DEFENSE THREAT REDUCTION AGENCY

NUCLEAR TEST PERSONNEL REVIEW PROGRAM

RADIATION DOSE ASSESSMENT

Standard Operating Procedure

RA07 – Expedited Processing of Radiation Dose Assignments for Enewetak Cleanup Project Veterans

Revision 2.1

Cleared for Release

Key to SOP Name ID Codes

RA (Radiation Assessment – Standard Operating Procedures)
ED (External Dose – Standard Methods)
ID (Internal Dose – Standard Methods)
UA (Uncertainty Analysis – Standard Methods)

Revision Control			
Revision	Revision Description	Revision Date	Authorization Official
1.0	Original version	12/31/2021	James D. Franks
1.1	- Revised Figure 1 to include EPG assignment and DSS completion - Revised Sections 5.3 and 5.4 to clarify assigning and verifying EPG assignments, and identifying exclusions - Added EPG selection flowchart as new Figure 2 - Updated References - Added diabetes to Table A1-1 - Revised Section A2 to update the description of exclusions - Updated Tables A2-4 and A2-5 based on revised skin doses in Table A4-2 - Revised Attachment 3 to clarify and provide additional details of the EPG descriptions - Corrected skin doses for "Back of neck" in Table A4-2 - Minor editorial changes.	06/15/2022	James D. Franks
2.0	- Revised Attachment 2 to update list of applicable general exclusions and deletion of EPG-specific scenario exclusion - Revised Section A3-1 to exclude transporting soil-cement slurry reformed into concrete blocks, moved in dump trucks - Revised Section A3-2 to add transporting soil-cement slurry reformed into concrete blocks and moved in dump trucks - Corrected testes dose in Table A4-1 - Corrected shoulder and Torso (back, sides) doses in Table A4-2 - Minor editorial changes	04/30/2023	Lee A. Alleman
2.1	- Revised Sections 5.6 and 5.7 to add guidance for veteran cases with multiple claimed skin cancer sites when some sites are the subject of an exclusion and others are not.	11/30/2023	Lee A. Alleman

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Standard Operating Procedure

RA07 – Expedited Processing of Radiation Dose Assignments for Enewetak Cleanup Project Veterans

1. Purpose and Summary

This standard operating procedure (SOP) describes the roles, responsibilities, and methodology for processing Department of Defense (DoD) Defense Threat Reduction Agency (DTRA) Nuclear Test Personnel Review (NTPR) radiation dose assessments (RDAs). These assessments are performed in response to requests from the Department of Veterans Affairs (VA) on behalf of Enewetak Cleanup Project (ECUP) veterans. In particular, the SOP provides specific criteria and detailed actions to accomplish expedited processing of the majority of ECUP cases received by DTRA. Expedited processing involves assignment of upper-bound group-based estimated radiation doses to ECUP veterans without the need for individualized RDAs. Expedited processing of ECUP RDAs supports more timely response to VA requests and more timely decision-making for veterans' claims than if individual-specific, full RDAs are performed for every case. For ECUP cases not qualified for expedited processing under the criteria in this SOP, technical reviews and/or full RDAs for those cases will be conducted based on appropriate DTRA NTPR SOPs. Finally, requirements and procedures for data and records management, and associated quality assurance (QA) activities are provided for completing the processing of the case.

This SOP is written for qualified NTPR Research Analysts, DTRA Analysts, RDA Analysts, and QA Auditors who process and evaluate ECUP veteran cases received from the VA, and for managers who oversee the entire dose assessment process. The SOP conforms to procedures, methods, quality standards, and established NTPR policies and guidelines.

2. Scope

This SOP applies to all ECUP participants, defined as veterans participating in the cleanup of Enewetak Atoll from 1977 to 1980. All ECUP participant cases are initially evaluated for eligibility for expedited processing and processed according to the detailed methodology described herein. The doses to be assigned under expedited processing described in this SOP are likely to be below the doses that could result in service connection for a claimant. Cases that do not pass the evaluation for expedited processing under the criteria in this SOP require technical reviews and/or individualized dose assessments as discussed in SOP RA06. This SOP is applicable to cases involving cancers of internal organs and skin and is also applicable to non-cancerous conditions when requested by the VA and documented in the NTPR veteran case file.

3. Responsibilities

3.1 NTPR Research Analyst

The NTPR Research Analyst is responsible for conducting the initial case review. The tasks include the following activities:

- Completing the input fields of the DTRA Dose Summary Sheet (DSS) that provide historical and dose-related information from the Nuclear Test Research Information System (NuTRIS) database
- Summarizing veteran's comments and notating them with differences between historical and dose-related information from records and the veteran's comments
- Documenting any special considerations or potential exclusions from expedited processing in the DSS
- Identifying the applicable expedited processing group (EPG) and corresponding doses based on the veteran's scenario of participation and affected organ(s), tissue(s), disease(s), or skin sites; Attachment 1 provides a cross-reference of an extensive list of organs and diseases along with the corresponding surrogate ECUP standard organs or diseases for which EPG doses have been estimated.

3.2 DTRA NTPR Case Manager/DTRA Analyst

The DTRA NTPR Case Manager or the Manager's designee performs most tasks required to assign the expedited processing doses estimated in DTRA (2023), to include the following:

- Reviewing veteran-provided, historical, NTPR-developed, and other information pertinent to the veteran's potential exposure
- Determining the need for additional, veteran-specific information
- Determining the applicability of the expedited processing dose assignments for an individual veteran's case
- Requesting further technical evaluation by an RDA Analyst and reviewing the findings of the evaluation
- Documenting the radiation dose assignment evaluation and basis of the decision-making process in the DTRA DSS
- Assigning, if applicable, and documenting the assignment of expedited processing doses from this SOP in the DTRA DSS and the VA response letter
- Evaluating the results of QA Auditor reviews and taking any corrective actions.

3.3 Radiation Dose Assessment Analyst (RDA Analyst)

An RDA Analyst performs dose assessment tasks, when required, for a veteran who has filed a claim with the VA for service-connected diseases and a dose request is received from DTRA. At the request of the DTRA Analyst, the RDA Analyst provides consultative discussions during any further evaluation of a case by the DTRA Analyst, to assist in determining the applicability of the expedited processing dose assignment. When the case does not qualify for expedited processing under the criteria in this SOP, the RDA Analyst is requested to perform a technical review and/or full RDA in accordance with SOP RA06. The analyst's tasks include simplification, modification, or development of dose calculation tools and preparation of a report that is specific to the veteran.

3.4 Quality Assurance Auditor

The quality assurance auditor (QA Auditor), with the assistance of a QA reviewer as needed, performs and documents independent quality assurance/quality control (QA/QC) reviews of the decision-making process and the resulting dose assignment and/or RDA documentation. The audit is performed to ensure that the documentation is clear, complete, and prepared in accordance with NTPR policies and procedures. The QA Auditor documents the results of the review on a QA/QC Review Report. (DTRA, 2022)

4. Definitions

DoD	Department of Defense
Dose component	Potential contributors to total organ or skin dose, including: ▪ External gamma dose from residual radiation ▪ External dose from other sources (e.g., radiological samples, diagnostic x-ray machine) ▪ Internal alpha organ dose ▪ Internal beta plus gamma organ dose ▪ Dermal contamination skin dose.
DSS	Dose Summary Sheet
DTRA	Defense Threat Reduction Agency
ECUP	Enewetak Cleanup Project
EPG	Expedited processing group as described in DTRA (2023)
EPG Doses	Expedited processing group doses, the estimated upper-bound dose values for external gamma, internal alpha, and internal beta plus gamma radiation (for internal organs); external beta and gamma, and dermal contamination doses (for skin)
Full RDA	An RDA developed by an RDA Analyst that uses veteran-specific dose parameter values to estimate doses and upper-bound doses in

	accordance with SOP RA06. A full RDA is performed for cases that are excluded from expedited processing
Further evaluation	Case file evaluation beyond the initial review by the DTRA Analyst. Further evaluation of an ECUP case may include one or both of the following actions: ▪ An additional documented DTRA Analyst review, supplemented with an RDA Analyst consultation as needed ▪ A technical review by an RDA Analyst, or recommendation to prepare a full RDA in accordance with SOP RA06.
LD	Limiting dose, radiation dose value that corresponds to a 40 percent probability of causation for cancers
LDα	Limiting dose based entirely on alpha radiation, listed in DTRA (2023) and Attachment 2 of this document
NIOSH-IREP	National Institute of Occupational Safety and Health-Interactive RadioEpidemiological Program, an online software application used to calculate the probability that a cancer was caused by a radiation dose (NIOSH, 2020)
NTPR	Nuclear Test Personnel Review
NuTRIS	Nuclear Test Research Information System: a computerized database containing veteran information and dosimetry data
PM	Program manager
QA	Quality assurance
QC	Quality control
RDA	Radiation dose assessment (see “Full RDA” above)
SOP	Standard Operating Procedure
Surrogate organ or skin site	An ECUP standard organ/skin site used for dose calculations as a substitute organ/skin site when no published dose coefficients are available for the requested disease or medical condition for the organ/skin site
Target organ/skin site	The biological organ, tissue, or skin site that is associated with the specific medical condition specified by the VA for which a radiation dose determination has been requested
TOD	Total organ dose, the total of all external and internal dose components for a target organ
VA	Department of Veterans Affairs

5. Procedure: Detailed Activity/Task Description

The methodology for expedited processing of NTPR ECUP cases described in this SOP utilizes the supporting technical information and the maximized EPG doses documented in DTRA (2023). The maximized EPG doses were developed for four broadly defined groups of exposed individuals: Soil Removal Workers, Northern Island Workers, Lojwa Support Workers, and Southern Island Workers. The EPG doses are not intended to be representations of doses actually received by an ECUP veteran. However, the EPG doses bound the actual doses received by any individual included in an EPG.

The major SOP actions are shown in the process overview diagram (Figure 1). The responsible NTPR personnel and more detailed activities are described in the text following Figure 1.

5.1 Initial Case Review by NTPR Research Analyst

The decision to expedite or otherwise respond to a VA claim inquiry starts with review by the NTPR Research Analyst of the program participant's identified diseases and the request and receipt of required records and other information in accordance with the NTPR Program Support and Management SOP (DTRA, 2021). The NTPR Research Analyst identifies any exclusions deemed necessary and appropriate based on the review. The NTPR Research Analyst reviews case file information that may include, but is not limited to, the following:

- Veteran-provided information, including comments, identification of unusual exposure conditions, and answers to questionnaires regarding the potential exposures
- VA-furnished information, particularly the disease(s), target organ(s), or target skin site(s) for which the doses are requested
- Historical veteran- and assignment-specific information
- Additional medical opinion(s) available regarding the disease(s), target organ(s), or target skin site(s).

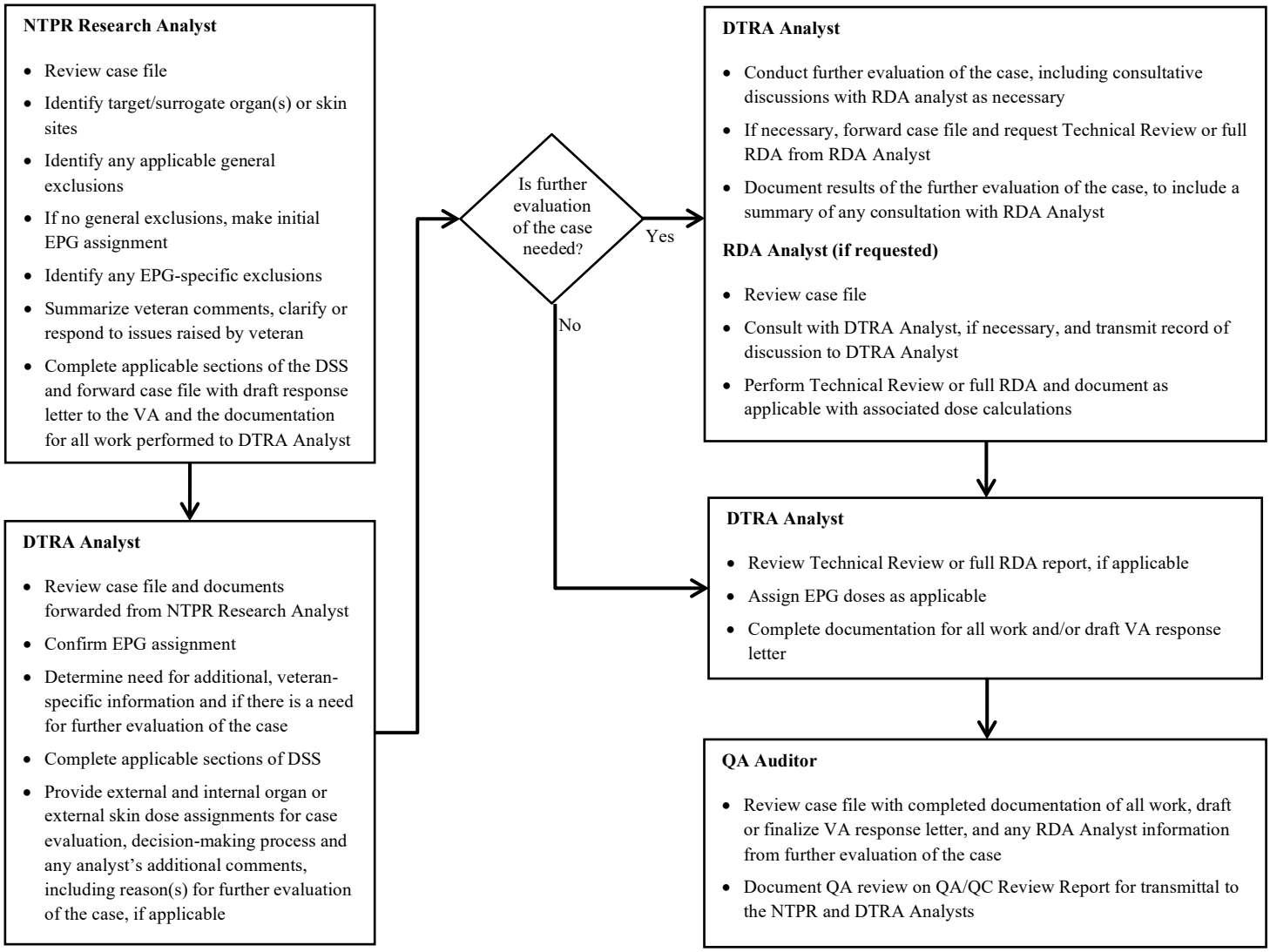


Figure 1. Expedited Processing of ECUP Dose Assessment – Process Overview

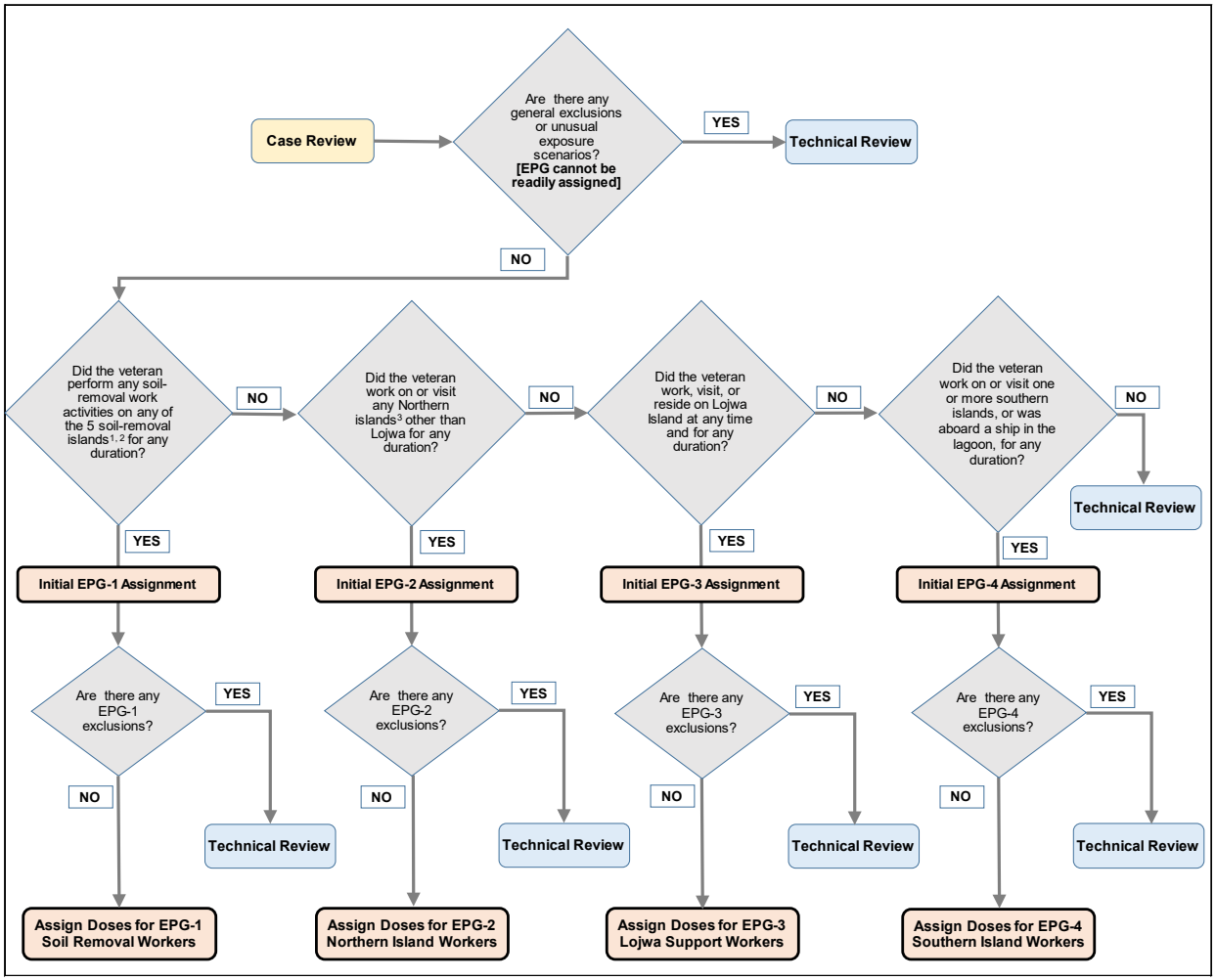
5.2 Identification of Standard or Surrogate Organ/Skin Site

The NTPR Research Analyst uses the VA dose request, which specifies the target organ, tissue, skin site, or disease, to identify the corresponding ECUP standard organ, tissue, or skin site. The ECUP standard organs and tissues are listed in Table A4-1 with the estimated organ doses, and are cross-referenced to target organs, tissues, and diseases in Table A1-1. The ECUP standard skin sites are listed in Table A4-2 along with the estimated skin doses. The identified standard organ/skin site is either the same as the target organ/skin site, or in the case where the target organ/skin site or disease is not a standard organ/skin site, it is a surrogate organ/skin site for the specified target organ, tissue, skin site, or disease. The NTPR Research Analyst documents the identified organ, tissue, or skin site in the DSS.

5.3 Assignment of EPG and Documentation in the Dose Summary Sheet by NTPR Research Analyst

Following the initial case review, the NTPR Research Analyst completes the "Research Analyst's Comments" section of the DTRA DSS. The following tasks need to be performed to complete the section:

- Summarize veteran comments, particularly those that might pertain to, or that the veteran might expect to pertain to, potential radiation exposure
- Clarify or respond to issues raised by the veteran when available pertinent historical information differs from the veteran's comments
- Identify any applicable general exclusions per Figure 2 and Attachment 2
- Make an initial EPG assignment using the EPG selection flowchart shown in Figure 2 and the EPG definitions contained in Attachment 3. If multiple EPGs are applicable to a veteran, assign the EPG with the highest doses regardless of the duration of time spent under each EPG. (See note below)
- Identify any applicable EPG-specific exclusions
- If no EPG-specific exclusions, assign the applicable EPG doses corresponding to the ECUP standard organs or skin sites as reported in Table A4-1 and Table A4-2
- Prepare a draft response letter for reporting NTPR assigned doses to the VA; for VA dose requests that are for a specific disease instead of a physical location or organ, such as chronic lymphocytic leukemia (CLL), the requested disease should be indicated in the draft VA response letter.



1. Soil-removal work activities are discussed in Section A3-1.
2. The 5 soil-removal islands are Boken (Irene), Enjebi (Janet), Lujor (Pearl), Aomon (Sally), and Runit (Yvonne).
3. The northern islands of Enewetak Atoll are defined in Section A3-2.

Figure 2. EPG selection flowchart

Note: For assigning doses when multiple EPGs are applicable to a veteran, the order of EPGs from highest to lowest doses is as follows:

1) Soil Removal Workers (EPG-1)
2) Northern Island Workers (EPG-2)
3) Lojwa Support Workers (EPG-3)
4) Southern Island Workers (EPG-4)

Although evidentiary documents may be missing to confirm a veteran's presence at a specific worksite given in statements or answers by the veteran, the veteran's information must be accepted unless other relevant documents or records are produced as proof the veteran was at a different location.

The NTPR Research Analyst then forwards the case, including the DTRA DSS and the draft response letter to the VA, to the DTRA Analyst for review and decision on dose assignment.

5.4 DTRA Analyst Case Review

The DTRA Analyst reviews available case information, including completed portions of the DTRA DSS, and conducts the following actions:

- Review the case file, including, as applicable, the information summarized by the NTPR Research Analyst, veteran comments, and clarifications and responses to the veteran's comments documented in the DSS
- Verify that the ECUP standard organ or tissue or skin site is correctly identified and, if necessary, request an expert medical opinion from a professional who is qualified and knowledgeable about radiogenic illnesses regarding the applicable standard organ/skin site or the radiogenicity of a medical condition
- Verify that the selected EPG is the applicable EPG based on the selection flowchart shown in Figure 2 and the EPG definitions contained in Attachment 3
- Check that any identified exclusions are necessary and appropriate
- Request additional veteran-specific information, if needed.

Following review and any subsequent actions as identified below, the DTRA Analyst provides the analyst comments, documents external and internal organ dose assignments in the DSS, and justification in the response letter to the VA. For cases in which the RDA Analyst completes a technical review or a full RDA, the total rounded external and internal doses are reported in the final VA response letter.

5.5 Further Evaluation of a Case

During review of the case file, the DTRA Analyst determines whether the applicable EPG Total Organ Dose (TOD) or total skin dose can be assigned, or if the case requires further evaluation to assign the appropriate dose components. The case requires further evaluation if it involves **any** of the following conditions:

- The applicable EPG TOD as shown in Table A4-1 is greater than the corresponding Limiting Dose (LDα) listed in Table A2-1. These exclusions are identified in Table A2-2.
- The applicable EPG Total Skin Dose(s) as shown in Table A4-2 is greater than the applicable LDα listed in Table A2-3. These exclusions are identified in Table A2-4 and Table A2-5.
- There is no applicable EPG for the veteran's exposure scenario.
- There are unusual aspects, or a poorly defined veteran exposure scenario identified by the DTRA Analyst; this type of exclusion would be driven by the veteran's exposure scenario that includes possible sources/pathways not fully accounted for by any of the EPG scenarios. General exclusions are identified in Section A2-1.

When further evaluation of a veteran's case is required to determine the appropriate dose components, a more detailed review by the DTRA Analyst should be performed. If deemed necessary, an RDA Analyst should be requested to perform a technical review and/or a full RDA.

A more detailed DTRA Analyst review is used to determine if the veteran's specific exposure scenario clearly indicates that the EPG TOD or EPG total skin dose is bounding to the veteran's actual TOD or total skin dose. If this cannot be determined, the DTRA Analyst requests a technical review or a full RDA due to indications of potential exposure beyond the criteria that define the applicable EPG.

The DTRA Analyst may request informal consultation with an RDA Analyst during this additional review. This consultation will normally consist of discussions and possibly minimal calculations or data evaluation so that the DTRA Analyst is able to determine if the EPG doses are adequate to assign or if a technical review or full RDA is required. If the RDA Analyst is consulted during the review, the RDA Analyst transmits a record of the communication to the DTRA Analyst to document the consultation.

If, after additional review, the DTRA Analyst determines that EPG doses are adequate to assign, i.e., the veteran's estimated TOD or total skin dose is less than both the EPG dose and the applicable LDα, the DTRA Analyst prepares a summary that documents the review and all pertinent results. If the EPG doses cannot be assigned, the case is excluded from expedited processing and the case is referred to an RDA Analyst for a technical review and/or full RDA as described in the following section.

5.6 RDA Analyst Technical Review

If the DTRA Analyst determines that the case is excluded from expedited processing, a technical review and/or full RDA is conducted by an RDA Analyst. The tasks involved in the technical review by an RDA Analyst include the following:

- Reviewing the case file, and if additional veteran-specific information is necessary to evaluate a case, requesting assistance from the DTRA NTPR Case Manager
- Performing technical review dose assessment by following the general methodology used for full ECUP RDA dose estimates (SOP RA06) with additional simplifications, minimal detailed calculations, and the use of maximum plausible parameter values to expedite the determination of bounding doses for the veteran's specific scenario; see note below for guidance in the case of multiple skin cancer sites.
- Comparing the estimated bounding TOD or total skin dose to the applicable EPG TOD or total skin dose, and for cancers verifying that it is less than the applicable LDα
- Documenting the technical review in the form of a memorandum with or without supporting dose calculations
- Recommending a full RDA to the DTRA Analyst if the estimate of the veteran's bounding TOD or total skin dose is greater than the applicable LDα.

NOTE: *When multiple skin cancer sites are part of a claim in a veteran's case, bounding doses should be estimated using the same veteran-specific exposure scenario dose parameter values regardless of whether the skin cancer site is the subject of an exclusion or not*.

If a full RDA is recommended, it should address all radiation dose components using detailed assumptions and calculations and should be performed and documented in accordance with SOP RA06. This requirement will be limited to cases excluded from expedited processing because the bounding TOD or bounding total skin dose is greater than the applicable LDα, or to cases where the veteran claims an unusual radiation exposure scenario that includes pathways not fully accounted for by any of the EPG scenarios and the selected ECUP default assumptions described in DTRA (2023).

If a full RDA is required, the DTRA Analyst documents the reason(s) for the full RDA requirement. The RDA Analyst completes and transmits the RDA report and accompanying calculations to the DTRA Analyst for review and inclusion in the case file.

5.7 Assigning Doses

Dose assignments are completed by the DTRA Analyst and transmitted to the DTRA NTPR Case Manager for inclusion in the veteran case file using the following guidance; see note below for guidance in the case of multiple skin cancer sites:

- If the participant is not excluded from expedited processing per Section 5.5, the DTRA Analyst assigns the applicable EPG dose components for the requested organ(s), disease, and/or skin cancer(s). All ECUP EPG doses are reported in Attachment 4.

  When a technical review is performed because the EPG TOD or total skin dose is greater than the applicable LDα, all estimated bounding dose components are assigned. In the case of cancers, the bounding TOD or total skin dose must be lower than the respective LDα.

- When a technical review is performed for reasons other than the EPG TOD is greater than the applicable LDα (e.g., unusual aspects to a veteran's exposure scenario), the dose components (bounding or EPG) that result in the larger TOD or total skin dose are assigned. In the case of cancers, the assigned TOD or total skin dose must be lower than the respective LDα.

- If a full RDA is performed, the DTRA Analyst assigns all dose components from the RDA report to the affected organs/diseases and/or skin sites.

NOTE: *When multiple skin cancer sites are claimed in a veteran's case, bounding doses for each skin cancer site should be assigned as estimated using the same veteran-specific exposure scenario dose parameter values; see note in Section 5.6. This applies regardless of whether the skin cancer site is the subject of an exclusion or not*.

5.8 Quality Assurance Auditor Review

The QA Auditor reviews the case file and records the performance of the quality review of the decision-making process, the DSS, the draft VA response letter, RDA Analyst documentation (if applicable), and the resulting dose assignment for clarity, completeness, and conformance to the NTPR Quality Assurance SOP (DTRA, 2022). The QA Auditor may be assisted by a QA reviewer in this review. A QA reviewer is a peer analyst from the team described in Sections 3.1, 3.2, and 3.3. If corrections or changes are recommended by the QA Auditor, actions described above in this section should be repeated as appropriate for the completion and documentation of the dose assignment and results to the VA.

6. Data and Records Management

Documentation resulting from implementation of this SOP is added to the case file and may include any of the following:

- Relevant documentation obtained or developed in accordance with DTRA (2021)
- NTPR Research Analyst's additions to the required documentation per Sections 5.1, 5.2, and 5.3
- DTRA Analyst's additions to the required documentation per Section 5.4 to 5.7

- Results of consultation with an RDA Analyst, consisting of a brief summary of any communications
- A technical review memorandum or an RDA Report and supporting radiation dose calculations, in accordance with SOP RA06 if a full RDA is performed
- Report of the QA Auditor QA/QC review
- Draft and/or final VA response letter.

7. Quality Assurance and Quality Control

The NTPR Quality Assurance SOP (DTRA, 2022) describes the quality procedures for controlling the NTPR processes and products to ensure that defensible, consistent, and objective case processing is accomplished. In addition, NTPR Program Support and Management SOPs (DTRA, 2021) and RDA SOPs have been written to ensure that QA requirements will be met, by documenting the procedures for all aspects of the program, including records research, case processing, dose assessments, and standard report template. Finally, when technical reviews are requested or full RDAs are recommended, the NTPR ECUP radiation dose assessment procedure, SOP RA06, and references therein provide conservative default assumptions and parameter values that further ensure consistency and defensibility of all dose assessments.

If a technical review is required because of identified exclusions or when a full RDA is recommended, internal quality control checks are performed throughout the dose estimation and reporting process. The RDA Analyst discusses with members of the RDA team proposed assumptions to perform the required dose estimations until a consensus on best approach to proceed is reached. Technical reviews of the draft Technical Review Memorandum are conducted by peer radiation analysts from the RDA team. When a full RDA is recommended, all aspects of the dose assessment including quality management are performed in accordance with SOP RA06. Consistency and conformance with policies and guidelines are further assured through the RDA team management review.

Further quality control actions are conducted by independent external reviewers according to the NTPR Quality Assurance SOP (DTRA, 2022). For this procedure, external reviews are defined as reviews conducted by qualified analysts who are not part of the RDA team. For full RDAs, the RDA Report is revised in response to significant comments from such external reviews in accordance with SOP RA06.

Independent review of the records, process, and results related to radiation dose assignment, including expedited processing, with or without a technical review, and full RDAs, is performed and documented by the QA Auditor. Results of case processing and quality reviews are reported to DTRA NTPR program management during semi-annual NTPR Program Management Reviews and the Reported Quality Issues spreadsheet.

8. Referenced SOPs from the NTPR/RDA SOP Manual

(1) SOP RA02 Expedited Processing of Radiation Dose Assessments for Atmospheric Nuclear Weapons Testing Veterans

(2) SOP RA06 Radiation Dose Assessment for Participants in the Enewetak Cleanup Project

9. References

DTRA (Defense Threat Reduction Agency), 2021. *DTRA NTPR Program Support and Management SOP (Rev. 7)*. Defense Threat Reduction Agency, Fort Belvoir, VA. October 29.

DTRA (Defense Threat Reduction Agency), 2022. *DTRA NTPR Program Quality Assurance SOP, Revision 6*, Fort Belvoir, VA. February 28.

DTRA (Defense Threat Reduction Agency), 2023. *Expedited Processing of Radiation Dose Assessments for Military Personnel of the Enewetak Atoll Cleanup Project (1977–1980) Revision 1.* DTRA-TR-21-050(R1), Defense Threat Reduction Agency, Fort Belvoir, VA. In review, to be published in December 2023.

ICRP (International Commission on Radiological Protection), 2011. *ICRP Database of Dose Coefficients: Workers and Members of the Public, Version 3.0*. The International Commission on Radiological Protection, Ottawa, Ontario.

NIOSH (National Institute for Occupational Safety and Health), 2020. *Interactive RadioEpidemiological Program, NIOSH-IREP ver. 5.9.* National Institute for Occupational Safety and Health, Washington, DC. December. Available at: https://irep.oraucoc.org/, accessed August 25, 2021.

Attachment 1.

Organ and Disease/Standard Organ Cross-References

Table A1-1. Cross-Reference of diseased organs, ECUP standard organs, and NIOSH-IREP cancer models

Organ, Tissue, or Disease	ECUP Standard Organ*	ECUP Standard Organ Type†	NIOSH-IREP Cancer Model
Acute lymphocytic leukemia (ALL)	Red Marrow	Surrogate	Acute Lymphocytic Leukemia
Acute myeloid leukemia (AML)	Red Marrow	Surrogate	Acute Myeloid Leukemia
Adrenal glands	Adrenals	**ICRP**	Other endocrine glands
Arthritic tissue	Bone Surface	Surrogate	Not applicable (not a malignant neoplasm)
Bladder	Bladder Wall	**ICRP**	Bladder
Blood, **bone marrow, red marrow**, yellow marrow	Red Marrow	**ICRP,** Surrogate	Leukemia, excluding CLL
Bone, bone surface, endosteum, joints, and all other **bones** (e.g., ankle, **elbow, femur**, hand, jaw, **pelvis,** shoulder, spine, vertebrae)	**Bone Surface**	**ICRP**, Surrogate	Bone
Brain, anterior commissure, brain stem, cranial nerve	Brain	**ICRP**, Surrogate	Nervous system
Breast	Breast	**ICRP**	Breast
Cervix	Uterus	Surrogate	Female Genitalia, excluding ovary
Chronic lymphocytic leukemia (CLL)	Spleen	Surrogate	Chronic Lymphocytic Leukemia

Organ, Tissue, or Disease	ECUP Standard Organ*	ECUP Standard Organ Type†	NIOSH-IREP Cancer Model
Chronic myeloid leukemia (CML)	Red Marrow	Surrogate	Chronic Myeloid Leukemia
Colon	Colon	**ICRP**	Colon
Connective tissue	Muscle	Surrogate	Connective tissue
Diabetes (type 1, type 2)	Pancreas	Surrogate	Not applicable (not a malignant neoplasm)
Endocrine glands (endocrine glands not included elsewhere)	Specific diseased organ must be known.	Surrogate	Other endocrine glands
Esophagus	Esophagus	**ICRP**	Esophagus
Eye, choroid, retina	Brain	Surrogate	Eye
Gallbladder, bile duct	Liver	Surrogate	Gallbladder
Heart, aorta, atrial sarcoma	Muscle	Surrogate	Other respiratory
Kidney	Kidneys	**ICRP**	Urinary organs, excluding bladder
Larynx, including glottis, vocal cords	ET Airways‡	Surrogate	Other respiratory
Leukemia (excluding ALL, AML, CLL, and CML)	Red Marrow	Surrogate	Leukemia, excluding CLL
Lipoma	Muscle	Surrogate	Not applicable (not a malignant neoplasm)
Liver	Liver	**ICRP**	Liver
Lower large intestine, large intestine	LLI Wall‡	**ICRP**	Colon
Lung, trachea, bronchus	Lungs	**ICRP,** Surrogate	Lung
Lymph system, including lymph glands, lymph nodes, lymphatic tissue, lymphoma	Thymus (If this is primary disease)	Surrogate	Lymphoma and multiple myeloma

Organ, Tissue, or Disease	ECUP Standard Organ*	ECUP Standard Organ Type†	NIOSH-IREP Cancer Model
Middle ear	Brain	Surrogate	Other respiratory
Multiple myeloma	Red Marrow	Surrogate	Lymphoma and multiple myeloma
Muscle, including, **thigh muscle**, eye muscle, eyelid muscle, neuro-muscular	Muscle	**ICRP**, Surrogate	Other and ill-defined sites
Nasal cavities, including sinus (maxillary), sinus (nasal), nasal tip	ET Airways‡	Surrogate	Other respiratory
Nervous system, spinal cord, spine nerves	Brain	Surrogate	Nervous system
Neuroendocrine system, including hypothalamus, pituitary gland, pineal gland	Brain	Surrogate	Other endocrine glands
Oral cavity and pharynx, including epiglottis, gum, hypopharynx, lip, mouth, nasopharynx, oropharynx, palate, parotid gland, salivary gland, throat, tongue, tonsil, uvula, and nasolabial fold (specific disease needed if not skin cancer)	ET Airways‡	Surrogate	Oral Cavity and Pharynx
Ovary	Ovaries	**ICRP**	Ovary
Pancreas	Pancreas	**ICRP**	Pancreas
Parathyroid	Thyroid	Surrogate	Other endocrine glands
Peritoneum, peritoneal cavity muscle	Muscle	Surrogate	All digestive
Pleura	Lungs	Surrogate	Other respiratory
Prostate	Testes	Surrogate	All Male Genitalia
Rectum, anus, anal canal	LLI Wall‡	Surrogate	Rectum
Respiratory other than Lung	ET Airways‡	Surrogate	Other respiratory

Organ, Tissue, or Disease	ECUP Standard Organ*	ECUP Standard Organ Type†	NIOSH-IREP Cancer Model
Small intestine, duodenum	SI Wall‡	**ICRP,** Surrogate	All digestive
Soft tissue, e.g., hip, shoulder, thigh, upper arm	Muscle	Surrogate	Other and ill-defined sites
Spleen	Spleen (Use only if solid cancer of spleen is the primary disease)	**ICRP**	All digestive
Stomach	Stomach Wall	**ICRP**	Stomach
Testes and other male genitalia, including penis and scrotum	Testes	**ICRP**, Surrogate	All Male Genitalia
Thymus	Thymus	**ICRP**	Other respiratory
Thyroid	Thyroid	**ICRP**	Thyroid
Upper large intestine, including appendix, cecum	ULI Wall‡	**ICRP**, Surrogate	Colon
Urinary tract, urethra, ureter	Bladder Wall	Surrogate	Urinary organs, excluding bladder
Uterus	Uterus	**ICRP**	Female Genitalia, excluding ovary

* Modified from Table A2-1 of SOP RA02. Several modifications were made due to use of ICRP organs for ECUP instead of FIIDOS organs used for SOP RA02.

† ICRP (in bold) means that there are ICRP 68 dose coefficients for the organ(s) in bold. "Surrogate" means that dose coefficients for the ECUP Standard Organ are used for the non-bolded diseased organ(s).

‡ ET=extra-thoracic, LLI=lower large intestine, SI=small intestine, ULI = upper large intestine

Attachment 2.

ECUP Veteran Cases Excluded from Expedited Processing

ECUP participants may be excluded from automatic expedited processing for several reasons. Although unlikely to be frequent, there may be cases in which there is insufficient information regarding a veteran's activities to justify expedited processing of the case. Another reason for exclusion from automatic expedited processing is for cases where information provided from the veteran indicates activities that represent the potential for doses higher than the applicable EPG doses. Finally, a case is excluded from automatic expedited processing if the applicable EPG TOD or total skin dose is greater than the LD value that is applicable to the target organ or skin site. Cases involving any of these situations are subjected to further review as described in Section 5.5. Several scenarios previously identified as exclusions or potential exclusions have been reevaluated and eliminated (DTRA, 2023). General and EPG-specific exclusions that should trigger a further evaluation by an RDA Analyst are discussed below.

A2-1 General Exclusions

Certain activities may have resulted in exposure scenarios that do not fit within any of the EPG definitions provided in Attachment 3. Possible activities that could initiate further review of a case are listed below and should be considered on a case-by-case basis as potential exclusions from expedited processing:

- Removing plutonium fragments from burial crypts on Aomon
- Disposing soil bags with plutonium fragments from Fig-Quince ground zero area on Runit
- Removing concentrated contaminated material from outside of the bunkers on Boken
- Participating in duties at the Decontamination Laundry Facility on Lojwa
- Being involved in or near accidents or abnormal events involving contaminated soil or debris
- Having an ECUP assignment at Enewetak Atoll for greater than one year
- Having unusual exposure aspects or a poorly defined veteran exposure scenario.

A2-2 EPG-specific Exclusions

EPG-specific exclusions are based on veteran exposure scenarios or on comparisons of EPG TODs or total skin doses to applicable Limiting Doses (LD).

A2.2.1 EPG Exposure Scenario Exclusions

There are no realistic ECUP veteran exposure scenarios that are applicable only to a specific EPG that would potentially result in organ or skin doses that could equal or exceed applicable EPG doses. EPG-specific exclusions based on comparison to applicable LD values are discussed in the following sections.

A2.2.2 EPG-specific Exclusions when EPG TOD is Higher than LD

Values of LD based on alpha radiation (LDα) have been estimated using the NIOSH-IREP software application (NIOSH, 2020). Cases with EPG TODs that are greater than the corresponding LDα value are initially excluded from expedited processing and are subject to further review.

Values of LDα for cancers associated with internal organs and diseases are shown in Table A2-1. EPG TODs that exceed the applicable LDα values are excluded from expedited processing and are shown in Table A2-2.

A2.2.3 EPG-specific Exclusions when EPG Total Skin Dose is Higher than LD

Values of LDα for three types of skin cancers and five NIOSH-IREP race categories are shown in Table A2-3. EPG total skin doses that exceed the applicable LDα values are excluded from automatic expedited processing. These occurrences are shown in Table A2-4 and Table A2-5.

Table A2-1. Limiting doses for cancers based on all alpha radiation

Cancer of Organ/Disease	LDα* (rem)
Acute Lymphocytic Leukemia (ALL)	20†
Acute Myeloid Leukemia (AML)	15†
All digestive, other than excluding esophagus, stomach, colon, rectum/anus	17
Bone	15
Breast (male)	10
Breast (female)	15
Chronic Lymphocytic Leukemia (CLL)	34†
Chronic Myeloid Leukemia (CML)	89†
Colon	11
Connective tissue	17
Endocrine glands, other than thyroid	12
Esophagus	11
Eye	16
Female genitalia	1400
Gallbladder	6.5
Leukemia, other than ALL, AML, CML, and CLL	27†
Liver	3.6
Lung (never smokers)	13
Lymphoma and multiple myeloma	28
Male genitalia	30
Nervous system	37
Oral cavity and Pharynx	36
Other and ill-defined sites	17
Ovary	14
Pancreas	34
Rectum	43
Respiratory tract, other than lung	48
Stomach	10
Thyroid	3.2‡
Urinary Bladder	16
Urinary organs, other than bladder)	13

* LDα = Limiting dose (PC of 40 percent) assuming the total organ dose is due entirely to alpha radiation. LDα values were estimated with the NIOSH-IREP online software. Assumptions include acute exposure at age 18 years and attained age of 50 years (elapsed time of 32 years) unless noted otherwise. Values are for males except values for three female-specific organs listed.

† LDα values for leukemia are calculated for an elapsed time of 30 years.

‡ LDα values for thyroid cancer are calculated for an elapsed time of ≥10 years.

Table A2-2. EPG and standard organ combinations excluded from expedited processing

ECUP EPG	ECUP Standard Organ	NIOSH-IREP Cancer Model
Soil Removal Workers	Bone Surface	Bone
	Liver	Liver, Gallbladder
Northern Island Workers	– None –	n/a
Lojwa Support Workers	– None –	n/a
Southern Island Workers	– None –	n/a

Table A2-3. Limiting doses for skin cancers assuming all alpha radiation

	LDα* (rem)		
NIOSH-IREP Race Category	**MM†**	**BCC†**	**SCC†**
American Indian or Alaska Native	1.0	0.85	63
Asian, Native Hawaiian, or other Pacific Islander	1.8	0.85	63
Black	1.7	0.85	63
White - Hispanic	2.1	2.4	165
White - Non-Hispanic	2.4	2.5	175

* LD values correspond to a PC of 40 percent. LD values are estimated with the on-line NIOSH-IREP software (NIOSH, 2020), using an acute exposure at age 18 and cancer diagnosis at age 50. LDα is estimated by assuming the total skin dose is due entirely to alpha radiation.

† MM = malignant melanoma; BCC = basal cell carcinoma; SCC = squamous cell carcinoma.

Table A2-4. Excluded skin cancer cases for "American Indian or Alaska Native", "Asian, Native Hawaiian, or other Pacific Islander", and "Black" participants

	EPG/Cancer/Skin Site Combinations that are Excluded (red) for ECUP Expedited Processing [*,†,‡]											
	Soil Removal			Northern Islands			Lojwa Support			Southern Islands		
Skin Site	**MM**	**BCC**	**SCC**	**MM**	**BCC**	**SCC**	**MM**	**BCC**	**SCC**	**MM**	**BCC**	**SCC**
Scalp												
Face												
Forehead												
Behind ear												
Neck												
Back of neck												
Shoulder												
Chest												
Torso (backside)												
Under belt												
Forearm												
Upper leg												
Palm												
Back of hand												
Lower leg												
Sole of foot												
Under boot edge												

* MM = malignant melanoma. LDα values for MM are 1.0–1.8 rem for the participants represented in this table; an LDα of 1.0 rem is used for expedited processing.
BCC = basal cell carcinoma. The BCC LDα value for all participants represented in this table is 0.85 rem.
SCC = squamous cell carcinoma cases. The SCC LDα value for all participants represented in this table is 63 rem.

† Red-shaded table cells indicate EPG/Skin cancer/Skin site combinations that are excluded from expedited processing for the participants represented in this table (see Table caption).

‡ Green-shaded table cells shaded green indicate EPG/Skin cancer/Skin site combinations that are recommended for expedited processing for the participants represented in this table (see Table caption), with assignment of the applicable doses from Table A4-2.

Table A2-5. Excluded skin cancer cases for "White (Hispanic)" and "White (Non-Hispanic)" participants

	EPG/Cancer/Skin Site Combinations that are Excluded (red) for ECUP Expedited Processing*,†,‡											
	Soil Removal			Northern Islands			Lojwa Support			Southern Islands		
Skin Site	MM	BCC	SCC	MM	BCC	SCC	MM	BCC	SCC	MM	BCC	SCC
Scalp												
Face												
Forehead												
Behind ear												
Neck												
Back of neck												
Shoulder												
Chest												
Torso (backside)												
Under belt												
Forearm												
Upper leg												
Palm												
Back of hand												
Lower leg												
Sole of foot												
Under boot edge												

* MM = malignant melanoma. LDα values for MM are 2.1–2.4 rem for the participants represented in this table; an LDα of 2.1 rem is used for determining cases excluded from expedited processing.
BCC = basal cell carcinoma. LDα values for BCC are 2.4–2.5 rem for the participants represented in this table; an LDα of 2.4 rem is used for expedited processing recommendations.
SCC = squamous cell carcinoma cases. LDα values for SCC are 165–175 rem for the participants represented in this table; an LDα of 165 rem is used for expedited processing recommendations.

† Red-shaded table cells indicate EPG/Skin cancer/Skin site combinations that are excluded from expedited processing for the participants represented in this table (see Table caption).

‡ Green-shaded table cells indicate EPG/Skin cancer/Skin site combinations that are recommended for expedited processing for the participants represented in this table (see Table caption), with assignment of the applicable dose from Table A4-2.

Attachment 3.

Description of Expedited Processing Groups for Enewetak Cleanup Project Radiation Dose Assessments

Four Expedited Processing Groups (EPGs) were defined to represent most of the ECUP participant population. Each EPG was expected to represent a large number of ECUP participants that were engaged in common activities and experienced similar radiation exposure environments at well-defined worksite locations. The EPG descriptions included below will aid in identifying an appropriate EPG to assign to a veteran based on the information available in the veteran's case file especially personal statements and answers in the ECUP Questionnaire.

A3-1 Soil Removal Workers (EPG-1)

This EPG consists of ECUP participants whose documented or stated duties included performing soil-removal activities that involved disrupting and/or handling contaminated soil that required removal from one or more of the five soil-removal islands. The soil-removal islands are the northern islands of Boken (Irene), Enjebi (Janet), Lujor (Pearl), Aomon (Sally), and Runit (Yvonne). These islands are located in the north rim and in the northeast quadrant of the atoll as shown in Figure A3-1.

Soil removal activities involved excising, windrowing, stockpiling, loading/unloading, transporting, and mixing contaminated soil for containment in the Cactus crater and dome. Sample activities that could have been performed by individuals under this EPG on any of the five soil-removal islands include, but are not limited to, the following:

- Digging, excavating, moving, stockpiling soil
- Loading soil into dump trucks, boats, and vehicles of any kind using heavy machinery
- Transporting soil to Runit
- Unloading soil on Runit
- Gathering and reforming the soil into other media for disposal, such as rejected soil-cement slurry from the tremie system reformed into concrete blocks
- Transporting soil to the disposal site for containment in Cactus crater.

Typical individuals who performed activities relevant to this EPG may include, but are not limited to, U.S. Army Engineer heavy equipment operators, soil transport truck drivers, crew of boats that transported contaminated soil, tremie workers and soil-cement mix teams that operated at worksites on Runit. Personnel that can be assigned this EPG are likely to have resided on

Lojwa Island while performing soil cleanup work on any of the five soil-removal islands identified above.

A3-2 Northern Island Workers (EPG-2)

This EPG includes ECUP participants whose documented or stated duties involved performing any activities such as those listed below on one or more of 21 northern islands of the atoll. The northern islands of this EPG include the five soil-removal islands. The 21 northern islands are listed in Table A3-1 and are shown in Figure A3-1. The 21 northern islands included in this EPG consist of the line of islands starting with Bokoluo (Alice) in the northwest going clockwise along the northern and northeast rim of the atoll to Runit (Yvonne), excluding Lojwa (Ursula). The residence island (Lojwa) where members of this EPG were typically billeted is not considered a work island for this EPG. However, participants who had work duties on Lojwa are considered under the Lojwa Support Workers (EPG-3).

Activities of members of this EPG involved removing, handling, and transporting debris, performing regular or periodic radiological safety monitoring or sampling, and removing brush from any of the 21 northern islands including the five soil-removal islands. Oversight, inspection, and other short-term activities conducted on any of the 21 northern islands are also included. Sample work activities that would have been performed by members of this EPG include, but are not limited to, the following:

- Handling contaminated and uncontaminated debris
- Preparing debris for transport
- Accompanying debris during transport
- Unloading, moving, and disposing of yellow debris at lagoon disposal sites and red debris in the Cactus crater
- Performing radiological monitoring, sampling, and inspections
- Removing brush
- Performing activities that are not specifically listed above on any of the northern islands, such as loading or unloading supplies, equipment, or personnel
- Transporting rejected soil-cement slurry reformed into concrete blocks, transferred in dump trucks to the Cactus crater
- Performing supervisory, oversight, assessment, or inspection duties, including RSAIT inspections
- Participating in short-term visits such as VIP and morale-boosting visits, and other visitor tours.

Typical individuals who performed activities relevant to this EPG may include, but are not limited to, members of U.S. Army Engineer Units, U.S. Navy Harbor Clearance Units, Water-

Beach Cleanup Teams, and U.S. Air Force Field Radiation Support Teams. Personnel that can be assigned this EPG are likely to have resided on Lojwa Island while performing cleanup work on the northern islands identified above.

A3-3 Lojwa Support Workers (EPG-3)

This EPG includes ECUP participants whose documented or stated duties involved working on Lojwa Island shown in Figure A3-1. It does not include individuals who resided on Lojwa and worked on other northern islands. Such participants should be considered as part of the Soil Removal Workers EPG (EPG-1) or the Northern Island Workers EPG (EPG-2).

Activities of members of this EPG generally involved maintaining the island's infrastructure and providing services that supported the cleanup operations. Oversight, inspection, and other short-term activities conducted on Lojwa Island are also included. Sample work activities associated with this EPG include, but are not limited to, the following:

- Maintaining instrumentation and analyzing samples at on-site laboratory facilities
- Maintaining the facilities and structures, such as residence buildings, power production units, and repair shops
- Installing and maintaining telecommunication systems
- Supporting petroleum, oil, and lubrication stores to supply other northern islands
- Operating postal, food, and recreation services
- Transporting workers to and from cleanup sites
- Producing potable and drinking water and operating desalination systems
- Running general laundry services
- Providing medical and dental care
- Performing activities on Lojwa that are not specifically listed above, such as loading or unloading supplies, equipment, or personnel
- Performing supervisory, oversight, assessment, or inspection duties, including RSAIT inspections
- Participating in short-term visits such as VIP and morale-boosting visits, and other visitor tours.

Typical members of this EPG may include, but are not limited to, personnel of U.S. Army Engineer Units, U.S. Army, U.S. Navy, and U.S. Air Force, who provided support services such as laundry, finance, laboratory, medical, postal, and communication services. Personnel that can be assigned to this EPG are likely to have resided on Lojwa Island or Enewetak Island while performing infrastructure and support work on Lojwa.

A3-4 Southern Island Workers (EPG-4)

This EPG includes ECUP participants whose documented or stated work duties involved working on one or more of the 18 southern islands. The 18 southern islands included in this EPG are listed in Table A3-1 and are shown in Figure A3-1. They comprise the line of islands starting with Boko (Sam) southeast of Runit and continuing clockwise along the southern rim of the atoll and ending with the island of Biken (Leroy).

Activities of members of this EPG included removal, transport, and disposal of uncontaminated debris; building and maintaining facilities and structures; and providing support services. Individuals performing oversight, inspection, and other short-term activities on the southern islands are also included. Also included are crews of aircraft and transient ships that spent time on any of the southern islands and nearby lagoon areas. In addition, personnel who participated in the removal of a small volume of soil from Medren that was contaminated with Co-60 should be included. Sample activities associated with work performed on the southern islands by members of this EPG include, but are not limited to, the following:

- Performing command, control, and communication functions
- Providing central logistical support to the cleanup operations
- Performing project management and administration
- Constructing and maintaining buildings and structures
- Preserving petroleum, oil, and lubrication stores
- Providing medical and dental care
- Installing and maintaining telecommunication systems
- Operating the postal, food, and recreation services
- Transporting personnel and materials, e.g., during MEDEVAC and SAR missions
- Performing radiological surveys
- Removing Co-60 contaminated soil from Medren
- Removing uncontaminated debris
- Removing unexploded ordnance
- Conducting mobilization and demobilization activities
- Crews of transport aircraft and transient ships transporting personnel, delivering materials and supplies, picking up cargo, or performing on-board support services. Transient ships generally anchored in the lagoon in the proximity of Enewetak Island.
- Performing supervisory, oversight, assessment, or inspection duties, including RSAIT inspections
- Participating in short-term visits such as VIP and morale-boosting visits, and other visitor tours.

Typical members of this EPG may include, but are not limited to, personnel from all of the service elements and FCDNA that provided construction or support services such as laundry, finance, medical, postal, communication, security, airfield, harbor, and administrative services on Enewetak, Medren, or Japtan islands, as well as cleanup activities in the identified southern islands. Personnel that can be assigned to this EPG are likely to have resided on Enewetak Island.

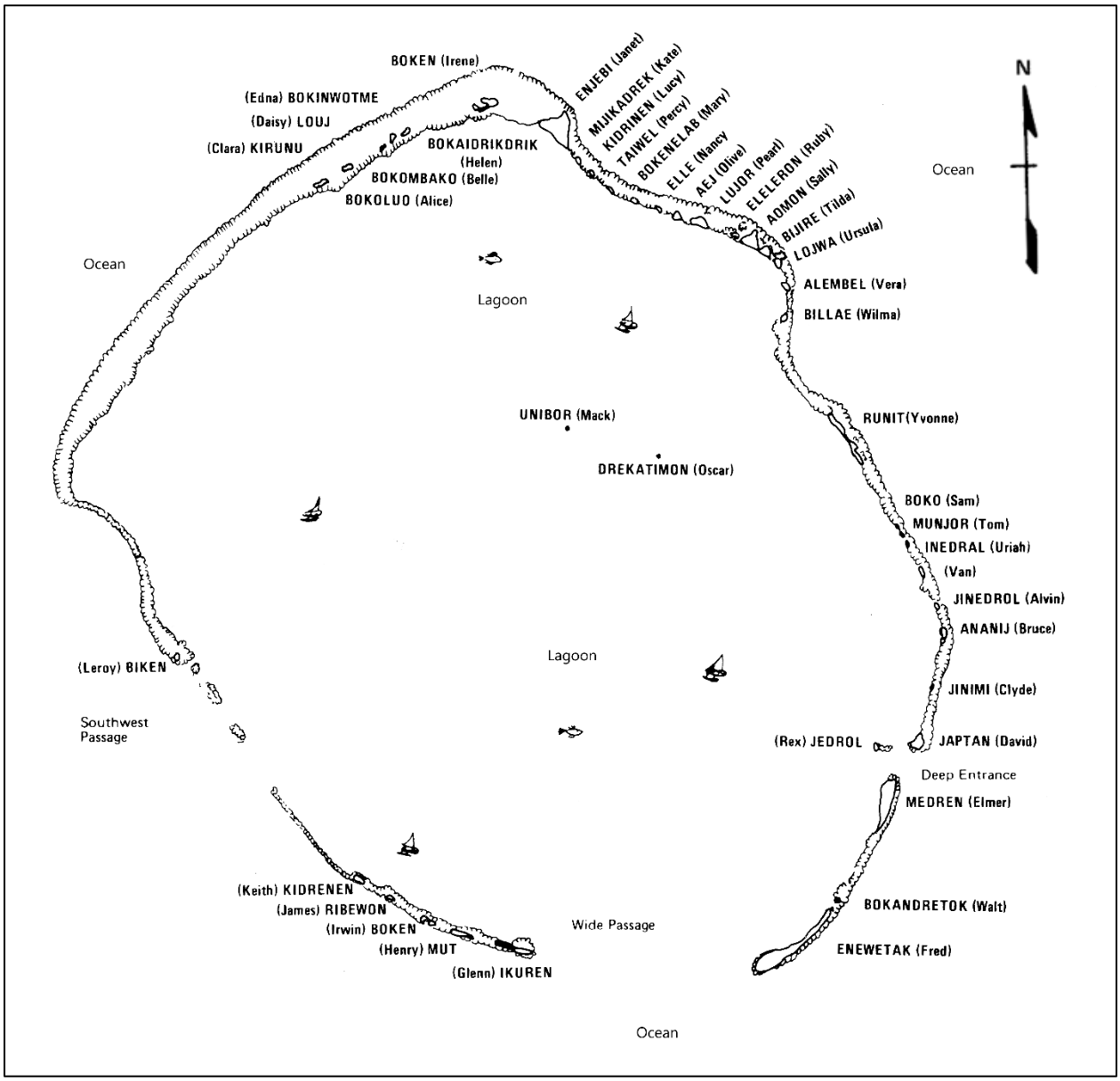


Figure A3-1. Islands of Enewetak Atoll (DTRA, 2023)

Table A3-1. Enewetak Atoll islands (DTRA, 2023)

Island Code	Site Name	Island Name
Northern Islands		
FA	Alice	Bokoluo
FB	Belle	Bokombako
FC	Clara	Kirunu
FD	Daisy	Louj
FE	Edna	Bocinwotme
FH	Helen	Bokaidrik
FI	Irene	Boken
FJ	Janet	Enjebi
FK	Kate	Mijikadrek
FL	Lucy	Kidrinen
MP	Percy	Taiwel
FM	Mary	Bokenelab
FN	Nancy	Elle
FO	Olive	Aej
FP	Pearl	Lujor
FR	Ruby	Eleleron
FS	Sally	Aomon
FT	Tilda	Bijile
FU	Ursula	Lojwa
FV	Vera	Alembel
FW	Wilma	Billae
FY	Yvonne	Runit
Southern Islands		
MS	Sam	Boko
MT	Tom	Munjor
MU	Uriah	Inedral
MV	Van	“No local name”
MA	Alvin	Jinedrol
MB	Bruce	Ananij
MC	Clyde	Jinimi
MC	David	Japtan
MR	Rex	Jedrol
ME	Elmer	Medren (aka Parry)
MW	Walt	Bokandretok
MF	Fred	Enewetak
MG	Glenn	Ikuren
MH	Henry	Mut
MI	Irwin	Boken
MJ	James	Ribewon
MK	Keith	Kidrenen
ML	Leroy	Biken
MO	Oscar (coral head)	Drekatimon
MM	Mack (coral head)	Unibor

Attachment 4.

Estimated Organ Doses, Eye Lens and Skin Doses for ECUP EPGs

The upper-bound external, UB α, and UB β+γ organ doses for all EPGs are listed in Table A4-1. These doses are recommended for assignment in expediting ECUP cases except as noted in Attachment 2 regarding exclusions. For each standard organ, the doses are recommended for all organs, diseases, and tissues for which the standard organ is applicable. The ECUP standard organs are the organs for which internal dose coefficients are available in ICRP 68 (ICRP, 2011).

The upper-bound total external doses for the lens of the eye and all skin sites for the four ECUP EPGs are shown in Table A4-2. These doses should be assigned except for those EPG/race/skin cancer/skin site combinations identified in Attachment 2 regarding exclusions.

Table A4-1. Estimated organ doses for ECUP EPGs (rem)

EPG Name		Internal Radiation Type and EPG TOD*	ECUP Standard Organs																							
			Adrenals	Bladder Wall	Bone Surface	Brain	Breast	Esophagus	Stomach Wall	SI Wall*	ULI Wall*	LLI Wall*	Colon	Kidneys	Liver	Muscle	Ovaries	Pancreas	Red Marrow	ET Airways*	Lungs	Spleen	Testes	Thymus	Thyroid	Uterus
Soil Removal Workers (EPG-1)		**UB α**	0.08	0.08	47	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.2	10	0.08	0.6	0.08	3	0.3	1	0.08	0.6	0.08	0.08	0.08
External Dose	Upper Bound	**UB β+γ**	0.02	0.02	0.07	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.1	0.3	**EPG TOD**	0.4	0.4	48	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.5	10	0.4	1	0.4	3	0.7	2	0.4	1	0.4	0.4	0.4
Northern Island Workers (EPG-2)		**UB α**	0.009	0.009	4	0.009	0.009	0.009	0.009	0.009	0.01	0.02	0.01	0.02	0.7	0.009	0.06	0.009	0.2	0.03	0.07	0.009	0.06	0.009	0.009	0.009
External Dose	Upper Bound	**UB β+γ**	0.02	0.02	0.07	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.1	0.3	**EPG TOD**	0.4	0.4	5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Lojwa Support Workers (EPG-3)		**UB α**	0.004	0.004	1	0.004	0.004	0.004	0.004	0.004	0.005	0.008	0.006	0.006	0.2	0.004	0.02	0.004	0.05	0.006	0.01	0.004	0.02	0.004	0.004	0.004
External Dose	Upper Bound	**UB β+γ**	0.02	0.02	0.07	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.03	0.09	**EPG TOD**	0.1	0.1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.3	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Southern Island Workers (EPG-4)		**UB α**	0.003	0.003	0.6	0.003	0.003	0.003	0.003	0.004	0.005	0.007	0.006	0.005	0.1	0.003	0.01	0.003	0.03	0.004	0.004	0.003	0.01	0.003	0.003	0.003
External Dose	Upper Bound	**UB β+γ**	0.02	0.02	0.07	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.002	0.005	**EPG TOD**	0.03	0.03	0.7	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.2	0.02	0.04	0.03	0.07	0.03	0.03	0.03	0.03	0.03	0.03	0.03

* TOD = Total Organ Dose; SI = small intestine; ULI = upper large intestine; LLI = lower large intestine; ET Airways = extra-thoracic airways.

Table A4-2. Upper-bound external lens of the eye and skin doses for ECUP EPGs

Dose location	Total Upper-Bound External (beta+gamma) Lens of the Eye Dose (rem)*			
	Soil Removal	Northern Islands	Lojwa Support	Southern Islands
Lens of the eye	0.4	0.4	0.4	0.4

Skin Site	Upper-Bound External Skin Doses (rem)											
	Soil Removal			Northern Islands			Lojwa Support			Southern Islands		
	UB α	UB β+γ	UB Tot†	UB α	UB β+γ	UB Tot	UB α	UB β+γ	UB Tot	UB α	UB β+γ	UB Tot
Scalp	45	0.4	45	3	0.4	4	0.3	0.1	0.4	0.02	0.006	0.02
Face	3	0.4	4	0.2	0.4	0.6	0.02	0.1	0.1	0.001	0.006	0.007
Forehead	3	0.4	4	0.2	0.4	0.6	0.02	0.1	0.1	0.001	0.006	0.007
Behind ear	60.	0.5	60.	9	0.4	9	2	0.2	2	0.1	0.007	0.1
Neck	3	0.4	4	0.2	0.4	0.6	0.02	0.1	0.1	0.001	0.006	0.007
Back of neck	60	0.5	60	9	0.4	9	2	0.1	2	0.1	0.006	0.1
Shoulder	3	0.4	4	0.2	0.4	0.6	0.02	0.1	0.2	0.001	0.006	0.007
Chest	6	0.4	7	0.5	0.4	0.8	0.04	0.1	0.2	0.002	0.006	0.008
Torso (back, sides)	3	0.4	4	0.2	0.4	0.6	0.02	0.1	0.2	0.001	0.006	0.007
Under belt	63	0.5	63	9	0.4	9	2	0.2	2	0.1	0.007	0.1
Forearm	2	0.4	2	0.1	0.4	0.5	0.009	0.1	0.1	<0.001	0.006	0.007
Upper leg	2	0.5	2	0.1	0.4	0.5	0.009	0.1	0.2	<0.001	0.006	0.007
Palm	0	0.4	0.4	0	0.4	0.4	0	0.1	0.1	0	0.006	0.006
Back of hand	0	0.5	0.5	0	0.4	0.4	0	0.1	0.1	0	0.006	0.006
Lower leg	2	0.5	2	0.1	0.5	0.6	0.009	0.2	0.2	<0.001	0.007	0.008
Sole of foot	0	0.7	0.7	0	0.7	0.7	0	0.2	0.2	0	0.009	0.009
Under boot edge	7	0.8	8	1	0.7	2	0.2	0.2	0.4	0.02	0.01	0.03

* A maximized upper-bound lens of the eye dose was estimated for the Soil Removal Workers EPG and is recommended as a bounding dose for all EPGs.

† "UB Tot" is the total upper-bound skin site dose. This dose may not equal the sum of UB α and UB β+γ because the doses shown are rounded up.