

Subchapter VII — Radiation Safety Requirements for Irradiators

DHS 157.73 Radiation safety requirements. (1) PERFORMANCE CRITERIA FOR SEALED SOURCES. (a) A sealed source installed in an irradiator shall meet all of the following requirements:

1. Be evaluated and receive a certificate of registration under 10 CFR 32.210 or the equivalent agreement state regulation.
 2. Be doubly encapsulated.
 3. Use radioactive material that is as nondispersible and insoluble as practical if the source is used in a wet-source-storage or wet-source-change irradiator.
 4. Be encapsulated in a material resistant to general corrosion and to localized corrosion such as 316L stainless steel or other material with equivalent resistance if the sources are for use in irradiator pools.
 5. In prototype testing of the sealed source, be leak tested and found leak-free after each of the tests in par. (b).
- (b) A sealed source used in an irradiator shall be subjected to all of the following tests prior to use:
1. 'Temperature.' The test source shall be held at -40°C for 20 minutes, 600°C for one hour, and then be immediately subjected to thermal shock test with a temperature drop from 600°C to 20°C within 15 seconds.
 2. 'Pressure.' The test source shall be twice subjected for at least 5 minutes to an absolute external pressure of 2 million newtons per square meter.
 3. 'Impact.' A 2 kilogram steel weight, 2.5 centimeters in diameter, shall be dropped from a height of one meter on to the test source.
 4. 'Vibration.' The test source shall be subjected 3 times for 10 minutes each to vibrations sweeping from 25 hertz to 500 hertz with a peak amplitude of 5 times the acceleration of gravity. In addition, each test source shall be vibrated for 30 minutes at each resonant frequency found.
 5. 'Puncture.' A 50 gram weight and pin, 0.3 centimeter pin diameter, shall be dropped from a height of one meter on to the test source.
 6. 'Bend.' If the length of the source is more than 15 times larger than the minimum cross-sectional dimension, the test source shall be subjected to a force of 2000 newtons at its center equidistant from 2 support cylinders, the distance between which is 10 times the minimum cross-sectional dimension of the source.

(2) ACCESS CONTROL. (a) Each entrance to a radiation room at a panoramic irradiator shall have a door or other physical barrier to prevent inadvertent entry of personnel when the sources are not in the shielded position. Product conveyor systems may serve as barriers as long as they reliably and consistently function as a barrier. It shall be impossible to move the sources out of their shielded position if the door or barrier is open. Opening the door or barrier while the sources are exposed shall cause the sources to return promptly to the shielded position. The personnel entrance door or barrier shall have a lock that is operated by the same key used to move the sources. The control panel lock shall be designed so that the key cannot be removed unless the sources have been returned to the shielded position. The doors and barriers may not prevent any person in the radiation room from leaving.

(b) Each entrance to a radiation room at a panoramic irradiator shall have an independent backup access control to detect personnel entry while the sources are exposed. Detection of entry while the sources are exposed shall cause the sources to return to their fully shielded position and shall activate a visible and audible alarm to make the person entering the room aware of the hazard. The alarm shall also alert at least one other person who is on-site of the entry. The person alerted shall be trained on how to respond to the alarm and prepared to promptly render or summon assistance.

(c) A radiation monitor shall be provided to detect the presence of high radiation levels in the radiation room of a panoramic irradiator before personnel entry. The monitor shall be integrated with personnel access door locks to prevent room access when radiation levels are high. Attempted personnel entry while the monitor measures high radiation levels shall activate the alarm described in par. (b). The monitor may be located in the entrance, normally referred to as the maze, but not in the direct radiation beam.

(d) Before the sources move from their shielded position in a panoramic irradiator, the source control shall automatically activate conspicuous visible and audible alarms to alert people in the radiation room that the sources will be moved from their shielded position. The alarms shall give persons enough time to leave the room before the sources leave the shielded position.

(e) Each radiation room of a panoramic irradiator shall have a clearly visible and readily accessible control that allows a person in the room to make the sources return to their fully shielded position.

(f) Each radiation room of a panoramic irradiator shall contain a control that prevents the sources from moving from the shielded position unless the control has been activated and the door or barrier to the radiation room has been closed within a preset time after activation of the control.

(g) Each entrance to the radiation room of a panoramic irradiator and each entrance to the area within the personnel access barrier of an underwater irradiator shall have a sign bearing the radiation symbol and the words, "Caution (or danger), radioactive material." A panoramic irradiator shall have a sign stating "Grave (or Extreme) danger, very high radiation area," but the sign may be removed, covered or otherwise made inoperative when the sources are fully shielded.

(h) If the radiation room of a panoramic irradiator has roof plugs or movable shielding, no person may operate the irradiator unless the shielding is in its proper location. The requirement may be met by interlocks that prevent operation if shielding is not placed properly or by an operating procedure requiring inspection of shielding before operating.

(i) An underwater irradiator shall have a personnel access barrier around the pool that shall be locked to prevent access when the irradiator is not attended. Only operators or facility management may have access to keys that operate the personnel access barrier. There shall be an intrusion alarm to detect unauthorized entry when the personnel access barrier is locked. Activation of the intrusion alarm shall alert a person who is not necessarily on-site but who is prepared to respond or summon assistance.

(3) SHIELDING. (a) The radiation dose rate in areas that are normally occupied during operation of a panoramic irradiator may not exceed 0.02 millisievert (2 mrem) per hour at any location 30 centimeters or more from the wall of the room when the sources are exposed. The dose rate shall be averaged over an area not to exceed 100 square centimeters having no linear dimension greater than 20 centimeters. Any area where the radiation dose rate exceeds 0.02 millisievert (2 mrem) per hour shall be locked, roped off or posted.

(b) The radiation dose at 30 centimeters over the edge of the pool of a pool irradiator may not exceed 0.02 millisievert (2 mrem) per hour when the sources are in the fully shielded position.

(c) The radiation dose rate at one meter from the shield of a dry-source-storage panoramic irradiator when the source is shielded may not exceed 0.02 millisievert (2 mrem) per hour and at 5 centimeters from the shield may not exceed 0.2 millisievert (20 mrem) per hour.

(4) FIRE PROTECTION. (a) The radiation room of a panoramic irradiator shall have heat and smoke detectors. The detectors shall activate an audible alarm. The alarm shall be capable of alerting a person who is prepared to summon assistance promptly. The sources shall automatically become fully shielded if a fire is detected.

(b) The radiation room of a panoramic irradiator shall be equipped with a fire extinguishing system capable of extinguishing a fire without the entry of personnel into the room. The system for the radiation room shall have a shut-off valve to control flooding into unrestricted areas.

(5) RADIATION MONITORS. (a) An irradiator with an automatic product conveyor system shall have a radiation monitor with an audible alarm located to detect loose radioactive sources that are carried toward the product exit. If the monitor detects a source, an alarm shall sound and product conveyors shall stop automatically. The alarm shall be capable of alerting a person in the facility who is prepared to summon assistance. An underwater irradiator in which the product moves within an enclosed stationary tube is exempt from the requirements of this paragraph.

(b) An underwater irradiator that is not in a shielded radiation room shall have a radiation monitor over the pool to detect abnormal radiation levels. The monitor shall have an audible alarm and a visible indicator at entrances to the personnel access barrier around the pool. The audible alarm may have a manual shut-off. The alarm shall be capable of alerting a person who is prepared to respond promptly.

(6) CONTROL OF SOURCE MOVEMENT. (a) The mechanism that moves the sources of a panoramic irradiator shall require a key to actuate. Actuation of the mechanism shall cause an audible signal to indicate that the sources are leaving the shielded position. Only one key may be in use at any time, and only operators or facility management may possess it. The key shall be attached to a portable radiation survey meter by a chain or cable. The lock for source control shall be designed so that the key may not be removed if the sources are in an unshielded position. The door to the radiation room shall require the same key.

(b) The console of a panoramic irradiator shall have a source position indicator that indicates when the sources are in the fully shielded position, in transit and exposed.

(c) The control console of a panoramic irradiator shall have a control that promptly returns the sources to the shielded position.

(d) The function of each control for a panoramic irradiator shall be clearly marked.

(7) IRRADIATOR POOLS. (a) An irradiator pool shall be one of the following:

1. Constructed with a water-tight stainless steel liner or a liner metallurgically compatible with other components in the pool.
2. Constructed so that there is a low likelihood of substantial leakage and with a surface designed to facilitate decontamination.

(b) A licensee shall have a method to safely store the sources during repairs of the pool.

(c) An irradiator pool shall have no outlets more than 0.5 meter below the normal low water level that may allow water to drain out of the pool. Pipes that have intakes more than 0.5 meter below the normal low water level and that may act as siphons shall have siphon breakers to prevent the siphoning of pool water.

(d) A method shall be available to replenish water losses from the pool.

(e) A visible indicator shall be provided in a clearly observable location to indicate if the pool water level is below the normal low water level or above the normal high water level.

(f) An irradiator pool shall be equipped with a purification system designed to be capable of maintaining the water during normal operation at a conductivity of 20 microsiemens per centimeter or less and with a clarity so that the sources are clearly visible.

(g) A physical barrier, such as a railing or cover, shall be used around or over irradiator pools during normal operation to prevent personnel from accidentally falling into the pool. The barrier may be removed during maintenance, inspection and service operations.

(h) If long-handled tools or poles are used in an irradiator pool, the radiation dose rate to the operator at the handling areas of the tools may not exceed 0.02 millisievert (2 mrem) per hour.

(8) SOURCE RACK PROTECTION. If the product to be irradiated moves on a product conveyor system, the source rack and the mechanism that moves the rack shall be protected by a carrier or guides to prevent products and product carriers from hitting or touching the rack or mechanism.

(9) POWER FAILURES. (a) If electrical power at a panoramic irradiator is lost for longer than 10 seconds, the sources shall automatically return to the shielded position.

(b) The lock on the door of the radiation room of a panoramic irradiator shall remain locked in the event of a power failure.

(c) During a power failure, the area of any irradiator where sources are located may be entered only when using an operable and calibrated radiation survey meter.

(10) DESIGN REQUIREMENTS. An irradiator shall meet all of the following design requirements:

(a) *Shielding.* For a panoramic irradiator, a licensee shall design shielding walls to meet generally accepted building code requirements for reinforced concrete and design the walls, wall penetrations, and entranceways to meet the radiation shielding requirements of sub. (3). If the irradiator will use more than 2×10^{17} becquerels (5 million Ci) of activity, a licensee shall evaluate the effects of heating of the shielding walls by the irradiator sources.

(b) *Foundations.* For a panoramic irradiator, a licensee shall design the foundation, with consideration given to soil characteristics, to ensure that the foundation is adequate to support the weight of the facility shield walls.

(c) *Pool integrity.* For a pool irradiator, a licensee shall design the pool to ensure all of the following:

1. That the pool is leak resistant.
2. That the pool is strong enough to bear the weight of the pool water and shipping casks.
3. That a dropped shipping cask would not fall on sealed sources.
4. That all outlets or pipes meet the requirements of sub. (7).
5. That metal components are metallurgically compatible with other components in the pool.

(d) *Water handling system.* For a pool irradiator, a licensee shall verify that the design of the water purification system is adequate to meet the requirements of sub. (7) (f). The system shall be designed so that water leaking from the system does not drain to unrestricted areas without being monitored.

(e) *Radiation monitors.* For all irradiators, a licensee shall evaluate the location and sensitivity of the radiation monitor to detect sources carried by the product conveyor system as required by sub. (5) (a). A licensee shall verify that the product conveyor is designed to stop before a source on the product conveyor would cause a radiation overexposure to any person. For a pool irradiator, if the licensee uses radiation monitors to detect contamination under sub. (16) (b), the licensee shall verify that the design of radiation monitoring systems to detect pool contamination includes sensitive detectors located close to where contamination is likely to concentrate.

(f) *Source rack.* For a pool irradiator, a licensee shall verify that there are no crevices on the source or between the source and source holder that would promote corrosion on a critical area of the source. For a panoramic irradiator, a licensee shall determine that source rack drops due to loss of power will not damage the source rack and that source rack drops due to failure of cables, or alternate means of support, will not cause loss of integrity of sealed sources. For a panoramic irradiator, a licensee shall review the design of the mechanism that moves the sources to ensure that the likelihood of a stuck source is low and that, if the rack sticks, a means exists to free the rack with minimal risk to personnel.

(g) *Access control.* For a panoramic irradiator, a licensee shall verify from the design and logic diagram that the access control system meets the requirements of sub. (2).

(h) *Fire protection.* For a panoramic irradiator, a licensee shall verify that the number, locations, and spacing of the smoke and heat detectors are appropriate to detect fires and that the detectors are protected from mechanical and radiation damage. A licensee shall verify that the design of the fire extinguishing system provides the necessary discharge patterns, densities, and flow characteristics for complete coverage of the radiation room and that the system is protected from mechanical and radiation damage.

(i) *Source return.* For a panoramic irradiator, a licensee shall verify that the source rack will automatically return to the fully shielded position if power is lost for more than 10 seconds.

(j) *Seismic.* For a panoramic irradiator to be built in seismic areas where the probability of a horizontal acceleration in rock of more than 0.3 times the acceleration of gravity in 250 years is greater than 10%, a licensee shall design the reinforced concrete radiation shields to retain their integrity in the event of an earthquake by designing the irradiator to the seismic requirements of local building codes.

(k) *Wiring.* For a panoramic irradiator, a licensee shall verify that electrical wiring and electrical equipment in the radiation room are selected to minimize failures due to prolonged exposure to radiation.

(11) CONSTRUCTION MONITORING AND ACCEPTANCE TESTING. An irradiator shall meet all of the following requirements prior to loading sources:

(a) *Shielding.* For a panoramic irradiator, a licensee shall monitor the construction of the shielding to verify that its construction meets design specifications and local building code requirements for reinforced concrete.

(b) *Foundations.* For a panoramic irradiator, a licensee shall monitor the construction of the foundations to verify that their construction meets design specifications.

(c) *Pool integrity.* For a pool irradiator, a licensee shall verify that the pool meets design specifications and shall test the structural integrity of the pool and its ability to hold water. A licensee shall verify that outlets and pipes meet the requirements of sub. (7) (c).

(d) *Water handling system.* For a pool irradiator, a licensee shall verify that the water purification system, the conductivity meter, and the water level indicators operate properly.

(e) *Radiation monitors.* For all irradiators, a licensee shall verify the proper operation of the radiation monitor to detect sources carried on the product conveyor system and the related alarms and interlocks required by sub. (5) (a). For a pool irradiator, a

licensee shall verify the proper operation of the radiation monitors and the related alarm, if used, to meet sub. (16) (b). For an underwater irradiator, a licensee shall verify the proper operation of the over-the-pool monitor, alarms, and interlocks required by sub. (5) (b).

(f) *Source rack.* For a panoramic irradiator, a licensee shall test the movement of the source racks for proper operation prior to source loading. The testing shall include source rack lowering due to simulated loss of power. For all irradiators with a product conveyor system, a licensee shall observe and test the operation of the conveyor system to assure that the requirements in sub. (8) are met for protection of the source rack and the mechanism that moves the rack. The testing shall include tests of any limit switches and interlocks used to protect the source rack and mechanism that moves that rack from moving product carriers.

(g) *Access control.* For a panoramic irradiator, a licensee shall test the completed access control system to assure that the control system functions as designed and that all alarms, controls, and interlocks work properly.

(h) *Fire protection.* For a panoramic irradiator, a licensee shall test the ability of the heat and smoke detectors to detect a fire, to activate alarms, and to cause the source rack to automatically become fully shielded. A licensee shall test the operability of the fire extinguishing system.

(i) *Source return.* For a panoramic irradiator, the licensee shall demonstrate that the source racks may be returned to their fully shielded positions without power.

(j) *Computer systems.* For a panoramic irradiator that uses a computer system to control the access control system, a licensee shall verify that the access control system will operate properly if power is lost and shall verify that the computer has security features that prevent an irradiator operator from commanding the computer to override the access control system when the system is required to be operable.

(k) *Wiring.* For a panoramic irradiator, a licensee shall verify that the electrical wiring and electrical equipment that were installed meet the design specifications.

(12) TRAINING. (a) Before a person may act as an irradiator operator without a supervisor present, the person shall be instructed in all the following:

1. The fundamentals of radiation protection applied to irradiators. The fundamentals shall include the differences between external radiation and radioactive contamination, units of radiation dose, dose limits, why large radiation doses must be avoided, how shielding and access controls prevent large doses, how an irradiator is designed to prevent contamination, the proper use of survey meters and personnel dosimeters, other radiation safety features of an irradiator and the basic function of the irradiator.

2. The requirements of subch. X and this subchapter.

3. The operation of the irradiator.

4. Operating and emergency procedures listed in sub. (13) that the person is responsible for performing.

5. Case histories of accidents or problems involving irradiators.

(b) Before a person may act as an irradiator operator without a supervisor present, the person shall pass a written test on the instruction received consisting primarily of questions based on the licensee's operating and emergency procedures that the person is responsible for performing and other operations necessary to safely operate the irradiator without supervision.

(c) Before a person may act as an irradiator operator without a supervisor present, the person shall have received on-the-job training or simulator training in the use of the irradiator as described in the license application. The person shall also demonstrate the ability to perform those portions of the operating and emergency procedures that he or she is to perform.

(d) A licensee shall conduct safety reviews for irradiator operators at least annually, at intervals not to exceed 13 months. At the review, the licensee shall give each operator a written test on the information presented during annual safety training. Each safety review shall include, to the extent appropriate, all of the following:

1. Any changes in operating and emergency procedures since the last review.

2. Any changes in regulations and license conditions since the last review.

3. Any reports on recent accidents, mistakes or problems that have occurred at irradiators.

4. Results of inspections of operator safety performance.

5. Results of the facility's inspection and maintenance checks.

6. A drill to practice an emergency or abnormal event procedure.

(e) A licensee shall evaluate the safety performance of each irradiator operator at least annually, at intervals not to exceed 13 months, to ensure that regulations, license conditions and operating, safety and emergency procedures are followed. The licensee shall discuss the results of the evaluation with the operator and shall instruct the operator on how to correct any mistakes or deficiencies observed.

(f) Persons who will be permitted unescorted access to the radiation room of the irradiator or the area around the pool of an underwater irradiator, but who have not received the training required for operators and the radiation safety officer, shall be instructed and tested in any precautions they should take to avoid radiation exposure, any procedures or parts of procedures listed in sub. (13) that they are expected to perform or comply with and their proper response to alarms required in this subchapter. Tests may be oral.

(g) Persons who must be prepared to respond to alarms required by subs. (2) (b) and (i), (4) (a), (5) (a) and (b), and (16) (b) shall be trained and tested on how to respond. Each person shall be retested at least annually, at intervals not to exceed 13 months. Tests may be oral.

(13) OPERATING AND EMERGENCY PROCEDURES. (a) A licensee shall have and follow written operating procedures for all the following:

1. Operation of the irradiator including entering and leaving the radiation room.
 2. Use of personnel dosimeters.
 3. Surveying the shielding of panoramic irradiators.
 4. Monitoring pool water for contamination while the water is in the pool and before release of pool water to unrestricted areas.
 5. Leak testing of sources.
 6. Inspection and maintenance checks required by sub. (17).
 7. Loading, unloading and repositioning sources if the operations will be performed by the licensee.
 8. Inspection of movable shielding required by sub. (2), if applicable.
- (b) A licensee shall have and follow emergency or abnormal event procedures, appropriate for the irradiator type, for all of the following situations:
1. Sources stuck in the unshielded position.
 2. Personnel overexposures.
 3. A radiation alarm from the product exit portal monitor or pool monitor.
 4. Detection of leaking sources, pool contamination or alarm caused by contamination of pool water.
 5. A low or high water level indicator, an abnormal water loss or leakage from the source storage pool.
 6. A prolonged loss of electrical power.
 7. A fire alarm or explosion in the radiation room.
 8. An alarm indicating unauthorized entry into the radiation room, area around pool or another alarmed area.
 9. Natural phenomena, including an earthquake, a tornado, flooding or other phenomena as appropriate for the geographical location of the facility.
 10. The jamming of automatic conveyor systems.
- (c) A licensee may revise operating and emergency procedures without department approval only if all of the following conditions are met:
1. The revisions do not reduce the safety of the facility.
 2. The revisions are consistent with the outline or summary of procedures submitted with the license application.
 3. The revisions have been reviewed and approved by the radiation safety officer.
 4. The users or operators are instructed and tested on the revised procedures before the procedures are implemented.
- (14) PERSONNEL MONITORING.** (a) Any irradiator operator shall wear ~~either a film badge, a thermoluminescent dosimeter or similar approved device~~ a personnel dosimeter while operating a panoramic irradiator or while in the area around the pool of an underwater irradiator. The ~~film badge or TLD processor shall be accredited by the national voluntary laboratory accreditation program for personnel dosimeter shall be capable of detecting~~ high energy photons in the normal and accident dose ranges. Each ~~film badge or TLD personnel dosimeter~~ shall be assigned to and worn by only one person. Film badges shall be ~~processed-replaced~~ at least monthly and ~~TLDs-all other personnel dosimeters that require replacement~~ shall be ~~processed-replaced~~ at least quarterly. All personnel dosimeters must be evaluated at least quarterly or promptly after replacement, whichever is more frequent.
- Note:** See s. DHS 157.25 (1) (c) for instructions concerning dosimetry processing.
- (b) A person other than an irradiator operator who enters the radiation room of a panoramic irradiator shall wear a dosimeter, which may be a pocket dosimeter. For groups of visitors, only 2 people who enter the radiation room are required to wear dosimeters.
- (c) If pocket dosimeters are used to meet the requirements of par. (b), a check of their response to radiation shall be performed at least annually, at intervals not to exceed 12 months. Acceptable dosimeters shall read within plus or minus 20% of the true radiation dose.
- (15) RADIATION SURVEYS.** (a) A radiation survey of the area outside the shielding of the radiation room of a panoramic irradiator shall be conducted with the sources in the exposed position before the facility starts to operate. A radiation survey of the area above the pool of pool irradiators shall be conducted after the sources are loaded but before the facility starts to operate. Additional radiation surveys of the shielding shall be performed at intervals not to exceed 3 years and before resuming operation after addition of new sources or any modification to the radiation room shielding or structure that might increase dose rates.
- (b) If the radiation levels specified in sub. (3) are exceeded, the facility shall be modified to comply with the requirements in sub. (3).
- (c) Portable radiation survey meters shall be calibrated at a frequency not to exceed 13 months to an accuracy of plus or minus 20% for the gamma energy of the sources in use. The calibration shall be performed at 2 points on each scale or, for digital instruments, at one point per decade over the range that will be used. Portable radiation survey meters shall be of a type that does not fail and read zero at high radiation dose rates.
- (d) Water from the irradiator pool, other potentially contaminated liquids and sediments from pool vacuuming shall be monitored for radioactive contamination before release to unrestricted areas. Radioactive concentrations may not exceed those specified in Table II, Column 2 or Table III of ch. DHS 157 Appendix E.
- (e) Before releasing resins for unrestricted use, the resins shall be monitored before release in an area with a background level less than 0.5 microsievert (0.05 mrem) per hour. The resins may be released only if the survey does not detect radiation levels above background radiation levels. The survey meter used shall be capable of detecting radiation levels of 0.5 microsievert (0.05 mrem) per hour.

(16) DETECTION OF LEAKING SOURCES. (a) Each dry-source-storage sealed source shall be tested for leakage at intervals not to exceed 6 months using a leak test kit or a method approved by the department, the NRC, another agreement state or a licensing state. In the absence of a certificate from a transferor that a test has been made within the 6 months before the transfer, the sealed source may not be used until tested. The test shall be capable of detecting the presence of 200 becquerels (0.005 μCi) of radioactive material and shall be performed by a person approved by the department, the NRC, another agreement state or a licensing state to perform the test.

(b) For a pool irradiator, sources may not be put into the pool unless a licensee tests the sources for leaks or has a certificate from a transferor that a leak test has been performed within the 6 months before the transfer. Water from the pool shall be checked for contamination each day the irradiator operates. The check may be done either by using a radiation monitor on a pool water circulating system or by analysis of a sample of pool water. If a check for contamination is performed by analysis of a sample of pool water, the results of the analysis shall be available within 24 hours. If the licensee uses a radiation monitor on a pool water circulating system, the detection of above normal radiation levels shall activate an alarm. The alarm set-point shall be set as low as practical, but high enough to avoid false alarms. A licensee may reset the alarm set-point to a higher level if necessary to operate the pool water purification system to clear up contamination in the pool if specifically provided for in written emergency procedures.

(c) If a leaking source is detected, a licensee shall arrange to remove the leaking source from service and have it decontaminated, repaired or disposed of by a department, NRC, another agreement state or a licensing state licensee authorized to perform decontamination, repair or disposal. A licensee shall promptly check its personnel, equipment, facilities and irradiated product for radioactive contamination. No product may be shipped until the product has been checked and found free of contamination. If a product has been shipped that may have been inadvertently contaminated, the licensee shall arrange to locate and survey that product for contamination. If any personnel are found to be contaminated, decontamination shall be performed immediately. If contaminated equipment, facilities or products are found, a licensee shall arrange to have the equipment, facilities or products decontaminated or disposed of by the department, the U.S. nuclear regulatory commission, another agreement state or a licensing state licensee authorized to perform decontamination or disposal. If a pool is contaminated, a licensee shall arrange to clean the pool until the contamination levels do not exceed the appropriate concentration in Table II, Column 2 of ch. DHS 157 Appendix E.

(17) INSPECTION AND MAINTENANCE. (a) A licensee shall perform inspection and maintenance checks that include each of the following at the frequency specified in the license or license application:

1. Operability of each aspect of the access control system required by sub. (2).
2. Functioning of the source position indicator required by sub. (6) (b).
3. Operability of the radiation monitor for radioactive contamination in pool water required by sub. (16) (b) using a radiation check source, if applicable.
4. Operability of the over-pool radiation monitor at underwater irradiators as required by sub. (5) (b).
5. Operability of the product exit monitor required by sub. (5) (a).
6. Operability of the emergency source return control required by sub. (6) (c).
7. Visual inspection of leak-tightness of systems through which pool water circulates.
8. Operability of the heat and smoke detectors and extinguisher system required by sub. (4), without turning extinguishers on.
9. Operability of the means of pool water replenishment required by sub. (7) (d).
10. Operability of the indicators of high and low pool water levels required by sub. (7) (e).
11. Operability of the intrusion alarm required by sub. (2) (i), if applicable.
12. Functioning and wear of the system, mechanisms and cables used to raise and lower sources.
13. Condition of the barrier to prevent products from hitting the sources or source mechanism as required by sub. (8).
14. Amount of water added to the pool to determine if the pool is leaking.
15. Electrical wiring on required safety systems for radiation damage.
16. Pool water conductivity measurements and analysis as required by sub. (18) (b).

(b) Malfunctions and defects found during inspection and maintenance checks shall be repaired within time frames specified in the license or license application.

(18) POOL WATER PURITY. (a) A pool water purification system shall maintain the conductivity of the pool water below 20 microsiemens per centimeter under normal circumstances. If pool water conductivity rises above 20 microsiemens per centimeter, a licensee shall take prompt actions to lower the pool water conductivity and shall take corrective actions to prevent future recurrences.

(b) A licensee shall measure the pool water conductivity frequently enough, but no less than weekly, to assure that the conductivity remains below 20 microsiemens per centimeter. Conductivity meters must be calibrated at least annually, at intervals not to exceed 12 months.

(19) ATTENDANCE DURING OPERATION. (a) Both an irradiator operator and at least one other person who is trained on how to respond and prepared to promptly render or summon assistance if the access control alarm sounds shall be present on site during any of the following times:

1. Whenever the irradiator is operated using an automatic product conveyor system.
2. Whenever the product is moved into or out of the radiation room when the irradiator is operated in a batch mode.

(b) A person who has received the training on how to respond to alarms described in sub. (12) (g) shall be on site at a panoramic irradiator at which product is exposed to radiation with no movement of the product.

(c) At an underwater irradiator, an irradiator operator shall be present at the facility whenever the product is moved into or out of the pool. Persons who move the product into or out of the pool of an underwater irradiator need not be qualified as irradiator operators, but shall have received the training described in sub. (12) (f) and (g). Static irradiations may be performed without a person present at the facility.

(20) ENTERING AND LEAVING THE RADIATION ROOM. (a) Upon first entering the radiation room of a panoramic irradiator after an irradiation, the irradiator operator shall use a survey meter to determine that the source has returned to its fully shielded position. The operator shall check the functioning of the survey meter with a radiation check source prior to entry.

(b) Before exiting from and locking the door to the radiation room of a panoramic irradiator prior to a planned irradiation, the irradiator operator shall do all the following:

1. Visually inspect the entire radiation room to verify that no one else is in it.
2. Activate a control in the radiation room that permits the sources to be moved from the shielded position only if the door to the radiation room is locked within a preset time after setting the control.

(c) During a power failure, the area around the pool of an underwater irradiator may not be entered without using an operable and calibrated radiation survey meter unless the over-the-pool monitor required by sub. (5) (b) is operating with backup power.

(21) IRRADIATION OF EXPLOSIVE OR FLAMMABLE MATERIALS. (a) Irradiation of explosive material is prohibited unless a licensee has received prior written authorization from the department. Authorization may not be granted unless a licensee demonstrates that detonation of the explosive would not rupture the sealed sources, injure personnel, damage safety systems or cause radiation overexposures of personnel.

(b) Irradiation of more than small quantities of flammable material with a flash point below 140°F is prohibited in panoramic irradiators unless a licensee has received prior written authorization from the department. Authorization may not be granted unless a licensee demonstrates that a fire in the radiation room could be controlled without damage to sealed sources or safety systems and without radiation overexposures of personnel.

(22) RECORDS AND RETENTION PERIODS. A licensee shall maintain all the following records at the irradiator for the periods specified:

(a) A copy of the license, the license conditions, documents incorporated into the license by reference and amendments thereto until superseded by new documents or until the department terminates the license for documents not superseded.

(b) Records of each individual's training, tests and safety reviews provided to meet the requirements of sub. (12) (a) to (d), (f) and (g) until 3 years after the person terminates work.

(c) Records of the annual evaluations of the safety performance of irradiator operators required by sub. (12) (e) for 3 years after the evaluation.

(d) A copy of the current operating and emergency procedures required by sub. (13) until superseded or until the department terminates the license. Records of the radiation safety officer's review and approval of changes in procedures as required by sub. (13) (c) 3. shall be retained for 3 years from the date of the change.

(e) Dosimetry results required by sub. (14) (a) and (b) until the department terminates the license.

(f) Records of radiation surveys required by sub. (15) for 3 years from the survey date.

(g) Records of radiation survey meter calibrations required by sub. (15) and pool water conductivity meter calibrations required by sub. (18) (b) until 3 years from the calibration date.

(h) Records of the results of leak tests required by sub. (16) (a) and the results of contamination checks required by sub. (16) (b) for 3 years from the date of each test.

(i) Records of inspection and maintenance checks required by sub. (17) for 3 years.

(j) Records of major malfunctions, significant defects, operating difficulties or irregularities, and major operating problems that involve required radiation safety equipment for 3 years after repairs are completed.

(k) Records of the receipt, transfer and disposal of all licensed sealed sources as required by s. DHS 157.13 (15) and (18).

(L) Records on the design checks required by sub. (10) and the construction control checks as required by sub. (11) until the license is terminated. The records shall be signed and dated. The title or qualification of the person signing shall be included.

(m) Records related to decommissioning of the irradiator as required by s. DHS 157.15 (7).

(23) REPORTS. (a) In addition to the reporting requirements in other parts of this chapter, a licensee shall report to the department all of the following events:

1. Source stuck in an unshielded position.
2. Any fire or explosion in a radiation room.
3. Damage to the source racks.
4. Failure of the cable or drive mechanism used to move the source racks.
5. Inoperability of the access control system.
6. Detection of radiation source by the product exit monitor.
7. Detection of radioactive contamination attributable to licensed radioactive material.
8. Structural damage to the pool liner or walls.

9. Water loss or leakage from the source storage pool, greater than the irradiator pool design parameters submitted by the licensee or applicant.

10. Pool water conductivity exceeding 100 microsiemens per centimeter.

(b) For any event in par. (a), a licensee shall provide a telephone report within 24 hours that meets the requirements of s. DHS 157.32 (2) and a written report within 30 days that meets the requirements of s. DHS 157.32 (3).

History: CR 01-108: cr. Register July 2002 No. 559, eff. — see Note at the start of the chapter; CR 06-021: am. (15) (c), (22) (k) and (m) Register October 2006 No. 610, eff. 11-1-06; **correction in (15) (d), (16) (c) made under s. 35.17, Stats., Register January 2018 No. 745.**