

Laboratory-wide Procedure

Response to Abnormal Radiological Situations



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1. PURPOSE

This procedure provides guidance for responding to and mitigating the effects of abnormal radiological situations. It covers initial response to abnormal radiological situations including criticality monitor alarm, continuous air monitor (CAM) alarm, radiation area monitor (RAM) alarm, stack monitor alarm, and electronic dosimeter alarm. This procedure also contains guidance for responding to radiological spills, radiological casualties, radiological fires, and personnel and/or equipment off-site suspected radiological contamination.

2. APPLICABILITY

This procedure applies to individuals that may be involved in an abnormal radiological event, Radiological Control personnel who respond to abnormal events and those individuals who provide re-entry and recovery actions during the event. It also applies to Line Management and outlines their responsibilities in the event of an abnormal radiological situation. Response to a PCM alarm is outlined in LWP-15010, "Personnel Radiological Survey".

3. ALL EMPLOYEE KEY ACTIONS

Key Actions	Section	Tools
Activating Emergency Response Organizations	Step 4.1	NA
Responding to an Accidental Criticality	Step 4.2	NA
Responding to a CAM Alarm	Step 4.3	NA
Responding to a RAM Alarm	Step 4.4	NA
Responding to a Suspected Intake	Step 4.5	NA
Responding to a Stack Monitor	Step 4.6	NA
Responding to an Electronic Dosimeter Integrated Dose Alarm	Step 4.7	NA
Responding to a Electronic Dosimeter Dose Rate Alarm	Step 4.8	NA
Responding to an Electronic Dose Rate Failure and/or Undetermined Alarm	Step 4.9	NA
Responding to Radiological Spills	Step 4.10	NA
Responding to Radiological Casualty	Step 4.11	NA
Responding to Fires	Step 4.12	NA
Responding to Personnel and/or Equipment Off-Site Suspected of Being Radiologically Contaminated	Step 4.13	NA

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4. INSTRUCTIONS

NOTE: *Surveys in facilities that contain tritium or transuranic isotopes may require survey techniques that are specifically adapted to those isotopes.*

4.1 Activating Emergency Response Organizations

- 4.1.1 Affected Personnel: Activate facility emergency response organizations or Emergency Operations Center (EOC) by contacting the Warning Communications Center (WCC) at 526-1515 when an event with serious consequences is identified.
- 4.1.2 Facility Management: Control ventilation systems, valves, controls, and switches in the event of an emergency.
- 4.1.3 Exercise caution to ensure that Technical Specifications, Operational Safety Requirements, or other operational procedures are not violated if the following are changed:
- Ventilation systems
 - Equipment such as valves, controls, and switches.
- 4.1.4 Ensure provisions are in place to accommodate rapid radiological area access by onsite and offsite emergency workers such as firefighters, medical personnel, and security personnel.
- 4.1.5 Emergency Response Personnel from onsite and offsite locations: Understand that you may be required to work in radiological areas.
- 4.1.6 Emergency Response Management: Prior to responding to an event, train and brief each individual who will be authorized to perform emergency actions in the known or anticipated hazards to which the individual will be subjected; response is likely to result in occupational doses exceeding limits established in LRD-15001, "INL Radiological Control Manual," (Table 2-1) and 10 CFR 835.1302(d).
- 4.1.6.1 Develop response training on DOE radiological worker core course and site-specific training materials.
- 4.1.6.2 If such workers are not trained, trained escorts will be assigned.

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4.1.6.3 Confirm that lifesaving has priority over radiological controls.

4.1.6.4 Maintain training records.

4.1.7 Ensure each individual authorized to perform emergency actions likely to result from a radiological occurrence shall receive counseling and risk communication per MCP-1, "Radiation Risk Counseling and Special Dose Control Level," as applicable.

4.2 Responding to Accidental Criticality

NOTE: *Some personnel protective equipment (PPE), such as airline respiratory equipment, must be partially doffed in order to evacuate an area. The amount of PPE removed should be minimized to reduce the time in the area and reduce any radiation dose to as low as reasonably achievable (ALARA).*

4.2.1 Affected Personnel: Immediately evacuate the area, without stopping to remove protective clothing or perform exit monitoring.

4.2.2 Report to designated assembly area.

4.2.3 Radiological Control Personnel: Provide on-scene support for an accidental criticality to screen personnel for possible exposure to high neutron fluxes.

4.2.4 Initiate Form 441.86, "Accidental Criticality Personnel Information Form," utilizing the checklist for actions to take. Document applicable information as each subsequent steps/sections is completed.

4.2.5 Segregate personnel wearing PPE from others.

4.2.6 Survey and sort individuals by completing the following steps:

NOTE: *The method can give inaccurate results when the subject is contaminated with radioactivity. The induced activity may mimic contamination, but the activation readings will not be significantly reduced on a closed window reading whereas the contamination readings will be reduced.*

4.2.6.1 Obtain exposure rates in mR/hr due to activation of the body by positioning the probe of a closed side-window Geiger Mueller (GM)-type portable radiation survey instrument under the arm and flat against the side of the chest.

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NOTE: *Some optically stimulated luminescent (OSL) dosimeters used at the INL have a CR-39 element. The CR-39 element has the capability to measure neutron dose, but it does not become activated in the event of a criticality. The personal nuclear accident dosimeter (PNAD) is a separate dosimeter that will become activated in the event of a criticality.*

4.2.6.2 Use the same GM-type portable radiation survey instrument to measure the closed window exposure rate from the PNAD. Align the probe lengthwise, and in contact with the PNAD, covering both sets of activation foils.

4.2.6.3 If the PNAD reading for any individual exceeds 0.2 mR/hr above background or whose body reads more than 0.05 mR/hr above background, collect the PNAD and OSL, bag, label, and send for processing. Restrict individual from further radiation work until PNAD and OSL readout is completed.

NOTE 1: *PNADs are not issued or tracked for anyone individual; therefore, it is vital the PNAD and OSL are not separated.*

NOTE 2: *Ensure personnel are properly badged to re-enter the affected area.*

4.2.6.4 If an individual's PNAD and body read less than the values in Step 4.2.6.3, collect the PNAD and OSL, bag, label, then send for processing. Do not restrict individual from radiation work.

4.2.6.5 If a PNAD reading for any individual exceeds 2 mR/hr above background or the body reading exceeds 0.5 mR/hr above background, collect PNAD and OSL, bag, label, and send for processing. Send individual to the medical dispensary for possible blood and hair sampling and notify the Warning Communications Center (WCC).

4.2.6.6 Restrict individual from further radiation work until PNAD and OSL reading is completed.

4.2.6.7 Record as much detail about the event as possible (location of event, position of personnel during exposure, length of exposure, and time of event) on Form 441.86.

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- 4.2.6.8 Provide a copy of Form 441.86 with the information recorded during the screening of personnel to the Health Physics Dosimetry Laboratory (HPDL) by FAX at 526-7020. Include copies of any additional information noted or requested. Provide copy to emergency response and management personnel as needed.

NOTE: *For information, the following can be used to perform a quick field dose measurement.*

- 4.2.7 Use the data received from the incident scene on Form 441.86 to estimate the neutron dose by using the relationship:

$$PD = 8000 D/W$$

where

PD = Neutron dose in rads estimated from body activation

D = Exposure rate of the person in mR/hr after subtracting background

W = Body weight in pounds

NOTE: *The PNAD and OSLs will be radioactive and may also be contaminated.*

- 4.2.8 Transport PNADs and OSLs for processing by completing the following steps:

- 4.2.8.1 Do not attempt any decontamination or disassembly of the PNADs or OSLs. Code numbers or other labels do not identify the PNAD assembly and its parts so individual components could be misidentified or lost if the PNAD or OSL is disassembled.

NOTE: *PNADs are not issued or tracked for any one individual; therefore, it is vital the PNAD and OSL are not separated.*

- 4.2.8.2 Package PNAD and OSL using one bag for each affected individual. Seal and label the bag as radioactive material; prepare it for transportation as appropriate.

- 4.2.8.3 Ship bag with the PNADs and OSLs and a copy of Form 441.86 with the information recorded during the screening of personnel.

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NOTE: *PNAD disassembly and analyses will normally occur at a facility designated by Radiological Control Management.*

4.2.8.4 Send the intact PNADs and OSLs to the analysis location as soon as possible.

4.2.8.5 Reentry and recovery actions will be per PLN-114, "INL Emergency Plan/RCRA Contingency Plan."

4.2.9 HPT/RCT: Complete Form 441.45, "Radiological Survey Report," and Form 441.56, "Radcon Daily Log Sheet," or electronic equivalents; documenting actions taken and survey results.

4.3 Responding to CAM Alarm

NOTE: *Airborne radioactivity (see def.) may be caused by a breach in a system, or resuspension of particulate radioactivity due to work evolutions such as welding, grinding, or other heavy-duty work. Indications that an airborne radioactivity event is occurring include CAM alarms, air samples exceeding limits, and increasing radiation levels.*

4.3.1 General

4.3.1.1 Emergency Response Personnel: Some CAM alarms initiate building evacuation alarms. Respond in accordance with the specific facility evacuation emergency procedure in those cases.

4.3.1.2 Consider the CAM alarm and indications until actual verifications are made otherwise. Where a positive determination of equipment malfunction can be made remotely, air sampling and other follow-up activities to characterize the affected area do not need to be performed.

4.3.1.3 Arrange the supplemental actions in a logical sequence assuming the alarm is caused by a radiological event. Some actions during reentry are performed simultaneously, and the applicability of subsequent actions is determined as data becomes available. If for instance, initial assessment determines the instrument has malfunctioned, air sampling and radiation surveys may not be required. Likewise, if high radiation levels exist at the CAM and air samples are normal, there may be no need to remove the CAM filter.

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4.3.1.4 HPT/RCT: To document a radiological event, remove the portion of the recorder chart that contains radiological data of significance as directed by the responsible Radiological Control Management and with facility management permission. The removed section of the chart may be copied for placement in the logbook or for storage with the routine survey maps and check sheets. Information describing and detailing the event should accompany the chart section. The original portion of the chart should be replaced back into the chart recorder.

4.3.1.5 Because removal of the CAM filter will interrupt the ability to track or trend a release that is still in progress, therefore chart recorders or electronic history files should be used to obtain air activity information. Continue grab sampling until the event has stabilized or is on a downward trend, then remove the filter as appropriate for analysis or to clear the alarm condition.

4.3.2 Initial Response

4.3.2.1 Affected Personnel: Stop work activities, and if safe to do so, place the area in a safe condition (e.g., secure welding equipment and terminate activities that may result in more severe conditions).

4.3.2.2 Evacuate to an area physically isolated from the affected area, such as an adjacent room, stairwell, immediately outside the building, or to an area up-wind from the source. Otherwise, relocate to an area of lower airborne radioactivity concentrations as designated by Radiological Control personnel.

4.3.2.3 Notify Radiological Control personnel and facility management.

4.3.2.4 Facility Operations: Secure unfiltered ventilation to help control the spread of airborne radioactivity, if applicable.

4.3.2.5 Affected Personnel: Remain in the area adjacent to, but isolated from the affected area, until released by Radiological Control. Notify Radiological Control personnel if any personal contamination monitors were bypassed during the evacuation so that a whole body survey may be performed.

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4.3.3 Supplemental Actions

4.3.3.1 HPT/RCT: Evaluate radiological conditions remotely prior to reentry for on site characterization. One or more of the following may assist in determination of area conditions:

- Check remote readouts such as computer consoles, charts, or remote meters. (A malfunctioning CAM will normally show as a single spike, followed by a return to normal levels or to zero. High radiation will show as a sudden increase that will be sustained at a higher level, or in the case of a transient field, return to normal levels.)
- Check maintenance and tag out logs to determine if maintenance is being performed on the affected instrument or if electronic interference adjacent to the area (such as welding) could be the cause of the alarm.
- Check other instruments in the same area such as RAMs or additional CAMs to see if levels are rising or if there is an alarm condition present on these instruments.

4.3.3.2 Based on an evaluation of the radiological conditions, don respiratory protection and protective clothing; perform applicable supplementary actions below.

- 4.3.3.2.1 Where the CAM has exceeded the alarm set point, take a representative air sample to determine the derived air concentration (DAC) and institute appropriate radiological controls. Acknowledge alarms as appropriate to silence the audible alarm.
- 4.3.3.2.2 Perform a radiation survey near the CAM detector to determine if an external source of radiation is affecting the detector. If radiation levels are high at the detector, initiate procedures to isolate and control the source of radiation affecting the detector.
- 4.3.3.2.3 Follow up with additional air samples to ensure that 0.3 DAC is not exceeded.

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- 4.3.3.2.4 Inspect CAM(s) for electrical malfunction. If the inspection indicates an electrical malfunction, take the CAM out of service and request repairs as applicable.
- 4.3.3.3 If needed to characterize the event, remove the CAM filter and count it as follows:
- 4.3.3.3.1 Perform an initial count of the filter.
- NOTE:** *As a rule of thumb, the presence of naturally occurring radioactive material (NORM) is usually indicated by a beta-gamma to alpha ratio of 1:1 to 5:1 when corrected for instrument efficiency, with a half-life of approximately 50 minutes or less.*
- 4.3.3.4 Count it again in about 30 minutes to evaluate for naturally occurring radioactive material (NORM) and to determine the DAC.
- 4.3.3.5 Consult facility-specific technical basis documents for information that may differ from the general thumb rule.
- 4.3.3.6 Perform a half-life calculation to determine if the activity of the sample is decaying at a rate that indicates the presence of NORM using the following formula:
- $$T_{1/2} = (-0.693 (t))/\ln(A/A_0)$$
- where
- t = time elapsed since the initial count
(units match $T_{1/2}$)
- A = Activity from the recount
- A_0 = Activity from initial count
- 4.3.3.7 Document count data on Form 441.48, "Airborne Survey Results."
- 4.3.3.8 Save the filter for further analysis if applicable.
- 4.3.3.9 If the alarm was not caused by naturally occurring radioactivity, take additional air samples to determine the airborne radioactivity boundary.

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- 4.3.3.10 Bag and label filters, then submit to analytical laboratory for analysis.
- 4.3.3.11 Identify radionuclide(s) to help determine the problem source.
- 4.3.3.12 Consider use of additional ventilation to minimize personnel exposure and reduce the need for respiratory equipment. High efficiency particulate air (HEPA) filtered ventilation should be used.
- 4.3.3.13 Obtain facility management and Radiological Engineer approval prior to using additional ventilation.
- 4.3.3.14 Measure the removable contamination on horizontal surfaces to determine if levels have increased and as necessary control surface contamination to minimize the spread of contamination.
- 4.3.3.15 Survey exhaust systems, ventilation filters, and ducts, as applicable.
- 4.3.3.16 Evaluate the potential for internal exposure and contact the area internal dosimetry coordinator for proper internal dosimetry protocol.
- 4.3.3.17 If internal uptake is suspected, perform nasal swabs as outlined in MCP-148, "Personnel Decontamination," document results on Form 441.02, "Personnel Contamination Record," and submit to facility Radiological Engineer.
- 4.3.3.18 If an intake is suspected, proceed to Section 4.5 to perform necessary actions to aid in internal dose assessment.
- 4.3.3.19 Radiological Control Engineer: Evaluate need for bioassay.
- 4.3.3.20 HPT/RCT: Take air samples, once operations resume, verifying the cause of the airborne release has been corrected.
- 4.3.3.21 Complete Form 441.45 and Form 441.56, or electronic equivalents; document actions taken and survey results.

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4.4 Responding to a RAM Alarm

NOTE: *Some RAM alarms initiate building evacuation alarms. Personnel should respond in accordance with the specific facility evacuation emergency procedure in those cases.*

- 4.4.1 Affected Personnel: Stop work activities and place the area in a safe condition (e.g., secure welding equipment and terminate activities that may result in more severe conditions).
- 4.4.2 Alert others.
- 4.4.3 Exit the area.
- 4.4.4 When exiting the area, attempt to exit to a location isolated from the source of the radiation, such as a shield wall, an adjacent room, or to outside the affected facility. Otherwise, exit to an area of lower radiation levels designated by Radiological Control personnel.
- 4.4.5 Notify Radiological Control personnel and facility management.
- 4.4.6 Remain in the area adjacent to, but isolated from the affected area, until released by Radiological Control. Notify Radiological Control personnel if any personal contamination monitors were bypassed during the evacuation so that a whole body survey may be performed.
- 4.4.7 Radiological Control Organization: Maintain control of the event by verifying that alarms are not false.
- 4.4.8 Perform radiation surveys to determine the extent and magnitude of the situation and to calculate dose and stay times (if personnel are to work in the area).
- 4.4.9 Ensure radiation boundaries are established, posted, and verified.
- 4.4.10 Check for loss of shielding integrity.
- 4.4.11 Determine, to the extent practicable, the radiation source and take corrective actions to reduce radiation fields.
- 4.4.12 Check radiation levels in adjacent areas to ensure personnel are not exposed to abnormal radiation fields.

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4.4.13 As applicable, estimate exposure of unbadged personnel, complete Form 441.04A, "Personnel Exposure Questionnaire," and route dosimeters to HPDL for readout.

4.4.14 HPT/RCT: Complete Form 441.45 and Form 441.56, or electronic equivalents; document actions taken and survey results.

4.5 Responding to Suspected Intake

NOTE 1: *Accidental radionuclide intake (see def.) by an individual may result in treatment of the individual by medical personnel.*

NOTE 2: *The decision to administer treatment is solely the responsibility of Occupational Medical physician in charge. HPDL personnel and Radiological Control Management provide advice on dose consequence or performing or not performing treatment.*

4.5.1 Radiological Control Management/Radiological Engineer: If an individual is sent to medical, as soon as possible following the event, provide Occupational Medical physician with the following information:

- Radiological inventory of facility where individual received potential intake.
- Chemical form of radioactive material(s)
- Absorption type (e.g., F, M, or S)
- Physical properties of the radioactive materials present.

4.5.2 Provide any other additional information such as nose swab results, surface contamination results, skin contamination levels, preliminary air monitoring results or any other pertinent information to aid in determining if possible early medical intervention is required in an internal contamination event.

NOTE: *Direct measurements can be useful when the radionuclide or its daughter emits gamma or x-rays that have a detectable energy level. GM survey instruments can be useful to initially screen and confirm intake to lungs, GI tract, systemic organs, and contaminated wounds.*

4.5.3 HPT/RCT: If possible, perform direct measurements of individual who had the suspected intake.

4.5.4 HPDL Personnel: Determine bioassay requirements for individual suspected of a potential intake.

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- 4.5.5 Radiological Control Personnel: Restrict individual(s) suspected of an intake in Access Control in order to prevent a second uptake or additional exposure during the course of the investigation.
- 4.5.6 HPDL Personnel: Perform calculations to estimate dose received by the individual, as outlined in TEV-500, "Internal Dosimetry".
- 4.5.7 Provide individual(s) with *dose assessment* (see def) results as outlined in TEV-500.
- 4.5.8 HPT/RCT: Document all survey results and pertinent information on Form 441.56 or electronic equivalent.

4.6 Responding to a Stack Monitor Alarm

NOTE: *This section is provided for response to stack monitor alarms in facilities that do not have a stack monitor response procedure. If a facility has a procedure, then that stack monitor response procedure should be followed.*

- 4.6.1 Operations: Upon annunciation of a stack monitor alarm, immediately notify facility management (or representative) and responsible Radiological Control manager.
- 4.6.2 HPT/RCT: Observe the remote readout in the facility control room to verify the alarm indication and evaluate other facility radiation monitors.
- 4.6.3 As applicable, proceed to the alarming unit. Observe the count-rate meters and recorder charts of the channel(s) in alarm status. Determine if the count rate meter indicates a single spike or continuing release.
- 4.6.4 If the gaseous channel alarms, request/obtain a grab sample of the effluent if sampling equipment is available.

NOTE: *Follow applicable facility procedures for pulling stack samples and chain of custody, as applicable.*

- 4.6.5 If a particulate channel indicates that a release above the alarm point may have occurred but the increase has leveled off:
- 4.6.5.1 Pull filters for counting and analysis if authorized by facility management. Use applicable technical procedures to pull filters for analysis when applicable.
- 4.6.5.2 Survey the filter with a portable instrument upon removal.

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- 4.6.5.3 Count the filter in a scaler and determine the first count ratio. If NORM ratios are not apparent or if there are unusually high counts, have the filter analyzed to identify the isotopes.
- 4.6.5.4 Record results on Form 441.48.
- 4.6.5.5 Save the filters for the end of month release calculation, if applicable.
- 4.6.6 If activity levels on the channel are still increasing, notify the responsible Radiological Control Management and facility management so that mitigating actions may be taken, if required.
- 4.6.6.1 If the channel is reading within the normal background range and the chart indicates a spike or short-term release, reset the monitor alarm as directed by facility management. Do not change the filter unless directed by the responsible Radiological Control Management or facility management.
- 4.6.7 Provide the following release information to the responsible Radiological Control Management and Facility Management:
- Type of release (which channel)
 - Time and duration of release
 - Maximum and average counts per minute or $\mu\text{Ci/ml}$ during the release
 - Results of filter count data (if applicable).
- 4.6.8 HPT/RCT: Complete Form 441.56, or electronic equivalent, documenting actions taken and survey results.
- 4.7 Responding to an Electronic Dosimeter Integrated Dose Alarm**
- 4.7.1 Affected Personnel: If the electronic dosimeter alarms, observe the digital readout and complete the following steps if a “DOSE” alarm is indicated.
- 4.7.1.1 Stop work activities and place the area in a safe condition.
- 4.7.1.2 Alert other workers in the area.
- 4.7.1.3 Exit the area and notify Radiological Control personnel.

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4.7.2 Radiological Control: Evaluate the cause of the electronic dosimeter integrated dose alarm and have the worker dosimeter(s) processed if needed.

4.7.3 Document any evaluations on Form 441.56, or equivalent, or Form 441.A81, "Radiological Control Evaluation Form."

4.8 Responding to an Electronic Dosimeter Dose Rate Alarm

4.8.1 Affected Personnel: If the electronic dosimeter alarms, observe the digital readout.

4.8.2 If a "RATE" alarm is indicated but was not anticipated and discussed with Radiological Control, then move to an area of lower radiation level until the dose rate alarm stops.

4.8.3 Alert other workers in the area.

4.8.4 If the HPT/RCT is not present, exit the area.

4.8.5 Follow any direction given by the HPT/RCT, which may include continuing work with a "Dose Rate" alarm, but will not allow work to proceed if a "Limiting Condition" or a "Dose Alarm" is met or exceeded.

4.8.6 HPT/RCT: Document findings and evaluations on Form 441.56, or electronic equivalent, or Form 441.A81.

4.9 Responding to an Electronic Dosimeter Failure and /or Undetermined Alarm

4.9.1 Affected Personnel: If the electronic dosimeter alarms, observe the digital readout.

4.9.2 If the cause of the alarm cannot be determined or if a "FAILURE MODE" is indicated, then perform the following:

4.9.2.1 Stop work activities and place the area in a safe condition.

4.9.2.2 Alert other workers in the area.

4.9.2.3 Exit the area and notify Radiological Control personnel.

4.9.3 Radiological Control: Evaluate the cause of the electronic dosimeter alarm/failure if possible and pull the workers dosimeter if needed.

4.9.4 Document evaluation on Form 441.56, or electronic equivalent, or Form 441.A81.

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4.10 Responding to Radiological Spills

NOTE 1: *Indications that a radiological spill has occurred include contaminated personnel at a control point, abnormal contamination levels within a contamination area, and CAM alarms.*

NOTE 2: *As a general rule, use of the “SWIMS” philosophy (stop, warn, isolate, minimize, shut off) for initial response actions in the event of a radiological spill will help control the situation.*

4.10.1 Initial Response

- 4.10.1.1 Affected Personnel: When spills may contain highly toxic chemicals, transuranic materials or mixed waste, immediately exit the area without attempting to stop or secure the spill and notify facility management, industrial hygiene, hazardous material operations, and radiological control personnel.
- 4.10.1.2 Radiological Workers: Control radiological spills with assistance from HPT/RCT.
- 4.10.1.3 Keep personnel away from the spill until trained personnel with appropriate PPE for the hazards expected arrive to stop the spill, unless the source of the spill is known and the spill can be safely stopped by the first responder.
- 4.10.1.4 Try to set any overturned containers upright, if applicable. When the spill or event is from a system or in a work area, ask cognizant personnel if it is feasible to close applicable valves, controls, and switches.
- 4.10.1.5 Warn personnel in the vicinity of the spill or others who may arrive to help control the spill.
- 4.10.1.6 Isolate the area by closing doors, roping off, and guarding the area to keep personnel away from the spill.
- 4.10.1.7 Minimize individual exposure to radiation and contamination by moving to the edge of the affected area, taking care to minimize the spread of contamination (for example stepping outside the room in which a spill occurred and closing the access).
- 4.10.1.8 Stay near the boundary to maintain control unless Radiological Control advises otherwise.

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- 4.10.1.9 With facility management approval, shut off unfiltered ventilation. Filtered ventilation should also be turned off if airflow spreads contamination.
- 4.10.1.10 Ensure Facility and Radiological Control Management is notified.
- 4.10.1.11 HPT/RCT: Ensure boundaries are established, properly posted, and verified. Upgrade radiological controls as necessary.

4.10.2 Supplemental Actions

NOTE 1: *Dry radioactive spills require different cleanup techniques than wet spills. Techniques may include promptly covering the spill with damp rags and using HEPA filtered vacuum cleaners for cleanup. Large dry spills may require consultation with cognizant professionals to determine if additional actions or techniques are needed to contain the spill.*

NOTE 2: *Supplementary actions below should be tailored to the extent of the spill, hazards associated with the spill source, and the effectiveness of the steps taken in the immediate actions. If the steps taken in the immediate actions are effective in stopping the spill and result in the removal of the contamination, required recovery actions will be limited. Not all of the supplementary actions will apply to each recovery operation.*

- 4.10.2.1 Line Management/Radiological Control: Complete follow-up actions to recover from a radiological spill and to minimize potential actions that may magnify the original problem.
- 4.10.2.2 Plan recovery and cleanup using the work control process or other reentry procedures, in order to identify and mitigate hazards associated with the specific area and systems involved.
- 4.10.2.3 HPT/RCT: Complete Form 441.45 and Form 441.56, or electronic equivalents; document actions taken and survey results.

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- 4.10.2.4 If internal uptake is suspected, perform nasal swabs and document on Form 441.02.
- 4.10.2.5 If no contamination is detected on nasal swabs, contact Radiological Engineer to determine if any for further evaluation is needed (e.g., whole body count, urine sample, fecal sample, etc.).

4.11 Responding to Radiological Casualty

NOTE 1: *An injured person has priority in a casualty event, and medical response to life-threatening or serious injury situations should not be deterred or restricted by radiological control requirements.*

NOTE 2: *Casualty events occurring in contamination or high airborne radioactivity areas may require an internal dose evaluation for both injured and rescue personnel.*

4.11.1 General

- 4.11.1.1 Radiological Worker/HCT/RCT: Do not decontaminate a severely injured person without the guidance of medical personnel or the consent of the injured person.
- 4.11.1.2 Treat less severe casualties as soon as possible. Observe applicable personnel protection counter measures (such as universal precautions, labeling, and use of personal protective equipment) at all times to minimize occupational exposure to blood and other potentially infectious materials.
- 4.11.1.3 WCC: Notify EOC personnel when an event with serious consequences is identified by line managers.
- 4.11.1.4 EOC Personnel: Notify area medical facilities such as Eastern Idaho Regional Medical Center and Portneuf Medical Center to handle INL casualties when necessary.

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4.11.2 Initial Response

- 4.11.2.1 First Responder: Call 777 at the site or WCC 526-1515 to request on-scene medical assistance. Call 9-911 for emergencies in Idaho Falls.
- 4.11.2.2 Radiological Workers/HPT/RCTs: Ensure when responding to a casualty resulting from or involving high radiation exposure, that the requirements of EPI-76, "Emergency Radiation Exposure Control," are implemented and the following needs are considered:
- An immediate evacuation of the injured in a life threatening situation
 - Radiation exposure to rescuers and others in the immediate area from the source or possibly from the injured
 - The need to administer first aid prior to evacuation of the injured
- 4.11.2.3 Respond to life threatening injuries with consideration given to the items in Step 4.11.2.2 as well as the following if properly trained:
- Do not move the injured (especially those with head, neck or back injuries or with compound fractures) unless directed to do so by medical personnel
 - Control bleeding, treat for shock, and restrict movement to the extent possible.
- 4.11.2.4 HPT/RCT: Ensure the area remains controlled by setting up barriers to restrict access.
- 4.11.2.5 Perform radiation and contamination surveys to determine the extent and magnitude of the event and to calculate dose and stay times for rescue personnel.
- 4.11.2.6 Maintain ALARA exposure levels to responding personnel.
- 4.11.2.7 Radiological Control: Determine, to the extent practicable, the radiation or contamination source and take corrective actions to reduce radiation field intensity or contamination.

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- 4.11.2.8 Line Management/Radiological Control: Contact appropriate plant personnel for technical assistance if a retrieval procedure becomes necessary.
- 4.11.2.9 Responsible Person: Set up evacuation route and install barriers along the route to prevent the spread of contamination, if possible.
- 4.11.2.10 HPT/RCT: Survey the injured person for contamination. In non-life-threatening situations, consult medical personnel to determine if wounds should be decontaminated.
- 4.11.2.11 If the individual has gross contamination, wrap in a blanket or other covering to contain contamination, as directed by medically-qualified personnel.
- 4.11.2.12 If the individual has been in an area with high radiation levels, provide an estimated dose to medically-qualified personnel.
- 4.11.2.13 Line Management/Radiological Control: If potentially contaminated personnel are transported offsite, notify the receiving medical facility, WCC at 526-1515 and request an HPT/RCT to accompany the injured, or meet the injured at the medical facility.
- 4.11.2.14 Radiological Control Management: Accompany the HPT/RCT or meet the HPT/RCT at the offsite medical facility.
- 4.11.2.15 HPT/RCT: If the event occurs on a back shift, weekend, or holiday, accompany the injured person to the medical facility and ensure the facility Radiological Control Manager is contacted.
- 4.11.2.16 Take survey instruments and decontamination supplies to the medical facility to monitor and control the spread of contamination as applicable.

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4.11.3 Supplemental Actions

- 4.11.3.1 Radiological Control: Send dosimetry of those involved in the event to Health Physics Dosimetry Laboratory (HPDL) for processing.
- 4.11.3.2 Radiological Engineer: Estimate the dose of personnel involved in the event and complete Form 441.04A, as applicable.
- 4.11.3.3 Line Management/Radiological Control: Ensure response personnel and the affected area(s) are decontaminated per recovery procedure and MCP-148, "Personnel Decontamination". Maintain control of waste materials.
- 4.11.3.4 Ensure applicable reports are completed and notifications are made.
- 4.11.3.5 Contact Occupational Medical to determine bio-hazard waste disposal.
- 4.11.3.6 HPT/RCT: Complete Form 441.45 and Form 441.56, or electronic equivalents; documenting actions taken and survey results.

4.12 Responding to Fires

NOTE: *Hazards associated with a fire are usually more dangerous than those associated with only radiological hazards. Fires that contain pyrophoric materials like sodium (Na) and sodium potassium (NaK) have additional hazards.*

4.12.1 General

- 4.12.1.1 Emergency Responders: When responding to fires involving radioactivity, use caution and situational awareness so that radiological controls do not impair fire fighting effectiveness or endanger individual safety.
- 4.12.1.2 Individual Reporting a Fire: Call 777 at the site and 9-911 in Idaho Falls to report a fire.
- 4.12.1.3 Line Management/Radiological Control: Ensure response personnel are aware of shielding around containers holding radioactive materials or sealed sources that could create

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increased radiological consequences should the shielding material melt or become deformed due to the fire.

4.12.2 Initial Response

- 4.12.2.1 Affected Personnel: Evacuate the area and report to designated assembly areas. Personnel initiating any fire alarm should make themselves available to responding fire department personnel to report their observations.
- 4.12.2.2 Radiological Control: Provide support by establishing barriers, air monitoring/sampling and surveys of personnel, material, and equipment. Do not impair fire-fighting effectiveness.
- 4.12.2.3 Provide assistance to the fire response personnel by ensuring response personnel are aware of radiological conditions at the fire location.
- 4.12.2.4 Perform airborne radioactivity and contamination surveys, as required. Ensure barriers are established at locations to contain radiological hazards and that contaminated material are properly bagged and tagged.

4.12.3 Supplemental Actions

- 4.12.3.1 Line Management: Ensure proper reports and notifications are completed in a timely manner.
- 4.12.3.2 Ensure the area is cleaned up and decontaminated after the fire.

4.13 Responding to Personnel and/or Equipment Off-Site Suspected of Being Radiologically Contaminated

- 4.13.1 Line Management: Use LWP-9301, "Event Investigation and Occurrence Reporting," to determine appropriate notifications when information is received that personnel and/or equipment suspected of being radiological contamination have left the INL.
- 4.13.2 INL Facility Management: Initiate occurrence reporting as required by LWP-9301.
- 4.13.3 Radiological Control Management: Ensure INL Line Management has made notification to WCC and that there is a Region 6 Radiological Assistance Program (RAP) team leader that will accompany the INL

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HPTs/RCTs to the off-site location to conduct surveys of suspected personnel and/or equipment.

- 4.13.4 HPT/RCT: Conduct surveys of the suspected personnel and/or equipment in accordance with procedures with a RAP team leader at the scene.
- 4.13.5 When surveys indicate radioactive contamination levels are equal to or greater than those defined in Title 10 of the Code of Federal Regulations 835, "Occupational Radiation Exposure," Appendix D, "Surface Contamination Values," the response becomes a RAP response in accordance with RAP procedures.

5. RECORDS

Executed copies of:

Forms

- 441.02, "Personnel Contamination Record"
- 441.04A, "Personnel Exposure Questionnaire"
- 441.45, "Radiological Survey Report"
- 441.48, "Airborne Survey Results"
- 441.56, "Radcon Daily Log Sheet" Form 441.48 "Airborne Survey Results"
- 441.86, "Accidental Criticality Personnel Information Form"
- 441.A81, "Radiological Control Evaluation Form"
- 441.86, "Accidental Criticality Personnel Information Form"

NOTE: [LWP-1202, "Records Management,"](#) the [INL Records Schedule Matrix,](#) and associated [record types list\(s\)](#) provide current information on the retention, quality assurance, and/or destruction moratorium requirements for these records. Contact a [Records Coordinator](#) for assistance if needed.

6. DEFINITIONS

None.

7. REFERENCES

- 10 CFR 835, "Occupational Radiation Protection"
- EPI-76, "Emergency Radiation Exposure Control"

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LRD-15001, "INL Radiological Control Manual"

LWP-15010, "Personnel Radiological Survey"

LWP-1202, "Records Management"

LWP-9301, "Event Investigation and Occurrence Reporting"

MCP-1, "Radiation Risk Counseling and Special Dose Control Level"

MCP-148, "Personnel Decontamination"

TEV-500, "Internal Dosimetry"

PLN-114, "INL Emergency Plan/RCRA Contingency Plan"

8. APPENDIXES

Appendix A, Responsibilities

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Appendix A

Responsibilities

Performer	Section	Responsibilities
Affected Personnel	4.1	Activate facility EOC and contact WCC when an event is identified.
Facility Management	4.1	Control ventilation systems, valve controls, and switches in the event of an emergency.
Emergency Response Personnel	4.1	May be required to work in radiological areas.
Emergency Response Management	4.1	Train and brief each individual who will be authorized to perform emergency actions.
Affected Personnel	4.2	Immediately evacuate area without stopping to remove PPE or perform exit monitoring.
Radiological Control Personnel	4.2	Provide on-scene support for accidental criticality. Completed required paperwork, segregate personnel, perform radiological surveys, and collect dosimetry for processing and send to HPDL. Calculate neutron dose estimate.
HPT/RCT	4.2	Complete Form 441.45 and Form 441.56 documenting actions taken and survey results.
Emergency Response Personnel	4.3	Consider CAM alarms and indications actual until verification is made otherwise. Arrange supplemental actions in a logical sequence assuming alarm was caused by a radiological event.
Affected Personnel	4.3	Stop work activities, place work area in safe condition and evacuate to an area physically isolated from the affected area. Notify Radiological Control personnel. Remain in an area adjacent to, but isolated from the affected area until released by Radiological Control. Notify Radiological Control personnel if any contamination monitors were bypassed during the evacuation.
Facility Operations	4.3	Secure unfiltered ventilation.
HPT/RCT	4.3	Remove CAM chart that contains the radiological data of significance as directed by Radiological Control Management and facility management permission. Evaluate radiological conditions. Perform supplementary actions by taking air samples, radiation surveys, and inspecting CAM.

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		<p>Characterize the event by removing and counting the filter, if necessary. Document results.</p> <p>Determine the need for additional ventilation, perform smear surveys, and evaluate the potential for possible uptake.</p> <p>Evaluate radiological conditions remotely prior to re-entry. Check readouts, charts, or remote meters. Check maintenance logs to determine if maintenance was being performed. Check other instruments in the same area to see if levels are rising or if there is an alarm on one of the instruments.</p> <p>Don PPE and enter the affected area to take additional air samples, radiation surveys. Pull CAM filters as necessary.</p> <p>Take air samples once operations resume verifying the cause of airborne release has been corrected.</p>
Radiological Engineer	4.3	Evaluate the need for bioassay and complete dose assessment, if necessary.
Affected Personnel	4.4	Stop work activities and place area in a safe condition. Exit the area and alert others. Notify Radiological control personnel.
Radiological Control Organization	4.4	<p>Maintain control of the event by verifying alarms are not false. Perform radiation surveys and establish boundaries. Post the area appropriately. Check for loss of shielding integrity and determine to the extent practical, the source of radiation. Take corrective actions to reduce radiation fields. Perform radiation surveys of adjacent areas.</p> <p>Document results on Form 441.45 and 441.56, or electronic equivalent.</p>
Radiological Control Personnel	4.4	<p>Maintain control of the event and perform radiation surveys.</p> <p>Determine extent and magnitude of situation and ensure radiation boundaries are established.</p>
Radiological Control Management/Radiological Engineer	4.5	Provide Occupational Medical with an inventory of the facility, chemical form of radioactive materials, absorption type, physical properties and any additional information to aid in determining if possible early medical intervention is required.

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HPT/RCT	4.5	Take direct measurements of the individual with the suspected uptake.
HPDL Personnel	4.5	Determine bioassay requirements and determine dose received by individual. Provide dose assessment results.
Radiological Control Personnel	4.5	Restrict individuals suspected of an intake in Access Control.
HPT/RCT	4.5	Documents results on Form 441.56 or electronic equivalent.
Operations	4.6	When a stack monitor alarms, immediately notify facility management and the responsible Radiological Control Management.
HPT/RCT	4.6	Observe stack alarm readout. Observe count rate meters and recorder charts. If requested, obtain a grab sample of the effluent. Pull filters if authorized and survey with a portable hand held instrument. Count filter in a scaler. Document results and save filters, if applicable. Notify Radiological Control Management and provide release information. Complete Form 441.56, or electronic equivalent, documenting actions taken and survey results.
Affected Personnel	4.7	If an ED alarms, stop work and place area in safe condition. Alert others and exit area. Notify Radiological Control personnel.
Radiological Control Personnel	4.7	Evaluate cause of ED alarm and process individual's dosimeter, if applicable. Document any evaluations on Form 441.56 or electronic equivalent, or Form 441.A81..
Affected Personnel	4.8	If ED alarms, observe readout. Move to an area of lower radiation. Alert other and exit the area if HPT/RCT is not present.
HPT/RCT	4.8	Document findings and evaluations from dose rate alarm on Form 441.56, or electronic equivalent, or Form 441.A81.
Affected Personnel	4.9	Stop work, exit the area and notify Radiological Control personnel.
Radiological Control Personnel	4.9	Evaluate the cause of alarm/failure and pull worker's dosimeter if needed. Document evaluation on Form 441.56, or electronic equivalent, or Form 441.A81.
Affected Personnel	4.10	If spill contains highly toxic chemicals, TRU material or

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		mixed waste, immediately exit area. Don't attempt to secure or stop the spill.
Radiological Workers	4.10	Control spill with assistance from HPT/RCT. Keep personnel away from spill until trained personnel arrive to stop spill. Practice SWIMS. Ensure facility management is notified of the spill.
HPT/RCT	4.10	Establish boundaries and post the area accordingly.
Line Management/Radiological Control	4.10	Complete actions to recover from spill. Plan recovery and cleanup.
HPT/RCT	4.10	Document actions taken in the event of the spill. If an uptake is suspected, take nasal swabs and document results. If no contamination is found on nasal swabs, contact Radiological Engineer to determine if further evaluation is needed. Complete Form 441.45 and Form 441.56 or electronic equivalent documenting actions taken and survey results.
First Responder	4.11	Call 777 at the Site or WCC to request assistances. In town facilities call 9-911.
Radiological Worker/HPT/RCT	4.11	When responding to a casualty resulting from or involving high radiation follow requirements of EPI-76. Do not decontaminate a severely injured person without guidance from Occupational Medical. Control bleeding, treat for shock, and restrict movement to the extent possible.
WCC	4.11	Notify EOC personnel when an event with serious consequences is identified by line managers.
EOC	4.11	Notify area medical facilities, if necessary.
HPT/RCT	4.11	Evaluate the need for immediate evacuation of the injured in a life threatening injury. Restrict access by establishing barriers. Perform radiation and contamination surveys. Survey injured person for contamination. Accompany injured individual or meet the injured at the

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		<p>medical facility.</p> <p>Take survey instruments and decontamination supplies to monitor for contamination and control spread of contamination.</p> <p>Document all actions taken and survey results.</p> <p>If the event occurs on the back shift, weekend or holiday, accompany the injured person to medical and contact facility Radiological Control Manager.</p>
Radiological Control	4.11	<p>Determine the radiation and contamination sources and take any necessary actions to reduce radiation fields or contamination.</p> <p>Send dosimetry of those involved in the event to HPDL.</p>
Radiological Control Management	4.11	Accompany HPT/RCT or meet HPT/RCT at the offsite medical facility.
Line Management/Radiological Control	4.11	<p>Contact plant personnel for technical assistance if retrieval becomes necessary.</p> <p>If contaminated individual is transported offsite, notify receiving facility, WCC and request an HPT/RCT to accompany injured individual.</p> <p>Ensure response personnel are decontaminated per MCP-148.</p>
Responsible Person	4.11	Establish evacuation route and install barriers, as necessary.
Radiological Engineer	4.11	Estimate personnel dose and complete form 441.04A, as applicable.
Affected Personnel	4.12	Evacuate area and report to designated assembly areas.
Radiological Control	4.12	Provide support by establishing barriers, air monitoring/sampling and surveying personnel, materials, and equipment.
Line Management	4.12	Ensure proper reports are made and area is cleaned up and/or decontaminated after the fire.
Line Management	4.13	Determine appropriate notifications when information is received that personnel and/or equipment is suspected of being contaminated off-site.
Facility Management	4.13	Initiate occurrence reporting.
Radiological Control Management	4.13	Ensure line management has made notification to WCC and the RAP team leader will conduct surveys of suspected personnel and/or equipment.

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HPT/RCT	4.13	Conduct surveys in accordance with procedures with a RAP team leader at the scene.
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