ships it under the M&D license, the requirements of 3.a. and 3.b do not apply.**

# IC 4 Portable & Mobile Devices

(Ref. Implementing Guidance)

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- **Portable Equipment:**
  - Device designed to be hand carried
  - Example: Radiography Equipment
- **Mobile Device:**
  - Device mounted on a permanent base with wheels or castors for moving while completely assembled
  - Example: Calibrators
- **Stationary Equipment:**
  - Device installed in a fixed location
  - Example: Blood Irradiator or Fixed Gauge

# Mobile Device – Calibrator on Wheels

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- **Mobile Devices**
  - **Outside Facility – Two Independent Controls**
  - **Inside Facility – One Tangible Barrier**