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NTPR Standard Operating Procedures: Radiation Exposure Assessment

Introduction

An overview is provided of the radiation dose reconstruction process and its application within the NTPR, both technically and procedurally. Technical topics addressed are the integration of information that characterizes and quantifies the source, types(s), and amount of radiation in a particular environment with information regarding the timing and activities of an individual or unit in that environment. Procedurally, dose reconstructions are applied within the guidelines of 32 CFR Part 218 to nuclear test participating units, from which refinements are made for individuals both in response to correspondence received by the NTPR as well as for inclusion the NTPR dosimetry database. Veterans who qualify as atmospheric nuclear test participants within the definitions established by DSWA have doses assessed for all of their exposures to nuclear device debris through 1962 except for worldwide fallout. The reconstructed doses are from radioactive sources external to the body, including gamma and neutron radiation, and from internally deposited radioactive material, including alpha, beta, and gamma radiation.

Radiation Environment Characterization

This section discusses the requirement to characterize a radiation environment and define radiological conditions when assessing reconstructed doses. Dose reconstruction depends on the determination of the radiation type and strength throughout the potential period of personnel exposure. Because such information is rarely continuously available for personnel, radiation sources are characterized from field measurements. With the linkage of these data through nuclear physics and mathematical analysis, radiation fields of each pertinent type are quantified geometrically and temporally. From the radiation environment so developed, doses can be calculated for an arbitrary itinerary of personnel activities.

The radiation environment is partitioned into initial radiation, defined as radiation within the first minute of the detonation, and residual radiation (thereafter). Initial radiation includes transient forms of radiation. If sufficiently close to a nuclear shot, personnel may be exposed to neutrons and gamma radiation produced during the detonation and in milliseconds to seconds thereafter. Exposure of ground-based personnel to initial gamma radiation from fission debris in the nuclear fireball may also occur before the nuclear cloud rises to a great height. Both initial and residual radiation exposure of airborne personnel may occur from fission debris in the nuclear cloud. Ground personnel are principally exposed to residual radiation from fallout, deposited mostly downwind of ground zero, and from neutron activation of surface materials surrounding ground zero. Residual radiation exposure also can occur as a transient from nuclear cloud debris passing overhead ("cloud shine"), even if fallout is not deposited locally.

Radiological Data Collection

Radiological data pertinent to U.S. atmospheric nuclear weapons testing are collected through channels established by DSWA (e.g., DSWA Technical Library, Federal Archives, DOE, National

Laboratories). The data include any information that constitutes a radiological measurement, or contribute to the interpretation of same, that can be utilized in the determination of radiation dose to defined DoD atmospheric nuclear test participants. The collection effort continues as new information becomes available. This occurs when new data sources are discovered or when the need for augmented data surfaces. The latter may occur because a participating organization is newly discovered or included as part of the NTPR by participant redefinition, or when additional data are determined to be applicable to upgrading existing dose reconstructions.

The types of applicable radiological data are from both personalized and field measurements and techniques. The former include dosimeter film evaluations and readings of film badge and pocket dosimeters, which registered participants' external gamma doses; the latter include the following, which mostly provided gamma radiation data in the field and beta radiation data in laboratory analysis:

- Radiation survey meters (ion chambers and Geiger-Muller counters)
- Surface and aerial monitoring
- Fallout collection devices (metal trays, gummed film, pellet beds/trays)
- Soil and water sampling
- Air/cloud sampling devices (hi-volume air samplers, cascade impactors)
- Radiochemical analysis
- Metallic foils (for neutron measurements).

In summary, all data expected to contribute through the use of any feasible and scientifically credible technique to present or future NTPR dose reconstructions should be collected.

Radiological Data Analysis

The collected radiological data are analyzed to facilitate the reconstruction of external gamma and neutron radiation doses and internal doses from alpha, beta, and gamma radiation. With information on radiation source and type, including shot-specific physical and radiochemical data and energy emission spectra, radiological measurements are interpolated and extrapolated in time and space (i.e., fit to analytical models having temporal and spatial variables) to develop applicable field characterizations of the radiological environment. External gamma intensities pertinent to personnel dose assessments are obtained from field characterizations. Neutron doses are calculated from shot-specific neutron output and spectra, as available, for the applicable personnel postures and distances from shots. Internal doses are based on external dose information (from film badge readings and/or reconstructed doses) and pathway analysis to determine the intake and characteristics of radioactive material.

The analysis must be adequate to characterize the radiation environment as needed for personnel dose applications. Where complete field characterization is not feasible, an iterative approach with the activity scenarios (discussed subsequently) may be required to ascertain a satisfactory field definition. Where direct data are unavailable, auxiliary physical relationships must be developed and operational constraints need to be considered to estimate or at least bound the relevant parameters. When more than one set of available data is relevant to a given situation, any inconsistencies are resolved through a determination of what constitutes the most credible data.

Site Application

The initial radiation environment is developed from appropriate radiation transport codes, using source terms provided by the weapons laboratories and calibrated to existing field data, such as neutron detector measurements and gamma readings of film badges placed in the area. Transport calculations for neutron, prompt gamma, and secondary gamma radiation are required for the troop distances involved as well as for the observer geometry, such as trench position.

In determining the residual radiation environment, all possible sources are considered, including radioactive clouds, radiation that may have been encountered from other tests, and radioactive debris that may have been deposited in water during oceanic tests. Because residual radiation decays, the radiation environment is defined by the radiation intensity as a function of type and time. Radiological survey data are used to determine specific intensities at times of personnel exposure. Interpolation and extrapolation are based on known decay characteristics of the individual materials that comprise the residual radiation.

Personnel Activity Scenario Development

Toward assessing the dose to personnel within a radiation environment, scenarios are developed of the activities of units or individuals within units which/who were potentially exposed to radiation. The scenarios are developed from historical sources of information — principally unit histories, operation plans, after-action reports, deck logs, and morning reports — as well as from the recollections of individual test participants. These scenarios typically involve both the arrival/departure at/from the test site (which often correspond to attach/detach dates for personnel), and the activities conducted while onsite.

Unit Activity Definition

This section discusses what constitutes a unit activity from the radiological standpoint. The radiological definition of a unit in the NTPR is a group with a common exposure to radiation. Once a military unit (or element thereof) is determined to have met the nuclear test participant definition of the NTPR, its potential for exposure to nuclear device debris through 1962 (except for worldwide fallout) is assessed. This includes its presence at any time at a contaminated test site or residence or proximate staging facility, or its involvement with contamination from testing such as may have been encountered during shipboard transport or in handling contaminated equipment. Exposures are regarded as *de minimis* if they do not result in as much as 0.001 rem in any discrete exposure or are incurred more than 1 year following any defined participant period (except 2 years after Operation CROSSROADS).

Unit activities are differentiated among whenever or wherever they result in a changed potential for radiation exposure. A unit is either characterized uniquely by its site if a single radiation timeline is involved, or by any set of movements in common to the unit. For example, a military unit on two islands with different radiation intensities cannot be characterized by a single label for dose reconstruction purposes; there are two functional units, one on each island. In contrast, two military units that marched together through the radiation fields from two shots engaged in a common (albeit

compound) activity; their labels could be aggregated from this standpoint. (Whether their labels actually warrant aggregation depends on the radiological commonality of all their activities and the existence of a suitable hierarchical umbrella.)

Unit Movements

A dose reconstruction is dependent on capturing all radiologically relevant unit movements. From characterized radiation environments, it is determined when and where there was a potential for radiation exposure. The interval during which a unit's presence corresponds to this potential is examined further. The aforementioned documentation and secondary references (e.g., NTPR historical volumes) are searched for all references to movements by all or some of its elements. These movements may be out of the test site or to another part of the test site. Some movements/ activities are at least partially linked with those of other units, which need to be cross-referenced.

The level of detail needed in scenario development is dependent on the comparative radiation levels and the degree with which they vary in space and time. For example, for a maneuver toward ground zero shortly after a shot, spatial resolution to 100 meters and timing within an hour may be important. In contrast, for most arrivals/departures/transfers, identification of the date (or even the approximate date) is usually satisfactory. For the latter reason, most movements of a unit (or individual) involving a shift in residence are resolved to the day, and (apart from test site arrival) are considered to occur at day's end. The applicable dose test is if a change of 0.1 rem or more would result from a refinement in timing. As this is not necessarily known during scenario development, it is evident that dose reconstruction can involve an iterative process between its historical and radiological components.

Field Postures

Where radiation dose may depend on troop posture in the field, an activity scenario needs to specify such posture. This is principally an issue for personnel in a troop trench at shot-time. The dose reconstruction methodology models the human body, in appropriate postures in a troop trench, to calculate the gamma dose that would have been recorded on a film badge worn on the chest, and the neutron dose.

Dose Reconstruction Methodology Application

This section discusses the methodology to reconstruct both external (initial and residual) and internal dose through the superposition of activity scenarios on the characterized radiation environments. While some aspects of the methodology are not explicitly addressed in 32 CFR Part 218, they are compatible with the guidance therein. Augmented methods result from both technical advancements and the greater breadth of exposure situations requiring dose assessment. Internal dose methods, which are described in Part 218 for only a single pathway, have had the most development.

Initial Radiation Methods

Initial radiation doses are principally dependent on troop positioning at the time of a nuclear

detonation. The computer code ATR6 is used to define the surface radiation field environment from the radiation source term. If troops are in trenches, additional codes derive the environment in the trenches and the codes used to calculate initial radiation. At whatever distance and posture the troops are in, the codes provide the inital gamma and neutron doses. The most complex situation occurs when troops, originally crouched in trenches, stand up while the rising fireball remains sufficiently proximate to contribute device debris gamma exposures.

Residual Radiation Methods

Residual radiation doses are principally dependent on the movement of troops within fallout or neutron activation fields in the shot areas or from the deposition of fallout on islands, ships, and lagoon waters. Shot-area fields are usually characterized with the computer code RFIELD, which also accommodates the time-dependent movement of troops within the field. The accumulation of dose can be integrated with every step. The free-air environment on each residence island and ship can usually be characterized by a single value (within a measured or estimated error) at any time. The principal adjustments are from shielding while indoors on land and while below decks in a ship. The default radioactive decay is according to $t^{-1.2}$ from fallout through 6 months and $t^{-2.2}$ thereafter. Variant decays are utilized when time-dependent survey data are available or as derived from nuclear physical and shot-specific radiochemical data. The decay rate for activation fields is determined from radiation survey data, augmented by the known elemental composition of surface materials. The resultant doses are taken as applicable throughout the human body, ordinarily a reasonable approximation; unusual situations of markedly non-uniform exposure are considered on a case-by-case basis.

Internal Radiation Methods

Internal doses depend on two principal things: the amount, radionuclide composition, and physical/chemical form of the intake (inhaled or ingested) of radioactive material; and metabolic behavior in the body (biokinetics) of that material. The latter uses metabolic modeling such as recommended by the International Commission on Radiological Protection, embodied into dose conversion factors that relate intake of a given form of each radionuclide to (50-year) committed dose equivalent to any organ. In the NTPR such factors are contained in and applied through the computer code FIIDOS (Fallout Inhalation and Ingestion Dose to Organs). The former usually is anchored in the NTPR to external dose because direct measurements of intake or of airborne radioactivity concentration are rare. Usually, surface readings are convertible to airborne radiation levels through a resuspension factor or related concept. The needed external dose quantity is the integrated intensity corresponding to the interval during which the resuspension occurs. That quantity is obtained from a reconstructed external dose and/or a film badge reading. FIIDOS accommodates any of these entry points and uses shot-specific physical and chemical data to determine the complete radionuclide intake, and, as indicated above, the internal dose.

Two key facets of the internal dose methodology unaddressed in 32 CFR Part 218 are its use in dose screening and its compatibility with bioassay analysis. Internal dose screening introduces no additional technology but represents the distillation of analytical observations made from thousands of applications of FIIDOS. Because it develops that internal doses tend to be lower than external doses, they often can be upper-bounded at a threshold dose level (e.g., 0.1 rem) without full-scale analysis.

Screening algorithms are analytically determined from the relationships derived between external dose and the concurrent potential for intake of radioactive material, coupled with generalizations derived from comparative analysis of shot radiochemistries. Internal dose screens can be developed for internal dose equivalent to any organ and for effective dose equivalent, and are done so as warranted by the efficacy of their application. Because no single organ has the greatest committed dose equivalent under all circumstances of exposure, there is no optimal organ for use in screening. Thus, screening results do not necessarily extend to other organs. However, generally applicable findings of dose below the threshold level result when (1) there was no potential for intake of contaminants (e.g., contaminants were fixed to surfaces, irradiating from a distance, or excluded from the air supply), or (2) exposure to contamination from the test operation was only to neutron-activated material. The latter was deduced for virtually all troop exposure situations from external/internal dose relationships.

The interpretation of internal dose from bioassay data depends on the basic internal dose methodology with modest auxiliary statistical and biokinetic analysis. With FIIDOS thus augmented, it calculates both internal dose and the expected bioassay result for the index radionuclide. All proportionate dosimetric quantities, including internal organ dose, can be normalized to the actual bioassay result. In the usual NTPR internal exposure situation, the utilization of bioassay data is conceptually most simple as an adjustment to the resuspension factor, the least certain parameter. The improvement in the internal dose so adjusted depends on there being a lesser uncertainty in the biokinetics of the index radionuclide and the bioassay result for the individual than the uncertainty in the application of a generalized resuspension factor to the individual's intake of radioactivity.

Unit Dose Reconstruction

This section discusses the methodology for reconstructing unit doses to determine the external radiation dose to generic unit participants for whom film badge data are not available or are incomplete for the potential periods of radiation exposure.

Generic Dose Assessment

The dose reconstruction for a unit involves the superposition of an appropriate scenario for the unit on the radiation environment. Where the unit is sufficiently cohesive with respect to radiation exposure potential, the scenario can be characterized by the average movements and postures of the unit. Uncertainties in this generic scenario contribute to the standard error of the mean dose. For example, the generic sailor may be topside 0.4 of the time, with a standard error of ±20 percent. This does not imply that any individual sailor is topside within that range, but the approach is used contingent on a continuous distribution of times topside among an undifferentiable crew.

Reconstructed external gamma doses are computed so as to be complementary to and comparable with film badge dosimetry data. This is accomplished through the conversion of integrated free-field gamma intensity to a film badge equivalence. That equivalence incorporates an analysis of the film response to the gamma energy spectrum, including the geometry of both the radiation source and badge wearer. For the most typical residual radiation exposure situation of individuals standing in a planar fallout field of low intensity gradient, Monte Carlo analysis of a film badge worn on the chest indicates a conversion of 0.7 rem of dose equivalent per free-field Roentgen. This value has an

uncertainty of about 10 percent over the range of typical fallout gamma emission energies. In the limit of a frontal exposure to a directional source, a conversion factor of unity is applied. Other values are derived as warranted, particularly for geometries relevant to initial gamma exposures.

Unit internal dose reconstruction first involves identification of any potential for the intake of radioactive material. Even if there is external dose (based on film badge readings or reconstruction), there is not necessarily such potential (e.g., support ships at Operation CROSSROADS had contaminated hulls and salt water piping, which exposed the crew from the penetrating gamma radiation but did not make contamination available for personnel intake). If there was exposure during a test operation only to fallout fields from preceding operation(s) or from neutron activation fields, it has been demonstrated that the potential for internal dose is below the 0.1 rem screening threshold for dose to any internal organ (with few identified exceptions). Otherwise, screening for a specific organ dose involves an upper-bounded representation of the internal dose. This usually enters through a high-sided estimation of resuspension factor, and is also based on the highest film badge reading or upper-bound external dose for the unit.

Subgroup Dose Assessment

This section discusses definition of subgroups for units with multiple exposure scenarios and determination of reconstructed doses to each subgroup. A subgroup is defined whenever it is determined that a portion of the group has experienced a materially distinct potential for radiation exposure. This may result from the partition of a group activity into different locations or times, or may be simply an additional activity by part of the group. Subgroups also may be empirically determined based on patterns of film badge dosimetry. This may be reflected in distinct badging periods and/or from the badge readings themselves. Dose distributions that exhibit multimodality or otherwise significant deviations from normality or lognormality are evidence of a combination of subgroups (or of suspect dosimetry). Conclusions to be drawn about upper-bound doses, reconstructed doses for unbadged periods, or internal doses must be based on an understanding of the radiological distinction between subgroups. Where the subgroups have some portion of their activities in common, these are analyzed for the group as a whole. Where necessitated by time or resource constraints, preliminary high-sided estimates of these quantities for the undifferentiated group are permitted, but as opportunities arise or as knowledge is available, such as stimulated by input from individual case information, refined dose determinations are to be made.

Documentation

There are two types of group dose reporting: formal and memorandum reports. Formal dose reconstruction reports are DSWA-published documents of broad scope, such as have been produced for major maneuvers, aggregations of observer units and ship crews, and atoll residence at test sites. The NTPR program emphasis is currently on the memorandum report to cover those units with more distinct radiological experiences that have not been covered in the formal reports. Otherwise, the content of the two types of reports is similar, reflecting the content of the methodology development section and its use of material obtained according to the radiation environment and scenario development sections that is relevant to the scope of the dose reconstruction. Memorandum reports may be less self-contained, referencing more from predecessor reports, which themselves may address

related aspects of the subject group. Unlike formal reports, memorandum reports are subject only to DSWA/NTPR review, rather than a broader agency review. Also, memorandum reports are without a distribution list and are generally not available other than through the NTPR program.

Individual Dose Reconstruction and Application

This section discusses the procedures attendant to individual dose reconstructions and the reporting and documentation of individuals' doses based on these and/or generic reconstructions.

Personal Dose Assessment

An individualized reconstruction usually includes some component from a generic reconstruction, melded with the assessment of the personal variations in the exposure scenario. The latter addresses the periods of the veteran's attachment to the participating unit for which valid dosimetry is unavailable, as well as statements by the veteran that suggest activities atypical of his unit. Uncertainty information as may be applicable from a generic dose assessment is used to provide an upper-bound external dose for the individual. As time and technological resource constraints permit, the upper bound is further tailored to the individual based on any personalized data that are pertinent to his radiation exposure potential. Internal dose is provided, appropriate to the organ(s) identified (effective dose equivalent, if no organ is indicated) in the correspondence to DSWA. Where additional organs can be covered in a concise statement (e.g., all organ doses are less than 0.1 rem) without involving extra analysis, this internal dose information is also provided.

Doses are assessed for individuals through procedures that do not differentiate among the various origins of the requirement for a dose. Thus, contacts from different origins concerning a veteran otherwise do not require dose changes, augmentations, and the explanations thereof. Examples of this procedural consistency include the routine assessment of internal dose and the routine evaluation of dosimeter films where there is a reason to consider the readings suspect.

Once a veteran's participant status has been established, all sources of dose are included from nuclear device debris through 1962 (except worldwide fallout and natural background radiation). There is no cutoff date, but doses have been determined not to vary at the level of reported precision (0.1 rem) beyond 1 year after defined operational (and any garrison force) periods, with exceptions as noted in the unit activity definition section. Accordingly, explicit dose calculations are not required past such times. For periods after those for which daily dose tables have been generated, no breakdown in time is required when there is no potential for more than an additional 0.1 rem of external gamma dose. Participation dates are not required to any greater degree of specificity than affects the dose to the 0.1 rem level. For example, identification of an individual's membership in a ship crew through the date by which the last 0.1 rem increment is accrued is all that is necessary; knowledge of a specific subsequent detach date would have no impact on dose.

All data that can be collected and applied to the individual participation and radiological situation are pursued through the 90 days allotted for case completion. If no reasonable dose determination can be made because of data unobtainable within that time frame, it is decided whether an extension is warranted by weighing the prospective value of the data against the estimated time to

acquisition. All valid scientific techniques are applied as relevant to the dose determination, including extended application of related disciplines at the judgment of the Chief Scientist. For example, concepts from radiological protection guidance are used as applicable to retrospective dose determination; the applicability or lack thereof is not a necessary corollary of such guidance. Findings from generic dose assessments and other individual cases are used as pertinent; beyond this, analysis of the individual situation is required. Refined techniques are applied where they have a meaningful expectation of improving dose estimates or reducing the level of uncertainty. An example is the examination of dosimeter films where there is reason to question their validity, such as the likelihood of environmental damage.

Within time and resource constraints, the best available scientific and historical information is used. What constitutes the best available information requires an assessment of the information and its quality. In general, primary radiological data are most reliable. Errors or oversimplified reductions of such data that may appear in derivative records are not accepted merely because of their uncritical inclusion in period documents. Film badge readings, medical record doses, reported operational dose totals, and even statements in after-action reports are not automatically the best available information if they cannot be corroboated as the information most pertinent to the individual. The best information is not necessarily what is specific to the individual, if that is suspect information. Just as subgroup film badge dosimetry data may be analyzed to provide a more reliable substitute for a missing reading than does a pure dose reconstruction, dosimeter film evaluation and analysis for the subgroup may also be more reliable than an individual's suspect film badge reading.

Previous related situations to an individual's case are researched to ascertain that there is a suitable consistency in approach. However, if new information or techniques are available, a potentially modified dose is the necessary consequence. Any more general applicability of the modified dose is tracked for appropriate individuals in the dosimetry database.

On occasion, an official request for a dose assessment is accompanied by stipulations regarding activities the veteran performed. If application of the foregoing procedures does not lead from the stipulated conditions to a credible scenario of meaningful specificity, the dose to the veteran is instead based on the best available information. However, a hypothetical dose associated with the stipulated conditions, insofar as they are properly posed, is furnished but is neither connected in the NTPR program to the veteran nor databased with his dose records.

Totaled doses are determined to a precision of 0.1 rem. Reasons for this level are that it:

- Is the appropriate order of magnitude relative to the general population's dose standards
- Expedites the analysis of full total dose through time without arbitrary truncation dates
- Eliminates the need for hard-to-obtain details of activities outside of rad-safe control areas
- Avoids the appearance of excess or false precision.

Intermediate doses that are available to the 0.001 rem level may be used. Otherwise, intermediate doses over 0.01 rem should not be determined to more than a 0.01 rem precision. Where the prudent use of resources so indicates, such doses may instead be determined to the next greater 0.1 rem.

Totals are at a minimum of external gamma dose. If there is a positive neutron dose, the gamma and neutron dose are summed to obtain the total external dose. Upon request from the correspondent, this is combined with the internal dose ([50-year] committed dose equivalent), if that is at least the reporting threshold of 0.1 rem, to arrive at the total organ dose equivalent to relevant organ(s). In totaling doses, the sum at the 0.001 rem level is truncated, but at the 0.01 rem level is rounded up. Thus, a dose of 0.009 rem or less is 0.0 rem as a total, but 0.01 rem is 0.1 rem as a total. Determine both the mean (or most probable) dose and the 95th percentile (upper 90-percent confidence limit of a two-tailed distribution) total dose. Avoid unquantified forms of high-siding. Provide the upper bound to the total gamma dose, or to the total external dose if there is a positive neutron dose. Even if a total organ dose equivalent has been requested, an upper bound thereto is reported only when determinable at the 95th percentile. That is the case when committed dose equivalent is expressed as a mean value with bounds, as opposed to the current high-sided entity in analyses not based on bioassay data.

Documentation

Documentation of the doses assessed for individuals includes what pertains to generic dose assessments with the following addition: In order to consistently serve the veteran, the veteran (or his representative) needs disclosure of the information that leads to his dose. Therefore, documentation of the dose reported to an individual includes, either explicitly or by reference, all scenario and radiological information pertinent to the dose determination. If this information or its analysis is detailed and not fully covered in previous documents, it is communicated in an individual dose memorandum attached to the case correspondence; otherwise, it is communicated in the body of the correspondence. Where information is too complex or generic or otherwise detracts from the presentation of the individual dose memorandum or correspondence (e.g., the statistical level of the upper-bound dose, film badge conversion from free-air exposure, internal dose methodology, and complete shot lists and statistics for longer operations), it is to be covered by the DSWA fact sheets (or other written material) that are distributed to the correspondent. General information on availability of cited formal reports is included in the case correspondence. For unpublished documents, their availability through the NTPR, subject to Privacy Act-related redactions, is indicated.

The appropriate disclosure of information to the veteran includes representations from the time of the operation, such as operational summary data or data entered into individual records, even if such is not corroborated. Explanation is provided when this information, if not the most credible, is not retained in the final analysis. This includes the listing of recorded film badge dosimetry data even if, for reasons such as damaged film or misentered period of badge use, the dose of record is obtained from other sources of information. Other types of information that do not necessarily furnish the dose of record include medical record dose entries and information elsewhere contradicted in records. No single data source is automatically accepted as authoritative when other sources can be better corroborated.

Beyond the referenced information, an individual dose assessment or synopsis includes an explanation for what is specific to the veteran's case. This includes, for example:

- The adaptation from a published report of the dose for the veteran's participation period
- The principal source of uncertainty that affects the upper-bound dose

- That internal dose potential has been considered, even if the finding is of no internal dose
- That a finding obtained from internal dose screening applies to the veteran's target organ
- That internal dose does not apply to skin or eye dose assessments
- The reason for a dose change from previous correspondence, when based on new data. (A dose change caused by a procedural change is addressed in the correspondence but not within a dose assessment memorandum.)

The total doses, as indicated above, are provided in a dose summary, which is in tabular form if there are multiple contributions to external gamma or neutron dose.

Upon its completion, the dose documentation for an individual is reviewed for accuracy, conformity with the above procedures, and appropriateness and responsiveness to the correspondence or request received by the NTPR. Although final documentation is to be expedited where practicable, there is no standard time interval associated with the review.

Exposure Assessment Procedural Summary

A synopsis is provided in this section of the foregoing procedures relating to radiation exposure assessment. The process for revising (or revoking) procedures identified as requiring updates is described.

Summary Guidelines for Dose Determination and Reporting

- Where dose reporting is required, treat cases consistently for defined participants using total dose
- Obtain all collectable data and apply credible techniques as feasible, given 90-day case time limit
- Use the best available scientific/historical information; apply consistently in comparable situations
- Disclose in correspondence and the database variant findings and reports of operational personnel
- Explain commonalities/generalities of a methodology or test operation through NTPR fact sheets
- Concentrate on case specifics, including the application of collective data, in individual responses
- Report pertinent total dose with upper bound consistently to the meaningful precision of 0.1 rem
- Database doses, retain audit trail, apply pertinent findings in purification of other veterans' doses.

Modification of Procedures

DSWA operating procedures for radiation exposure assessment are periodically reviewed for currency with NTPR program objectives and technological resources. Proposed changes to procedures in dose assessments and their documentation, reporting, and databasing require written evidence of at least the maintenance of, if not improvement of, the level of consistency and scientific credibility among procedures and the quality of communicability and disclosure to veterans, their representatives, and other organizations/agencies to which they are furnished. Representations by qualified parties within the NTPR program as to the validity of such evidence regarding a proposed change are recorded and maintained until made moot by an updated version of the SOP manual, regardless of the original DSWA disposition of the proposal. Proposed changes to specific dose assessment documentation that pertain to these procedures require the same standard of evidence.