3.0 Internal Dose Assessment

The process of assessing internal dose involves collecting and analyzing information concerning a potential intake, and then developing a conclusion regarding the magnitude of the intake in terms that can be related to radiation protection standards. In a broad sense, the dose assessment process consists of three parts:

- identifying a potential intake
- collecting pertinent data
- evaluating and documenting intake magnitude and dose equivalent.

A successful intake assessment effort at Hanford depends on the support of both the contractor dosimetry organization (i.e., Field Dosimetry) and the IDP. Field Dosimetry has the primary responsibility for identifying potential intakes for assessment. Internal Dosimetry supports this effort by providing guidelines and recommendations for establishing routine bioassay monitoring programs and for identifying situations that warrant intake assessment (see Chapters 5.0, 6.0, and 7.0). The performance of bioassay measurements and the collection of other data and information used in the assessment require the combined efforts and cooperation of Field Dosimetry and Internal Dosimetry.

Evaluating the data, assessing internal dose, and documenting the assessment are primarily the responsibility of Internal Dosimetry, as discussed in this chapter.

3.1 General Description of an Intake Assessment

Determining when and what kind of an assessment of potential intake is necessary, and how the assessment is conducted for various intake scenarios, is key to the assessment process.

3.1.1 Criteria for Performing an Assessment

Program practice statements in Chapter 2.0 establish the criteria for determining when an intake assessment is needed and provide the general guidance used in performing the assessment.

3.1.2 Types of Assessments

Assessments of potential intakes generally fall into one of three categories:

- preliminary evaluation
- final evaluation
- reevaluation.

Preliminary Evaluation The purpose of the preliminary evaluation is to provide a prompt or interim assessment of the potential seriousness of an intake prior to obtaining the data required for a final evaluation. Because the preliminary evaluation is performed before completing the investigation, the estimates of intake and dose are based on relatively conservative assumptions. Thus, preliminary evaluations tend to result in a higher assessed dose than do final evaluations.

In cases where the significance of the potential intake is obviously small, the conclusions of the preliminary evaluation are reported verbally. For cases with greater significance, Field Dosimetry may request a written preliminary evaluation.

Final Evaluation A final evaluation represents the conclusion of the intake assessment process based on the follow-up investigation. (See Exhibit 3.1, Internal Dose Evaluation Report Form, at the end of this chapter.) A report on the final evaluation is generally issued within 3 months of the receipt of the necessary data, with some exceptions as mentioned in Section 2.1.3. Generally, the time period between identifying an intake and issuing a final report ranges from 1 month, for simple cases, to 1 year, for complex cases requiring long-term bioassay data. Final evaluations may be revised by issuing a reevaluation report if additional evidence that affects the conclusion of the previous final evaluation is obtained.

Reevaluation A reevaluation is an updated final evaluation report. The criteria for determining when a reevaluation should be performed are provided in Section 2.1.4.

3.1.3 General Approach

Intake assessments are conducted by investigating the nature of the exposure and by analyzing bioassay measurement results and other pertinent data. Bioassay measurement data, which provide information on the deposition and retention of radionuclides in the involved individual(s), are the preferred basis for assessing internal dose. In cases where bioassay data are not available, an internal dose assessment can be made using other relevant information that is available, such as air sample data, source terms, and contamination surveys.

3.1.4 Intake Assessment Situations

Various situations necessitate an assessment of potential intake. Table 3.1 lists possible situations for which an assessment may be needed and the criteria used to determine whether an assessment should be initiated.

3.2 Performing the Assessment

When one of the situations in Table 3.1 occurs and the dose assessment criteria are met, an evaluation of potential intake is performed. The assessment process includes investigating the potential intake, documenting the results, and reporting the conclusions. Figure 3.1 depicts the steps that make up the complete assessment process. (The Internal Dose Evaluation Report is described in Section 3.2.2. See Chapter 4.0 for information on the INTERTRAC and REX databases.)

3.2.1 Investigation of a Potential Intake

The investigation phase of the assessment process involves the performance of special bioassay measurements and the collection of other pertinent data. Special bioassay measurements have three purposes:

1. identifying (confirming) that an intake occurred

2. establishing the material's distribution in and clearance from organs in the body.

3. assessing dose equivalent

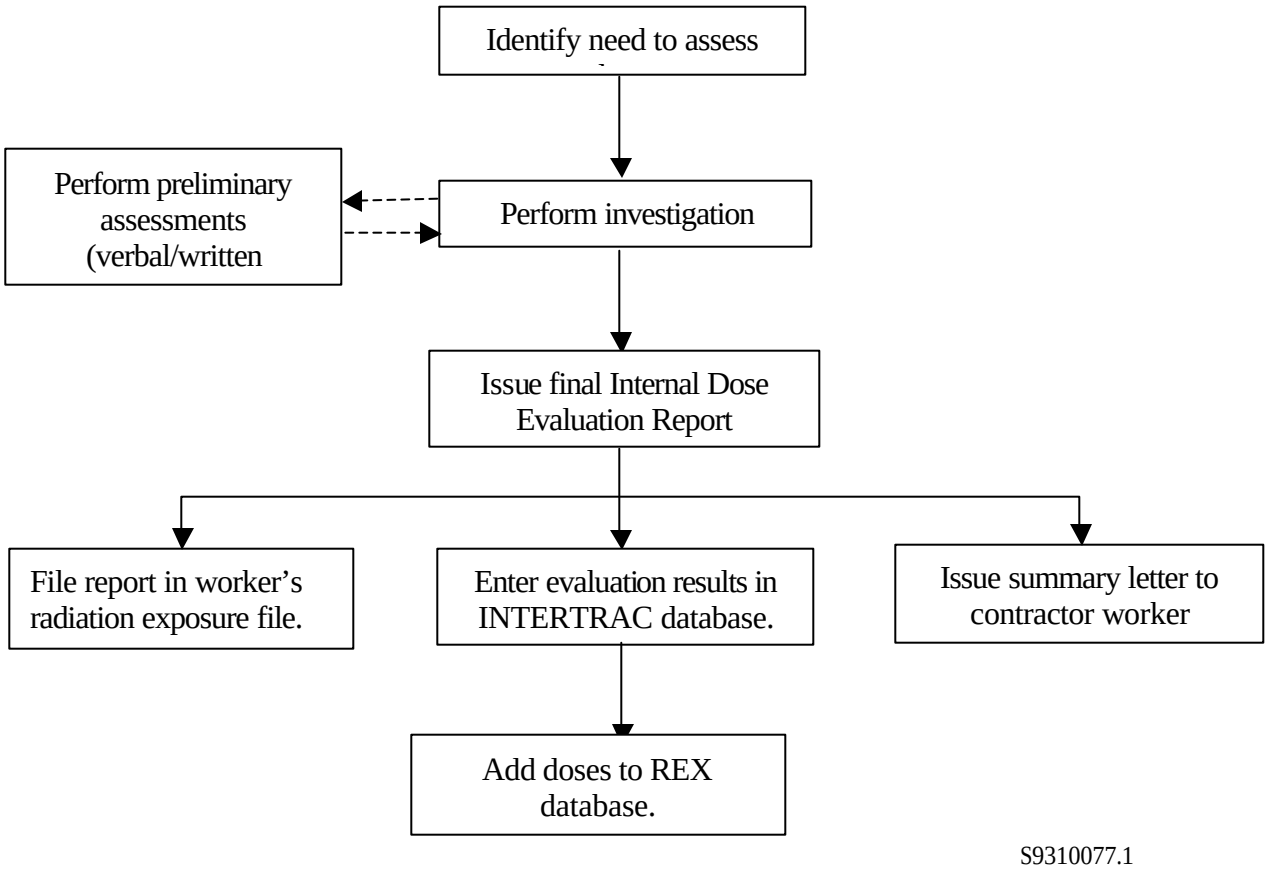
Recommendations for special bioassay measurements are made by Internal Dosimetry on a case-by-case basis, according to stated practices in Chapter 2.0 and other guidance provided in Chapters 6.0 and 7.0, Appendix E, and with the concurrence of Field Dosimetry. The type and extent of the measurements depend on the significance and complexity of the case.

Special measurements for assessing dose are based on the need to establish the magnitude of the internal deposition and its clearance rate from the body. Generally, the frequency for performing special bioassay measurements can be decreased with time post-intake, until, for long retained nuclides, the measurements can be continued on an annual monitoring frequency. It is recommended that special bioassay measurements continue until the measurement results are consistently less than detectable or below the screening level established for routine bioassay monitoring. Other information that may be important to the assessment is listed in Table 3.2.

The investigation determines whether an intake occurred. If the conclusion is that an occupational intake did occur, the magnitude of the intake or deposition and the CEDE are determined and assigned. If an occupational intake is not confirmed, no dose is assigned.

TABLE 3.1. Potential Intake Assessment Situations

Situation	Criteria for Initiating a Potential Intake Assessment
Field Dosimetry identifies a potential intake incident.	Field measurement data meet contractor criteria for potential intake. (Recommendations for these criteria are provided in Chapter 7.0.)
Special (nonroutine) bioassay measurement shows detectable activity above natural background.	Measurement results indicate internally deposited radionuclides.
Routine bioassay measurement shows activity.	Measurement results exceed the screening level of the routine bioassay monitoring program. (See Appendix A.)
Bioassay result for a worker with a known internal deposition shows an unanticipated increase.	When recent and previous bioassay measurements are compared, it is determined that the recent result exceeds normally expected fluctuations.
Bioassay data collected subsequent to an evaluated intake suggest that the assigned dose may be incorrect.	Evidence suggests that the assigned CEDE may be in error by 0.5 rem or a factor of 1.5 of the previously assigned dose, whichever is higher.
Field Dosimetry requests a special internal dose assessment.	Request by Field Dosimetry.
Prior work history or baseline bioassay measurement for a newly hired employee indicates a previously incurred occupational intake.	Bioassay or other information indicates internally deposited radioactivity at the time of employment.



~~FIGURE 3.1~~. Internal Dose Assessment Process

3.2.2 Documentation

Internal Dose Evaluation Report

Occupational intakes of radionuclides are assessed and formally documented through the Internal Dose Evaluation Report. This report describes the methods, assumptions, data, and conclusions of the assessment. All subsequent detailed or summary accounts of internal dose from a particular intake are derived from the report.

Internal Dose Evaluation Reports are prepared by Internal Dosimetry, using methods and assumptions described in this manual, in the internal manual *Methods and Models of the Hanford Internal Dosimetry Program (PNNL-MA-860)*, and in other resources, as appropriate. Before any report is issued, it is reviewed internally by a peer internal dosimetrist.

Exhibit 3.1 (at the end of this chapter) shows the form used to document Internal Dose Evaluation Reports. This form is used to identify the assessment, organize the content of the report, summarize the conclusions, and identify the staff that prepared and reviewed the report. When an assessment is complex, special attachments containing the details of the assessment are included with the form.

Each internal dose evaluation is identified by a unique identification number. Prior to 1987, numbers were assigned sequentially. Beginning on January 1, 1987, the numbering system was revised to include a five-digit event number, followed by a two-digit person designator and a one-digit evaluation revision designator. The first two digits of the event number represent the calendar year during which the evaluation was originally initiated, and the next three digits are assigned sequentially to each event during that year. The sequence character after the two-digit individual worker number indicates that the evaluation report is either the original (A) or a revision (B,C,D...). For example, the evaluation number "87005-02A" identifies the evaluation as the original version issued for individual number 2, who was involved in the fifth potential internal exposure event of 1987.

Evaluation numbers are assigned by the Internal Dosimetry technician upon notification that an assessment will be performed. The evaluation number may also be referred to as the Dose Evaluation Management System (DEMS) number, which is used to track evaluations.

The following information is provided in the evaluation report:

- the evaluation number
- the worker's name, payroll number, and social security number
- the date or period of exposure (actual or assumed)

- the area and building where the exposure occurred or is assumed to have occurred
- a summary of the exposure scenario, if known
- mode(s) of intake (actual or assumed)
- Contractor statement of appropriate source term radionuclides, or a concurrence with the evaluation assumptions. This item is not required for routine tritium oxide assessments, unconfirmed high routine tritium oxide assessments, unconfirmed high routine measurements or for situations with source terms well established in technical basis documentation.
- radionuclides addressed by the assessment.
- Contractor statement of the measured or calculated determination of air sample representativeness if dose is to be assigned based on air sample results or DAC-hours record. (Not required if assessment is based on records from prior employer.)

The evaluation report also contains:

- a summary of data used in the assessment
- a description of assessment methods and assumptions
- Intake magnitude and identity
- CEDEs
- the committed dose equivalent to organs meeting the criteria in Section 2.1.2
- references, as required
- the author's name and signature
- the peer reviewer's signature.

TABLE 3.2. Information Supporting the Internal Dose Assessment

Information Type	Examples
General Information	Location where exposure occurred Description of the exposure event, including time, suspected mode of intake, duration of intake, and other individuals involved Personnel contamination survey results and decontamination actions Radionuclides involved, including relative abundance in mixtures Physical and chemical characteristics of contamination and host matrix.
Inhalation Intake Information	Airborne radionuclide concentrations Respiratory protection used Observed facial, nasal, and/or other personal contamination Breathing habits (mouth/nose breather).
Absorption/ Wound Information	Location of wound Cause and description of wound Wound contamination survey results Characteristics of contamination in and around the wound site Medical and health physics actions.
Materials for Potential Analysis	Analysis of the following materials can also provide useful information, and it is recommended that, to the extent practical, these materials be identified and retained until the final evaluation report is issued: • air sample media (filters, canisters) • contamination smear survey pads • nasal swab and irrigation fluid • respirator filters • wound debris (blood, tissue, foreign matter).

3.2.3 Assessment Reporting

Summary Letter

A letter summarizing the conclusions of the evaluation is prepared for each evaluation. Summary letters are sent either directly to the worker or to Field Dosimetry, depending on the circumstances of the evaluations and the conclusion.

Sent Directly to Worker

The summary letter is sent by the IDP directly to the worker, with a copy to Field Dosimetry, when it is considered unlikely that the worker will have questions about the evaluation or conclusion. Examples of such conditions include the following:

- No occupational dose was assessed.
- The evaluation was a reassessment and Field Dosimetry concurs with addressing the cover letter to the subject.
- Dose was assigned without obtaining confirming bioassay measurements.
- The intake occurred prior to Hanford employment. Field Dosimetry will be verbally notified if the CEDE exceeds 50 mrem.

The letter should be sent to the worker's Hanford plant address. If there is no plant address or the worker has terminated Hanford employment, the home address will be used. Field Dosimetry will contact the worker's supervisor if that appears to be necessary. Any worker contacting PNNL Internal Dosimetry with questions concerning the evaluation will be referred to Field Dosimetry.

Sent to Field Dosimetry for Communication to Worker

The summary letter is sent to Field Dosimetry, for subsequent communication to the worker by Field Dosimetry, when it is considered likely that discussion about the evaluation may be needed or that the worker may have specific questions. Examples of such conditions include the following:

- The evaluation assigns occupational dose associated with Hanford employment.
- The evaluation is for a Hanford visitor.
- ~~Summary letters will be sent to the event contractor field dosimetry organization if the worker's potential intake occurred in a facility not operated by the worker's employer. A copy of the letter will also be provided to the worker's field dosimetry organization.~~

Summary Letter Contents

The summary letter contains the following information:

- the worker's name and payroll number
- the date or period of the intake

- the area and building where the intake occurred
- the intake magnitude and identity
- the assigned CEDE and pertinent committed organ doses
- recommendations for further follow-up sampling.

A copy of the evaluation report will be provided to Field Dosimetry upon request. Hanford employees seeking a copy of their evaluation reports should request it through Field Dosimetry. Requests from former Hanford employees are processed by the HRRP staff.

3.3 Dose Assessment Methods

Program practices, discussed in Chapter 2.0, provide general statements regarding the operation of the IDP. Technical considerations for the internal dose assessment process are covered in PNNL-MA-860. The methods and approaches used for investigating, evaluating, and reporting internal dose assessments are summarized in this section. These "default" methods are used unless available information points to a more appropriate method or assumption. If methods and techniques other than those discussed here are used, they are to be documented in the evaluation report.

3.3.1 General Approach

Intakes are preferably assessed based on bioassay measurement results. However, if bioassay data are unobtainable, the assessment is performed using any relevant information that is available.

Direct (in vivo) measurements of internal content and retention patterns are preferred to indirect (excreta) methods that require the use of excretion functions and biokinetic models.

Assumptions used in the dose assessment process should be conservative but realistic. Caution should be exercised when multiple conservative assumptions could compound errors and result in an unrealistic estimate. Assumptions should not be made when actual data or information are available.

The expected baseline from any past intake must be factored into evaluations of any new intake.

When the actual intake time or period is not known, it is necessary to identify the probable intake date(s). This may be done by considering available evidence, such as air monitoring results, contamination surveys, operating periods, and previous bioassay measurement results. After the intake time is narrowed to a probable time period, it is assumed that an acute intake occurred at the midpoint of that period. If the evidence suggests that a chronic intake is more reasonable, it is assumed that the chronic intake occurred uniformly throughout the probable exposure period.

If the mode of intake is not known, it is assumed that the intake was by inhalation.

Uncertainties in internal dose assessments are presently not quantifiable. Almost any factor in the internal dose process can result in a change of 50% or more. The possible factors are numerous, e.g., the number of bioassay measurements taken, assumed intake date, particle size, solubility in lung fluid, solubility in blood at the wound site, actual versus reference excreta levels, organ sizes, clearance and retention half-times, accuracy of corrections for skeletal, liver, or lymph system contents, differences in metabolic behavior between ionic material and material bound in a parent-material matrix, etc. The evaluation philosophy is to weigh the merits of default assumptions versus obtaining additional data on a case-by-case basis. Default assumptions are used when no other data is available.

3.3.2 Evaluating Lung Dose for Inhalation Exposures

Potential lung doses from inhalation exposures must be considered, even if direct in vivo measurements do not identify the nuclide in the lung. In such cases, assessments of the lung burden and dose should be performed using alternative techniques, such as excreta measurements, air samples, or other available information. However, the assessed activity in the lung should not exceed the reported minimum detectable activity (MDA) level of the chest measurement.

3.3.3 Solubility and Particle Size Assumptions

Input terms for biokinetic models should be based on field data and on bioassay measurements that are specific to the intake being evaluated. If the model requires input values that cannot be reasonably obtained, appropriate conservative assumptions should be used. The default particle size for the biokinetic model of the respiratory tract is 5µm AMAD (activity median aerodynamic diameter for workers). The transportability characteristics should be determined based on the known or probable chemical and physical makeup of the material. The evaluation should include appropriate discussion of the rationale for choosing these parameters.

3.3.4 Radionuclides Included in the Assessment

The internal dose assessment should consider all radionuclides that are identified by in vivo or field measurements, as well as additional radionuclides that are reported by Field Dosimetry as being present or that are known to be present from previous experience. If field measurements indicate gross radioactivity levels only (gross beta, gross alpha), appropriate radionuclide representations of these levels should be used, based on a conservative evaluation of radionuclides potentially present. Reference radionuclide mixtures developed PNNL-MA-860 can be considered applicable in this situation. Field Dosimetry will provide characterization data appropriate for assessing confirmed Hanford intakes, or concur in the characterization used for the assessment. This characterization shall be documented in the evaluation.

3.3.5 Assessment of Exposures of Localized Tissue

For radionuclide depositions in localized tissues, such as in regional lymph nodes or at wound sites, the quantity of the radionuclide deposited in the tissue and its projected ~~clearance~~ half-~~time~~ are assessed and documented. The assessment becomes part of an individual's radiation exposure file, but it is not used for determining compliance with either stochastic or nonstochastic dose equivalent limits. Additional discussion is provided in Section 2.5 of the *Methods and Models of the Hanford Internal Dosimetry Program (PNNL-MA-860).*

3.3.6 Biokinetic Models

Biokinetic models for specific applications are discussed in the *Methods and Models of the Hanford Internal Dosimetry Program (PNNL-MA-860)*. The standardized models summarized below are used for initial evaluation of internal exposure. These models are applied to final evaluations unless a more appropriate model is determined to apply to the specific exposure situation.

Respiratory Tract Model

The general model for the respiratory tract presented in ICRP Publication 30 (1979) ~~or ICRP Publication 66 (1994)~~ is used to evaluate retention and elimination of inhaled particulates by the respiratory system.

Gastrointestinal Tract Model

The model for the gastrointestinal (GI) tract presented in ICRP Publication 30 (1979) is used to evaluate retention and absorption of materials by the stomach and small and large intestines.

Systemic Retention Models

The systemic retention models used are those described in *Methods and Models of the Hanford Internal Dosimetry Program (PNNL-MA-860)*. Generally, the models used are based on the concepts and models of the ICRP. Retention models are most useful when organ uptake and retention cannot be determined using in vivo measurements.

Systemic Excretion Models

The systemic excretion functions listed in Table 3.3 are applied to excreta data unless a more appropriate model applies to a specific situation. The models are discussed further in the *Methods and Models of the Hanford Internal Dosimetry Program (PNNL-MA-860)*..

3.3.7 Computer Programs Used for Dose Calculations

The computer program codes listed in Table 3.4 are consistent with the retention and/or excretion models discussed previously. The codes are used in the assessment process unless another approach is determined to be more appropriate for the specific situation. Each of the computer programs is documented in the Hanford Radiation Protection Historical Files.

TABLE 3.3. Excretion Functions

Element	Systemic Excretion Model
Plutonium	Jones function (Jones 1985)
Strontium	Alkaline earth model, as implemented by CINDY computer code
Uranium	ICRP Publication 30 (1979) retention model
Tritium	ICRP Publication 30 (1979) retention model

TABLE 3.4. Computer Programs Used for Dose Calculations

Computer Program Code Name	Purpose
CINDY	A dosimetry code specifically developed by DOE for implementing the ICRP-30 techniques and models.
PUCALC	A set of programs for estimating systemic uptake of plutonium from urine data.
AMERIN	A code for calculating biological half-life and ingrowth for mixtures of ^{241}Am and ^{241}Pu.
Pu.EXE	Utility for determining isotopic composition of aged plutonium mixtures
IMBA	IMBA Expert ™ USDOE Edition. A comprehensive internal dosimetry code implementing the ICRP 66 respiratory tract model and advanced recycling biokinetic models of ICRP.

3.3.8 Simplified Dose Assessments

The simplified dose assessment procedure is a standardized approach for assessing internal doses. The procedure is generally employed for

- calculations used in bioassay program design
- initial dose assessments when available bioassay and other data regarding the exposure are minimal
- final assessments for which the dose equivalent is relatively low.

Generally, the simplified dose assessment procedure is used for the final assessment of intakes resulting in CEDEs of less than 100 mrem.

The simplified dose assessment procedure employs the standardized excretion and retention functions and assumptions discussed previously in this section, as well as specific assumptions and methods described in the *Methods and Models of the Hanford Internal Dosimetry Program (PNNL-MA-860)*..

If the assessed dose calculated using the simplified dose assessment procedure exceeds 500 mrem CEDE, then models, methods, and assumptions are reviewed to determine their applicability.

3.3.9 Dose Assessment Flowcharts

Flowcharts have been developed to guide the assessment process for several situations where doses are usually small and may be complicated by environmental rather than occupational sources. These flowcharts were developed to allow practical decisions to be made without severely impacting the worker or the work when the consequences of a wrong decision are small. The following flowcharts and supporting items are provided at the end of this chapter:

Exhibit	Title
3.2	Determining Occupational and Nonoccupational Intakes
3.3	Baseline Samples - Tritium
3.4	Baseline Samples - Elemental or Isotopic Uranium
3.5	Chronic Exposure Assessment – ~~for soluble Uranium (class D) or similar with quarterly or more frequent monitoring.~~
3.6	Detection of Cesium-137 in the Whole Body Exam
3.7	In Vivo Exam Questionnaire
3.8	Review of Elemental Uranium Urinalysis Results

3.3.10 Internal Dose Assessment to the Embryo/Fetus

The internal dose to the embryo/fetus considers contributions from radionuclides deposited in the embryo/ fetus and dose equivalent arising from radionuclides deposited in the declared pregnant woman. Unless better information is available, the dose calculation methods described in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 8.36, "Radiation Dose to the Embryo/Fetus" (NRC 1992), ~~or ICRP Publication 88 (ICRP 2002)~~ shall be used.

3.4 Good Practice Recommendations for Field Dosimetry

Monitoring and assessing intakes at Hanford are accomplished through the mutual effort and cooperation of the IDP and Field Dosimetry. These activities are complementary; that is, the responsibilities of both the contractor and Internal Dosimetry must be fulfilled. The following recommendations are suggested by Internal Dosimetry as general guidance for Field Dosimetry administration of monitoring programs. In addition to this general guidance, Internal Dosimetry provides specific guidance and technical support as needed.

3.4.1 Identifying Routine Bioassay Monitoring Needs

The following good practice recommendations cover activities that are required for a complete internal dosimetry program:

- Identify the routine bioassay monitoring needs of individuals and arrange for a routine bioassay monitoring program that is responsive to these needs. The bioassay monitoring program should be radionuclide-specific; that is, the program should be established by radionuclide and exposure scenario, rather than by measurement type. General guidance on the needs of the bioassay monitoring program is provided in Chapter 5.0 of this manual. Internal Dosimetry can recommend measurement types to ensure the inclusion of radionuclides of concern.

- Apprise Internal Dosimetry of the radiological conditions in facilities. Include identification and physical and chemical characteristics of the radionuclides, as well as the potential internal exposure situations that exist.

- Contact Internal Dosimetry as needed for specific guidance and support in the setup and operation of the routine bioassay monitoring program.

- In cooperation with Internal Dosimetry, identify the radionuclides for which bioassay monitoring is not performed or is not adequate, and ensure that appropriate monitoring of these radionuclides (using other techniques) is provided. This could apply, for example, to short-lived radionuclides that cannot be reliably detected through routine bioassay monitoring.

- Maintain procedures for collecting workplace and personnel monitoring data, evaluating the data, documenting the results, and maintaining records.

3.4.2 Identifying Potential Intakes

Identify potential intake events and report these promptly to Internal Dosimetry. Assessments of internal dose are more accurate and can be performed with less expense if the intake time is known, if follow-up samples are collected shortly after intake, and if field data are available regarding the nature and characteristics of the exposure. Special bioassay measurements should be obtained if a worker incurs a potential intake of 0.02 ALI in an incident or over a short period of time.

3.4.3 Managing Internal Dose

Good practice in managing internal dose includes adhering to the following recommendations:

- Avoid potential intakes to workers until baseline bioassay measurements have been performed and prior exposure history has been reviewed.

- Consider the impact of intakes on allowable external exposure for workers with internal doses.

- Consider a work restriction if the committed dose from intakes significantly impacts administrative control levels.

- Consider a temporary work restriction to avoid exposure to similar radionuclides if such exposures could adversely affect an ongoing investigation of a potential intake.

- Provide long-term follow-up bioassay measurements for workers with significant internal depositions. These measurements track the retention of the radionuclide and establish a baseline against which to evaluate possible future exposures.

- Inform the worker of the status of the follow-up investigation and dose assessment.

3.5 Reference

International Commission on Radiological Protection (ICRP). 1979. "Limits for intakes of radionuclides by workers." IICRP Publication 30, Part 1.), *Annals of the ICRP*, 2:3-4, Pergamon Press, New York.

International Commission on Radiological Protection (ICRP). 1994. "Human respiratory tract model for radiological protection.". (ICRP Publication 66), *Annals of the ICRP*, 24:1-3, Pergamon Press, New York.

International Commission on Radiological Protection (ICRP). 2002. "Doses to the embryo and fetus from intakes of radionuclides by the mother. Corrected Version, May 2002" (ICRP Publication 88), *Annals of the ICRP*, 31:1-3, Pergamon Press, New York.

Jones, S. R. 1985. "Derivation and validation of a urinary excretion function for plutonium applicable over tens of years post uptake." *Radiation Protection Dosimetry* 11(1):19-27.

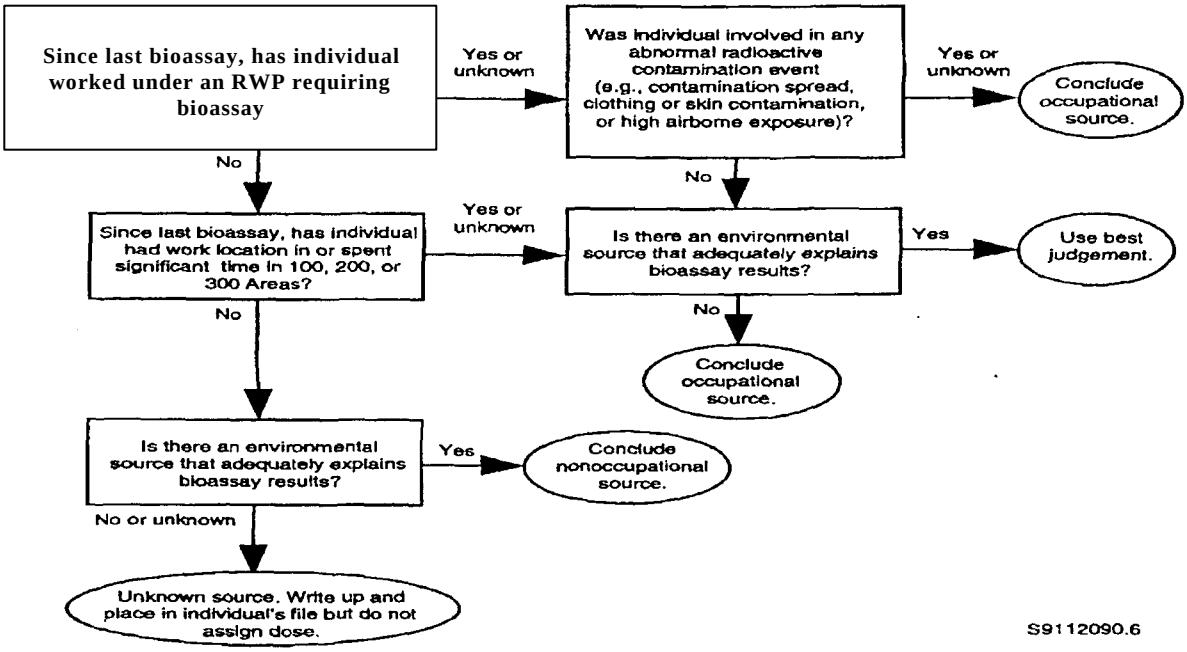
Pacific Northwest National Laboratory (PNNL). *Methods and Models of the Hanford Internal Dosimetry Program*, PNNL-MA-860. Richland, Washington. (Internal manual.) Available at URL http://www.pnl.gov/eshs/pub/pnnl860.html.

U.S. Nuclear Regulatory Commission (NRC). 1992. "Radiation Dose to the Embryo/Fetus." NRC Regulatory Guide 8.36, U.S. Government Printing Office, Washington, D.C.

EXHIBIT 3.1. Internal Dose Evaluation Report Form

Battelle Pacific Northwest Laboratories	STRICTLY PRIVATE EVALUATION OF POTENTIAL INTERNAL EXPOSURE		
Name	Payroll No.	Soc. Sec. No.	Potential Intake No.
Potential Intake Scenario:		Date of Potential Intake:	
Dose Evaluation Summary:			
Attachments:		Evaluated by: Reviewed by:	

EXHIBIT 3.2. Determining Occupational and Nonoccupational Intakes*



*Does not apply to ^{241}Am or plutonium because of possible increases over long time periods.

EXHIBIT 3.3. Baseline Samples - Tritium

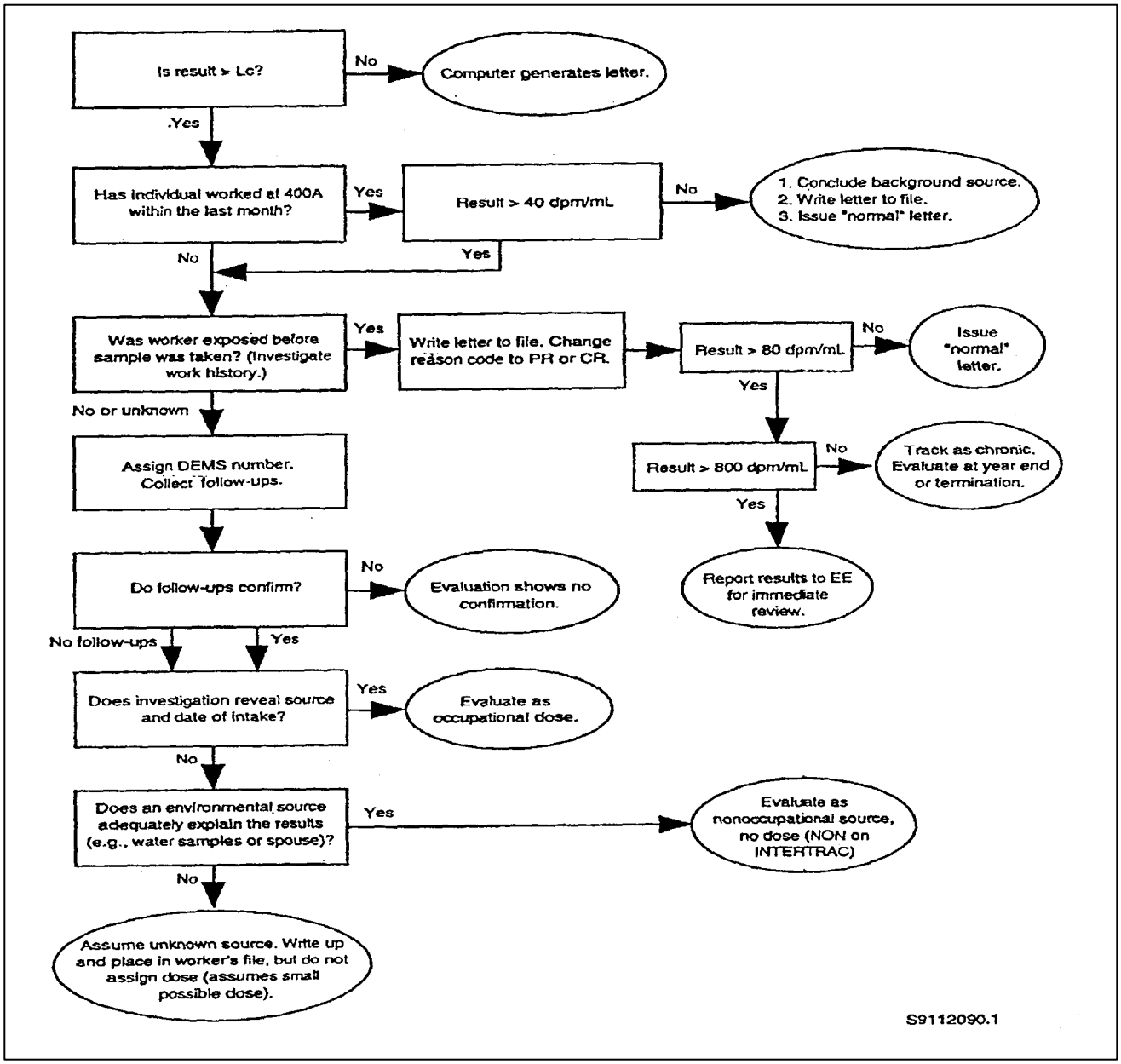


EXHIBIT 3.4. Baseline Samples - Elemental or Isotopic Uranium

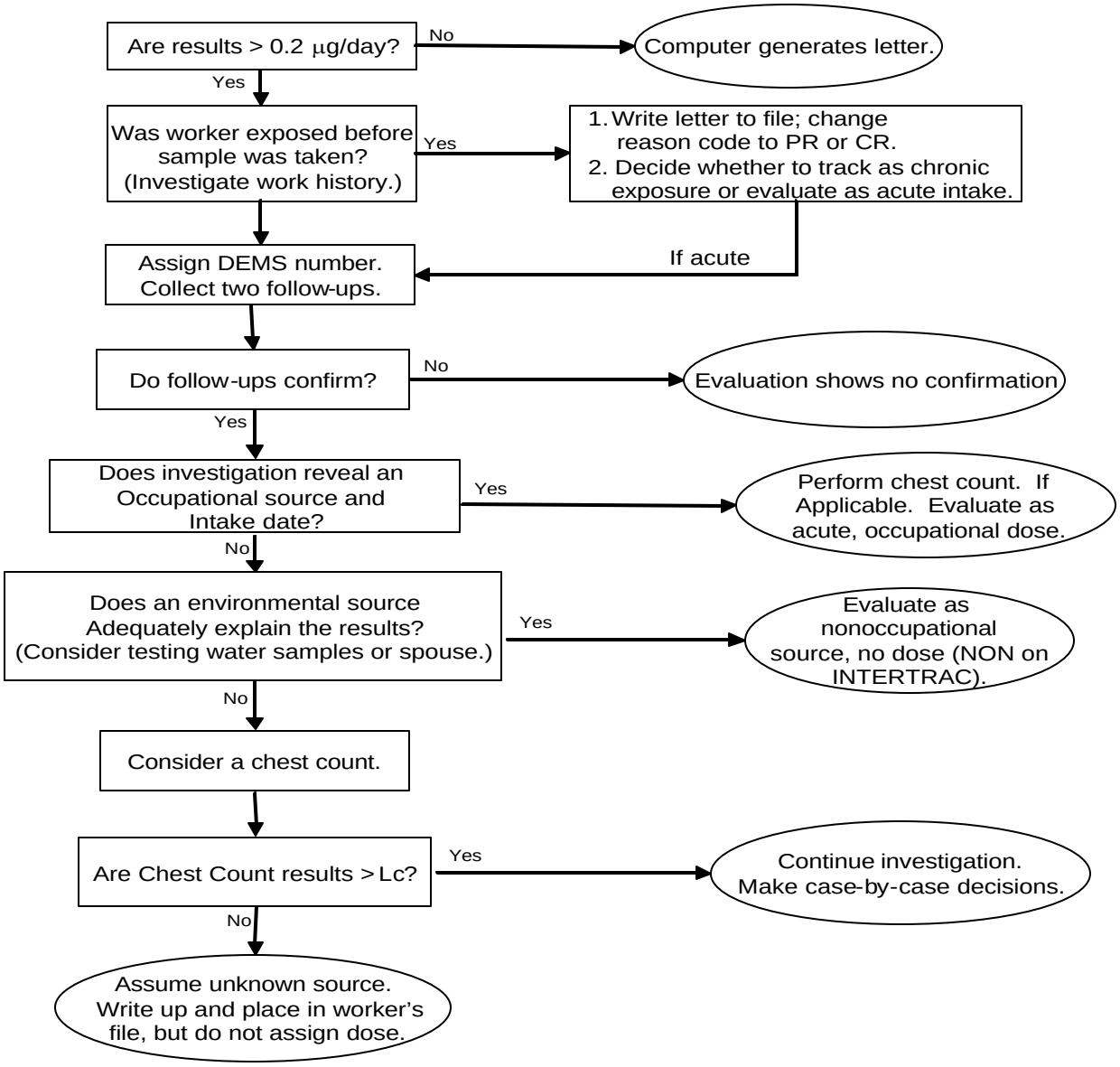


EXHIBIT 3.5. Chronic exposure assessment for soluble uranium (class D or similar) with quarterly or more frequent monitoring.

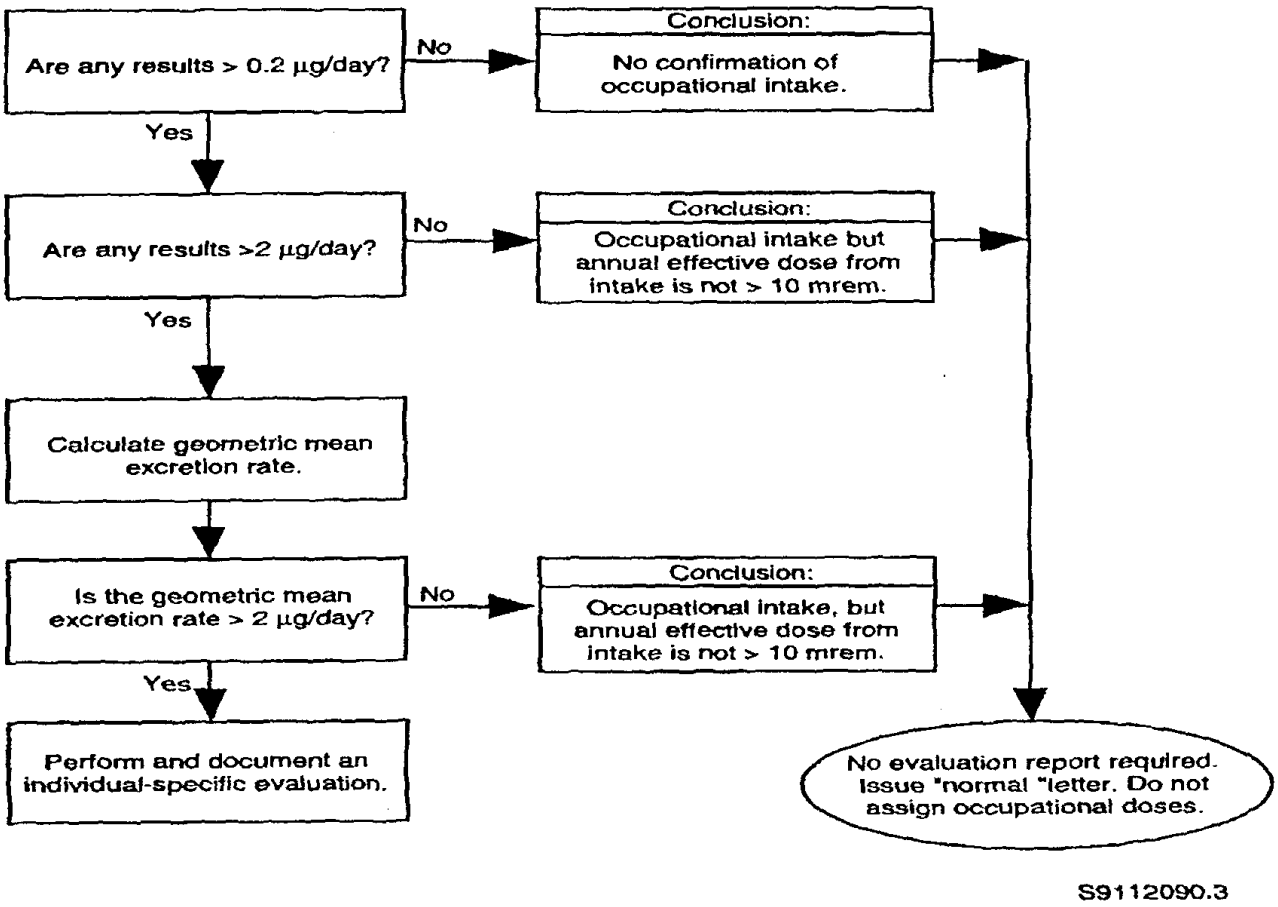


EXHIBIT 3.6. Detection of Cesium-137 in the Whole Body Exam

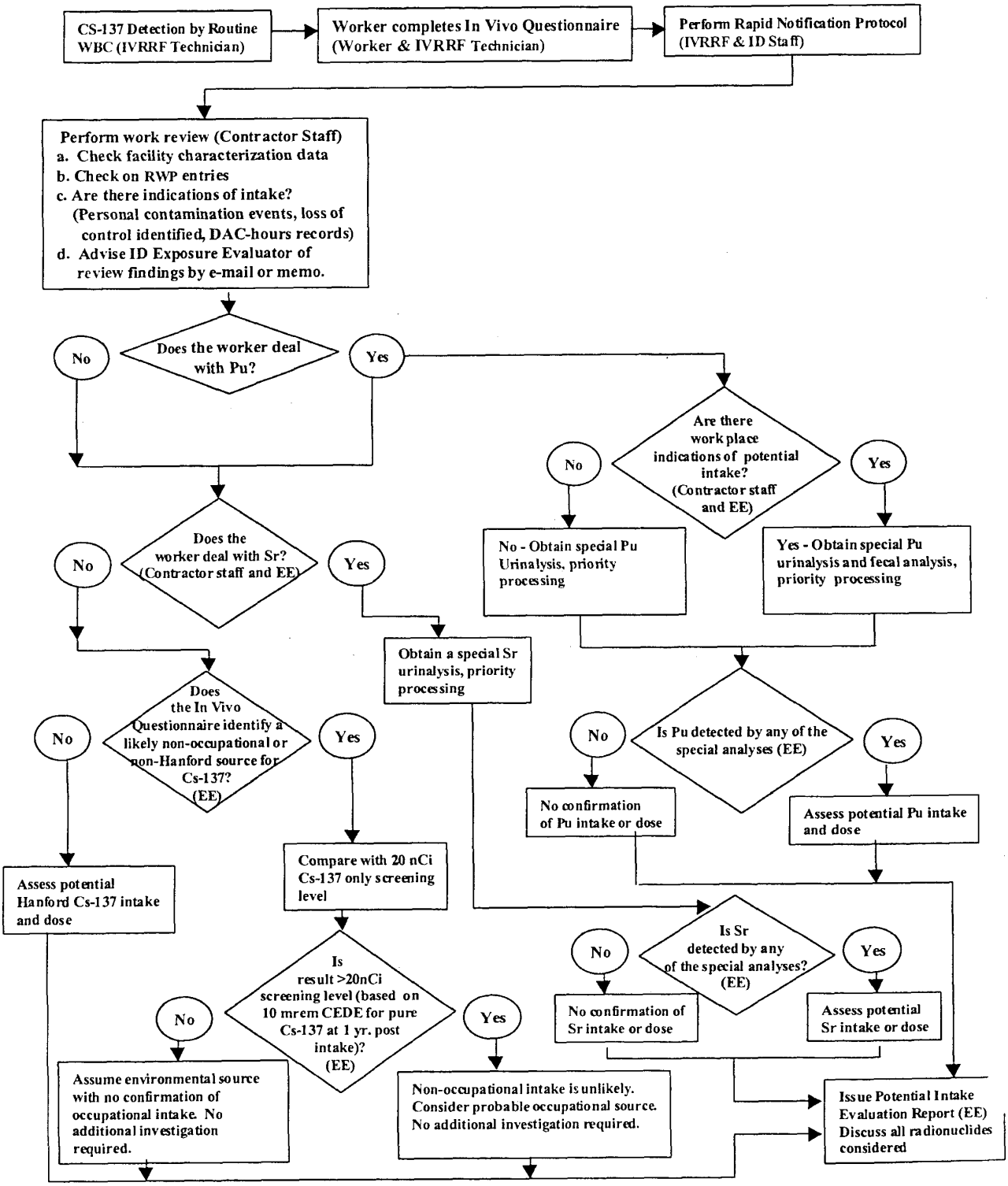


EXHIBIT 3.7. In Vivo Exam Questionnaire

IN VIVO EXAM QUESTIONNAIRE

Name: _____ Payroll No.:

Contractor: _____ Exam Date:

Your in vivo exam on the above date detected the presence of _____ Please answer the following questions to help us determine the follow-up required.

1. Yes No Since your exam, have you been involved in any incidents of personal contamination or potential intake?

If YES, please briefly describe where, when, and what happened.

2. Yes No If you have not been involved in any incidents, have you worked with or around unsealed sources containing the radionuclide identified in your exam?

If YES, and this work occurred at facilities other than Hanford, please indicate what facility and where it is, and when the work occurred.

3. For Cesium-137 (^{137}Cs) Only: This nuclide can occur naturally from some lifestyle choices.

Yes No Do you eat wild big game (e.g., deer, elk, moose)?

If YES, please describe:

Type of Game	Where Bagged	How Often	How Much

Yes No Have you recently (within the last year) been in Europe, Scandinavia, Russia, Ukraine, or Byelorussia or eaten foodstuffs from those areas?

If YES, please describe:

4. If you wish to make any additional comments that you think might be helpful in determining the source of the detected radioactivity, please note them here:

Please sign and date this form and return it to the technician who gave it to you, or mail it to Internal Dosimetry at MSIN P7-51. If you have any questions, contact your dosimetry representative.

_____

Your signature Date

EXHIBIT 3.7. In Vivo Exam Questionnaire (contd)

FOR INTERNAL DOSIMETRY USE ONLY

? Nonoccupational Source

? Below Occupational Screening Level

? Investigation Needed

Comments:

Internal Dosimetry

Date

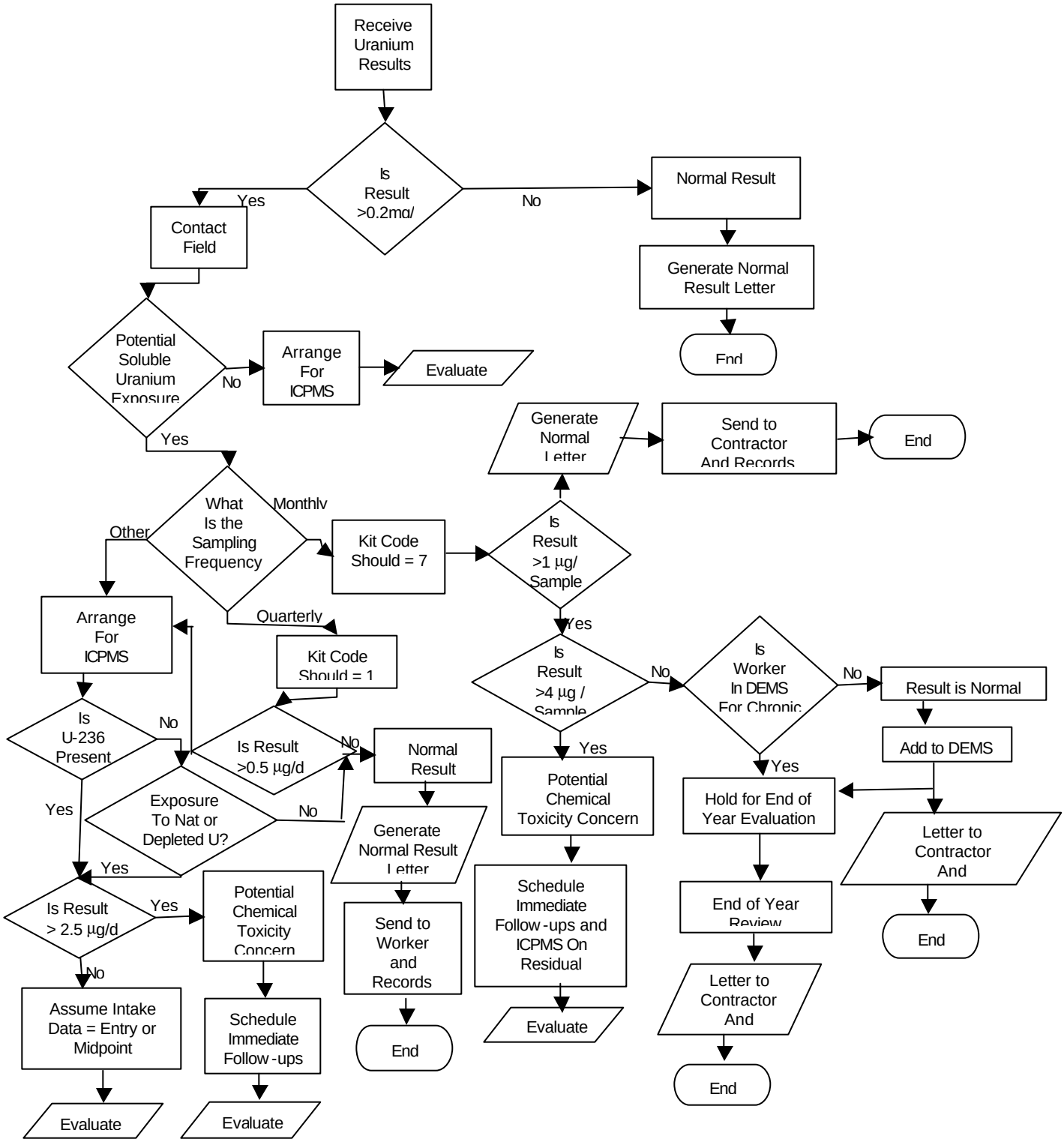



EXHIBIT 3.8. Review of Elemental Uranium Urinalysis Results