

7.0 Potential Intake Incident Response

This chapter provides guidance for recommended dosimetry response to incidents of potential radionuclide intake. The roles of the contractor, Internal Dosimetry (via the Exposure Evaluator [EE]), and other support groups in obtaining dosimetry data and in performing early assessments of intake are discussed. Also addressed are some EE tasks that are performed under the auspices of the IDP but are not directly related to Internal Dosimetry.

For the purposes of this chapter, a potential intake incident is defined as any circumstance involving loss of containment or administrative control that may result in a worker incurring an intake requiring an internal dose assessment. However, the majority of the material in this chapter is directed toward the circumstance where knowledge of a potential intake is recent (i.e., within one to three days).

7.1 Incident Response Objectives of the Hanford Internal Dosimetry Program

In responding to potential intake incident, the IDP's principal objective is to perform initial and follow-up assessments of the seriousness of the exposure. Such assessments support the contractors' reporting and investigating requirements, and address the medical considerations regarding the effectiveness of dose-reduction therapy. In addition to the role in responding to potential intake incidents, the EE provides notification services for other types of incidents at Hanford.

7.2 Incident Response Services Provided By the Hanford Internal Dosimetry Program

The IDP provides incident response by means of its EE function. The EE is a sitewide 24-hour on-call contact for dosimetry and notification assistance.

Internal Dosimetry Services

The following intake assessment services are available through the EE:

- consultation regarding the need for and priority of special bioassay measurements
- arrangements for bioassay measurements and samples
- identification of supplemental measurements and samples to aid in the performance of internal exposure evaluations (e.g., measurement of air filters and smears)
- arrangement with PNNL Radiological Control for Radiological Control Technicians (RCT) support for the IVRRF and the Emergency Decontamination Facility (EDF)
- initial assessment of the potential severity of intakes based on early data

- discussion with workers about the results of specific measurements (done in conjunction with Field Dosimetry)
- arrangement for appropriate follow-up bioassay measurements.

Services Not Related to Internal Dosimetry

The following services, not related to internal dosimetry, are also available through the EE:

- dosimetry assistance for unusual external exposure situations
- request for assistance from PNNL Radiological Control for monitoring potentially contaminated Hanford patients who report to Kadlec Medical Center, HEHF first aid stations, the EDF, or the IVRRF.

7.3 Determining the Need for Internal Dosimetry Support

Criteria for EE Notification

Internal Dosimetry should be contacted whenever an intake of radioactivity is suspected, or when the dosimetric significance of an observation or event is in doubt.

The following are examples of circumstances that could warrant contacting Internal Dosimetry:

- abnormal radioactivity detected on nasal smears
- suspected intake of radioactive material with the potential for a CEDE of 100 mrem
- single or cumulative airborne exposures totaling more than 10 DAC-hours in a calendar year, after correction for respiratory protection worn at the time of exposure.
- extended or extensive personal skin contamination
- loss of containment or exposure control, such as failure of a ventilation system or respiratory protection, resulting in exposure to high concentrations of radioactivity in the air
- spread of contamination that results in levels of radionuclides at or exceeding the levels given in Table 7.1
- unplanned releases of radioactive material to the environment that may have affected workers.

It is also recommended that Internal Dosimetry be included on the distribution list for radiation occurrence reports.

Criteria for Notifying HEHF

Internal Dosimetry recommends that HEHF Occupational Medicine be promptly alerted to potential intakes when the criteria of Table 7.2 are exceeded. The primary purpose of this notification is to alert HEHF to the possibility that dose reduction therapy may be warranted. At the request of the contractor, the EE may make this notification. The EE may also

informally notify HEHF if there seems to be a possibility that therapy is warranted.

Table 7.1. Contamination Levels for Notifying Internal Dosimetry

Indicator	Alpha-Emitters, DPM	Beta-/Gamma-Emitters, dpm
Nasal or mouth smears	Above background	Above background
Facial contamination	200	4,000
Skin breaks	Any skin break while handling alpha-emitters other than sealed sources.	Any detectable activity while handling around or on a skin break; or detectable activity on a blood smear.
Head, neck contamination	2,000	40,000
Contamination inside respirator	Detectable activity inside respirator after use.	
Hands, forearms, clothing ^(a) (spotty, loose)	10,000	200,000
Airborne contamination <u>after incorporating respiratory protection factor</u>	Acute exposure <u>exceeding 40 DAC-hours^(b) should undergo special bioassay. .Acute or cumulative exposures exceeding 10 DAC-hours in a calendar year should undergo dose assessment; use DAC-hours or special bioassay as appropriate.</u>	
(a) Clothing contamination levels apply to exposure without respiratory protection, such as contamination levels on <u>personal clothing or</u> inner coveralls while undressing.		
(b) DAC-hours = time-integrated exposure to airborne contamination.		

7.3.1 Notifications for Prompt Intake Assessment and Dose Reduction Therapy

When to Notify the EE

The EE should be notified immediately when prompt actions may be required to evaluate internal exposure. The criteria recommended for immediate notification and request for support are shown in Table 7.1. These criteria are based primarily on Hanford experience, which may be taken as indicators that the CEDE may exceed 100 mrem.

The EE should be notified the same day that intakes or potential intakes occur or are identified to ensure that adequate provision is made to obtain bioassay measurements for dose assessment.

When the criteria of Table 7.1 are not met, it is unlikely that therapeutic actions would be taken based on early bioassay measurements. Bioassay measurements are still needed for dose assessment purposes. In some cases the measurements may not need to be immediate (i.e., same day), but may be scheduled on a priority basis a few days after the potential intake. Under these circumstances, the EE may suggest a delayed measurement protocol in consideration of convenience and cost.

Table 7.2. Contamination Levels for Notifying the Hanford Environmental Health Foundation

Indicator	Alpha-Emitters, DPM	Beta-/Gamma-Emitters, DPM
Nasal or mouth smears	1,000	100,000
Facial contamination	25,000	500,000
Skin Breaks	100	20,000

7.3.2 Information to Provide when Notifying the Exposure Evaluator

What Information to Provide

Exhibit 7.1 (at the end of this chapter) provides a summary checklist of information that may be useful to the EE for dosimetry evaluation. The EE Office maintains a telephone log for each separate incident notification, using a form similar to the one shown in Exhibit 7.2.

7.4 Contacting the Exposure Evaluator

How to Contact the EE

Contacting the on-call EE may be done using several methods which are described here. During normal working hours, it should be possible to contact the EE within a few minutes by one phone call. After-hours procedures have been established with the intent that the maximum response time for obtaining EE support should not exceed 40 minutes.

7.4.1 Preferred Method

Call 376-2222

The preferred method of contacting the EE is to call the EE Office on 376-2222. During working hours, Internal Dosimetry staff usually answers the phone. After working hours, the phone is forwarded to the on-call EE's residence. If no answer is obtained, wait 5 minutes and try again. Make at least two attempts, waiting at least 5 minutes between each call. If contact cannot be made by this method, use one of the alternate methods described below.

7.4.2 Alternate Methods

*Radio Pager:
Onsite 85-9901
Offsite 376-4190
(9901)*

The on-call EE carries a pager that can be activated from a Hanford Site telephone by dialing 85-9901. From an offsite phone, the pager can be activated by dialing 376-4190 and then entering "9901" at the tone. At the cue from the recorded message, enter the phone number for the EE to call. This method is particularly useful after hours if the EE is not at home to answer the EE office number (376-2222). Expect some delay in response to allow the EE to reach a telephone.

If no response is received within 15 minutes, contact the Hanford Patrol Operations Center (POC) or the PNNL Single-Point Contact and request an alternate EE.

*Patrol Operations
Center or PNNL-Single
Point Contact*

Call one of the following and ask them to contact the EE:

Patrol Operations Center:	373-3800
PNNL Single-Point Contact:	375-2400

Both the Hanford Patrol Operations Center (POC) and the PNNL Single-Point Contact have emergency procedures for contacting the EE, including a radio pager and alternate contacts.

*Cellular Phone
(544-8067)*

The cellular telephone is used at the discretion of the EE when responding to a radio page. The phone is not normally carried by the EE.

7.5 Exposure Evaluator Response to Incidents

This section briefly describes the general EE response to [a potential intake](#) incident. Details of some example incident response protocols are provided in Appendix E.

7.5.1 Receiving Incident Notification

Upon notification of an incident, the EE initiates an incident telephone log similar to Exhibit 7.2. The initial priority of the EE is to obtain the identification of the workers and the circumstances surrounding the exposure, and to determine the appropriate bioassay measurements. Based on the information provided by the contractor and the specific services requested, the EE makes appropriate emergency notifications and arranges for bioassay measurements. The EE then makes a preliminary assessment of the potential effectiveness of therapeutic measures, and identifies additional information that might assist in assessing the significance of the exposure.

The EE Office does not normally report incidents to DOE or HEHF. The decision to report incidents to DOE or HEHF is the responsibility of the contractor, unless other arrangements have been made with the EE Office. However, if the probability of intake is considered serious enough to possibly warrant therapy, HEHF may be informally advised by the EE Office. (Note: These statements should not be construed as restricting the EE Office in any way from responding to requests from DOE or HEHF regarding the dosimetry associated with an incident.)

7.5.2 Scheduling and Performing Bioassay Measurements

Initial Bioassay Measurements

A variety of bioassay measurements may be requested. Some of the typical reasons for requesting particular bioassay measurements are described in Table 7.3.

The EE arranges to obtain suitable bioassay measurements. The EE also establishes priorities for measurement types and, if necessary, for individuals needing measurements.

In addition to direct in vivo counts, which can be performed within a few hours of the incident, the EE may arrange for rapid processing of excreta samples, which can provide an analytical result within a few hours of sample delivery to the Lab. With rapid sample processing, analytical sensitivity is sacrificed for quick turn-around time. The purpose of rapid processing is to obtain immediate results to assess the potential need for, or effectiveness of, dose reduction therapy. The EE should determine if trading analytical sensitivity for quick results is appropriate for dosimetry. Circumstances may also warrant rapid processing to provide the contractor with preliminary information.

Follow-Up Bioassay Measurements

Based on initial measurements, the EE determines the need for follow-up bioassay measurements and advises Field Dosimetry of the needed measurements. In some cases, it may be appropriate for the EE to arrange

Table 7.3. Typical Incident-Response Bioassay Measurements and Their Purposes

Measurement	Purpose
Whole body counts and lung counts	Measure activity present in a person at a specific post-intake time. Multiple measurements are used to establish the specific retention pattern in the person.
Head counts	Estimate skeleton burden of bone-seeking radionuclides. This estimate is used to confirm skeleton deposition and to convert chest count results to lung content by correcting for interference from skeleton activity.
Organ counts or wound count	Measure activity present in a specific organ or tissue at a specific post-intake time. Used to estimate the retention pattern of the individual.
Urine samples <u>approximate</u> 12_h <u>approximate</u> 24_h total	Estimate excretion rate of radionuclides not readily detectable by direct in vivo counting. Internal deposition of such nuclides is estimated based on standard models. Multiple samples may be required to determine the individual excretion patterns and appropriate excretion model.
Urine samples (single voiding or “spot”)	Provide initial order-of-magnitude estimate of exposure based on excretion model. This measurement is also suitable for routine and nonroutine tritium dosimetry.
Fecal samples	Confirm intake. Provide isotope identification and ratio information. Estimate dose based on early clearance (may require multiple samples). Differentiate soluble from insoluble materials.

follow-up measurements directly with the worker at the time of the initial measurements. As information becomes available, the EE advises the contractor and discusses results with workers, if requested. The intent of the EE function is to work through Field Dosimetry for all but the most pressing worker communications.

*Measurement
Protocols*

The EE determines measurement protocols for incidents. Some example protocols are included in Appendix E.

7.5.3 Dose Assessment Capability

The dose assessment and reporting practices are described in Chapters 3.0 and 4.0 of this manual. Summary statements are provided here because they are related to incident response.

Dose Sensitivity

The IDP has the capability to assess a CEDE of 100 mrem for all radionuclides of concern at Hanford. In some cases, however, the ability to do so is contingent upon obtaining appropriate bioassay measurements (fecal samples, urine samples, in vivo measurements) within the first few days post-exposure. For most nuclides, if early data are obtained within the first few days following exposure, the dose assessment capability is 10 mrem or less. The exhibits in Chapter 5.0 and Appendix E of this manual describe the capability of bioassay measurements with regard to minimum detectable

dose. The Methods & Models of the Hanford Internal Dosimetry Program (PNL-MA-860) provides additional discussion on the methods of determining the sensitivity.

*Preliminary
Dose Assessment*

An initial assessment of the magnitude of a potential intake and internal dose is made as soon as the data permit. Because the circumstances of each intake are different, initial estimates may be inaccurate. In general, when bioassay measurements confirm an intake, follow-up measurements are required to estimate an internal dose accurately. Early estimates of an exposure should be considered as order-of-magnitude estimates only.

Initial assessments are normally communicated directly to Field Dosimetry without a formal evaluation and transmittal letter. If requested by the contractor, a preliminary dose assessment letter is provided.

*Final Dose
Assessment*

Final dose assessments are issued when sufficient data have been obtained to confidently estimate the doses required to be reported to DOE. These dose assessments become part of the permanent REX files.

7.6 Guidance for Exposure Evaluator Response to Incidents

This section provides general guidance for EE responses to some anticipated situations. It is not intended to be an all-encompassing statement of EE response, nor is it intended to replace other contractor and EE policies, procedures, or requirements.

7.6.1 Managing Uninjured Workers Who Are Externally Contaminated

The incident contractor is responsible for the management of externally contaminated uninjured workers. Normally, workers should be decontaminated before being released from the facility. If external contamination is detected on workers at the IVRRF, the EE, RCT, contractor, and IVRRF staff must determine the action to be taken. The IVRRF is not used as a decontamination center, and workers with removable contamination should not be counted until such contamination has been removed.

Clothing or personal items discovered to be contaminated in surveys made at the IVRRF or EDF are bagged and dispositioned according to the contractor instructions. Normally, the contractor radiological controls organization deals with these items.

7.6.2 Managing Injured Workers Who Are Externally Contaminated

The primary responsibility for management of all injured workers, whether contaminated or not, lies with the responding medical authority. This authority may be HEHF, Kadlec Medical Center, or the Hanford Fire Department ambulance operating under the direction of the Mid-Columbia Emergency Medical Service.

When dealing with contaminated workers, the EE supports medical staff by providing advice in matters of dosimetry for the patients and attending staff. The decontamination of an injured worker is a medical staff responsibility, although the EE or RCT may be requested to assist in the decontamination

efforts. Medical staff also determine the priority of medical treatment versus decontamination.

The EDF is the facility designated to receive contaminated injured workers who do not have life-threatening medical conditions. The EDF is a medical facility operated by HEHF, and HEHF must authorize its use for receipt and treatment of patients. It is HEHF's responsibility to decide whether to treat a worker at a first-aid station, the EDF, or to send the worker to a hospital.

When notified of EDF activation, the EE arranges for PNNL Radiological Control at the EDF. In addition, an EE is dispatched to the EDF to participate as part of the treatment team. A second EE may also be sent to assist. In addition to patient dosimetry evaluation, the EE also provides initial radiation protection coverage for the team until RCT support arrives. The overall responsibility for all EDF related activities lies with the lead HEHF physician.

If decontamination efforts fail to completely remove personal contamination, it may be appropriate to release a worker with residual skin contamination. This decision must be made by the contractor representative. Under such circumstances, the worker should be advised of appropriate techniques to limit the potential spread of contamination after release.

Such techniques might include the use of shower caps, gloves, or bandages, to provide a barrier against contamination spread. In addition, it is suggested that the worker be advised when spread of contamination would not be a significant concern upon release. Home surveys may be appropriate in some cases, and are the responsibility of the event contractor and the worker's employer.

7.6.3 Taking Therapeutic Measures to Reduce Internal Dose

Therapeutic measures to reduce dose are the responsibility of HEHF Occupational Medicine. These methods may include the use of various drugs (e.g., diethylenetriamine pentaacetic acid [DTPA], potassium iodide, alginates, or diuretics) and surgical techniques (e.g., minor tissue excision, wound debridement). The EE advises HEHF of the potential effectiveness of various treatment alternatives to reduce dose, and informs HEHF of the potential internal dose to patients as subsequent bioassay data become available. [Guidance on therapeutic actions and associated intervention levels for bioassay measurements is contained in Appendix E.2.](#)

7.6.4 Releasing Workers Following an Incident

The initial bioassay measurements that are necessary following an incident should be performed before the worker is released. The personal comfort of a worker is considered if extensive hold-over following a workday has already occurred or if discomfort occurs because of injury or extensive counting times. Actual measurements for the initial worker assessment should not normally require more than about 2 hours at the IVRRF. If more than one worker is involved in an incident, this time could be extended, or workers may be requested to return for additional counts at a later time.

When workers involved in an incident are initially counted or treated, a contractor representative should be present. This representative bears the responsibility for release of the workers and for dealing with their questions regarding such items as overtime compensation or when to return. The EE addresses, to the extent that the available data allow, questions about potential internal dose and arranges for necessary excreta samples.

7.6.5 Assisting in External Radiation Exposure Situations

If the contractor requests special assistance regarding an external radiation exposure incident or concern, the EE arranges for the Hanford External Dosimetry Program to provide this assistance.

7.6.6 Offsite Assistance Request

If the EE receives a request for assistance from a non-Hanford source, the EE attempts to determine the nature of the requested assistance and to direct the inquiry to the appropriate authority. Specific requests for Hanford services are directed to RL.

7.7 Reference

[Pacific Northwest National Laboratory \(PNNL\). *Methods and Models of the Hanford Internal Dosimetry Program*, PNNL-MA-860. Richland, Washington. \(Internal manual.\) Available at URL <http://www.pnl.gov/eshs/pub/pnnl860.html>](http://www.pnl.gov/eshs/pub/pnnl860.html)

Exhibit 7.1. Checklist for Incident Data

General Information

- Description of incident—one or two sentences and date and time of incident
- Location of incident (area, building, room)
- Personnel involved (name, payroll number, job title, and address for each person).

Internal Exposure -Related Information

- Retain any object causing contamination for possible investigation
- Radionuclides
- Form of material (wet/dry, chemical form, soluble/insoluble)
- Mode of intake
- Respiratory protection (type, evidence of leakage)
- Nasal, mouth, or blood smear results (dpm)
- Facial contamination level (dpm)
- Other skin contamination (dpm)
- Clothing contamination (dpm)
- Area contamination (dpm)
- Airborne activity concentration ($\mu\text{Ci/cc}$)
- Correlation of contamination levels to potential exposure of worker.

External Exposure -Related Information

- Radionuclides (or type and energy of emission)
- Source activity
- Source geometry
- Estimated dose rate (type of instrument and distance)
- Pencil dosimeter reading or pocket alarming dose integrator (PADI) dose
- Duration of exposure
- Worker position relative to source
- Shielding around worker
- Shielding around source
- Anticipated delivery of dosimeters for processing.

Criticality Exposure -Related Information

- How detected?
- Number of workers exposed?
- Quick sort performed? Results of gut readings?
- Readings on worker personal effects
 - Item, reading
 - Instrument used, efficiency and background
 - Elapsed time between criticality and reading
- Orientation and distance of worker to critical assembly
- Any immediate symptoms? (describe)
- Fissile material
- Shielding material and thickness
- Current status of area; any chance for recurrence?
- Environmental release?
- Have nuclear accident dosimeters (NADs or “candles”) been collected?
- Have worker dosimeters been collected?

Exhibit 7.2. Incident Telephone Log

RADIATION INCIDENT - TELEPHONE REPORT

Date of Report _____ DEMS No. _____
 Time of Report _____
 Reported by _____ Contractor _____

Employee _____ Payroll/SS # _____ Company, Job, address if needed _____

1. _____
2. _____
3. _____
4. _____
5. _____

Incident Date _____ Time _____ Bldg. _____ Area _____

Incident Description: Intake External _____

Prin. Isotope(s) _____ Mode of Intake _____

Employ. No.	Nasal Contamination		Skin, Other Personal Contamination
	Alpha	Beta	
1.	Rt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
	Lt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
2.	Rt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
	Lt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
3.	Rt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
	Lt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
4.	Rt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
	Lt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
5.	Rt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____
	Lt _____ dpm cpm _____ dpm cpm	_____ dpm cpm	_____

Exhibit 7.2 (contd)

ACTIONS TAKEN

	DTPA	1	2	3	4	5
EE Assigned _____	Worker	<input type="checkbox"/>				
	Date/Time	_____				

<u>In Vivo Counts</u>	<u>Employ. No.</u>	<u>Date Performed</u>	<u>Results</u>
WBC	1	_____	_____
	2	_____	_____
	3	_____	_____
	4	_____	_____
	5	_____	_____
Chest Count	1	_____	_____
	2	_____	_____
	3	_____	_____
	4	_____	_____
	5	_____	_____

Other Counts
(List employee no. and type and results of counts)

<u>Excreta</u>	<u>Employ. No.</u>	<u>Type and Sample Date(s)</u>
	1	_____
	2	_____
	3	_____
	4	_____
	5	_____

Contractor Rep. Notified: Who _____ Time _____ By _____

External Notified: Who _____ Time _____ By _____