INSPECTION PROCEDURE 83501

SIGNIFICANT UNCONTROLLED RADIATION EXPOSURES

PROGRAM APPLICABILITY: 2515

83501-01 INSPECTION OBJECTIVE

To evaluate the licensee's response to events that involved significant uncontrolled radiation exposures of plant staff, contractors, or visitors that resulted in or could have resulted in the dose limits in 10 CFR Part 20 being exceeded.

83501-02 INSPECTION REQUIREMENTS

02.01 Risk Assessment. The inspector should perform the following, if a significant uncontrolled exposure event occurred or could have occurred.

a. Evaluate whether the licensee's initial dose or risk estimate is consistent with the known sequence of events.

b. Evaluate whether the licensee's immediate response to the event is commensurate with the initial risk estimate. Consider whether the following actions are needed, and were taken by the licensee as appropriate;

   1. Additional controls on source(s) of exposure/intake.
   2. Medical screening or treatment of involved individual(s).
   3. Stop work to limit additional risk to other individuals.
   4. In-vivo or in-vitro bioassay for those events that involve or may involve significant intakes of radioactive material.
   5. Evaluation to determine if other individuals may have been exposed to radiation source(s).

02.02 Event Reconstruction. Evaluate whether the licensee's understanding of the event is supported by the facts. Evaluate whether assumptions made concerning the sequence of events (i.e., exposure, proximity to the source, time interval, etc.) are reasonably conservative and are supported by the logical extension of verifiable facts.

02.03 Significance Determination. In light of the findings from the above, determine if the significance of the event(s) has been appropriately characterized.

02.04 Root Causes and Corrective Actions. Evaluate whether the licensee has adequately determined the causes of the uncontrolled exposure(s) and has instituted corrective actions sufficient to prevent reoccurrence.

83501-03 INSPECTION GUIDANCE

General Guidance

This inspection procedure applies to situations where the licensee has experienced one or more events involving the uncontrolled exposure(s) of individual(s) at the site that resulted in, or had a substantial potential for, personnel exposures in excess of regulatory limits. This procedure does not address unintended exposures that only have a significant impact on collective dose and not individual dose . As discussed below, necessary licensee actions can be time sensitive. Nothing in this procedure should be interpreted as limiting or interfering with the licensee's ability to take those actions the licensee deems necessary to preclude additional exposures from, mitigate the health impact of, or properly characterize the consequences of, the exposure event.

Specific Guidance

03.01 Risk Assessment

In cases of serious radiation exposures, immediate licensee actions necessary to minimize the health impact may be warranted or prudent. These actions may include medical examination and intervention for individuals that have received doses from external sources several times the dose limits. In addition to the early medical considerations, the need to initiate prompt in-vivo or in-vitro bioassay (for significant intakes) should be evaluated. These are judgement calls by the licensee usually made early in the event, and may be based on incomplete information. Inspector review of these actions may start prior to arriving at the site, (e.g., telephone discussions with the licensee).

Verify that the licensee's methods of quantifying the dose, such as time and motion studies, classification of radionuclide transportability, and intake dose factors, are complete and appropriate for the exposure situation. For example, verify; whether the licensee has contacted and interviewed all individuals who may have been exposed during the event or during previously undetected instances, whether all potential intakes of radioactive materials or dose pathways have been considered, and whether the licensee has fully evaluated the source term (e.g., unidentified pure beta or alpha emitters) for purposes of dose calculation. If the licensee is focused on whole body effective dose (TEDE), verify whether a different dose limit (i.e., fetal dose or extremity dose) is more limiting.

The risk assessment should review all appropriate or reasonable outcomes as well as the actual consequences (dose) of the event. For example, uncontrolled exposure events in Very High Radiation Areas could result in life threatening exposures.

03.02 Event Reconstruction

Uncontrolled exposure events are typically identified after the event by alarming electronic dosimeters, results of TLD dosimeter processing, access point monitor alarms, or other actions, and require reconstruction of the event to model the exposure condition and doses received. In addition, the initial risk or dose assessment made by the licensee is followed by a more thorough review of the event.

The licensee's investigation of the event(s) may be ongoing during this inspection. Additional information, as it becomes available, should be evaluated in terms of impact on the initial risk assessment. Notwithstanding, the inspector should conduct sufficient independent review to evaluate the reasonableness of the exposure circumstances and dose evaluation. The review may include interviews of exposed individuals.

Assumptions concerning the course of the event and the related risk assessment should be directly supported by verifiable facts. In some cases, a time and motion re-enactment of the event can verify or quantify the sequence of events.

For exposure events involving uncontrolled intakes at plants with poor fuel performance, determine whether the licensee has considered the potential for intakes of transuranic and other hard-to-measure radionuclides. The inspector should evaluate the adequacy of the licensee characterization of the intake source term by reviewing results of independent analyses made by the licensee including 10 CFR Part 61 analyses of waste streams. In addition, intake assessments may be complicated by specific characteristics of the in-vivo counters. For example, the following questions should be considered: Does the licensee's whole body counter treat the intake as total body or organ specific? For the in-vitro analyses, are samples being analyzed for the appropriate excretion pathway? Are analyses of lower limits of detection (LLDs) appropriate? Specifically, are the LLDs sufficiently low enough to detect the specific radionuclide of importance and thus be useful in providing a meaningful indication of excretion rate for purposes of intake determination?

For external exposure events, the inspector should evaluate the characterization of the source term and the adequacy of the instrumentation/dosimetry used to evaluate or measure the dose. Note that underwater exposure events may involve significant dose determination problems including potential changes of energy of radiation.

03.03 Significance Determination

An event presents a substantial potential for overexposure when it was fortuitous that the resulting exposure did not exceed the

limits of 10 CFR Part 20. The concern is not the significance of the actual resulting (or potential) exposure, but whether the licensee exercised adequate control over the situation, as required, to prevent exceeding the 10 CFR Part 20 limits.

When evaluating whether an exposure event could have a substantial potential for overexposure, the inspector should attempt to construct a reasonable scenario in which a minor alteration of circumstances would have resulted in a violation of 10 CFR Part 20 limits. Circumstances such as (a) timing, (b) source strength, (c) distance, and (d) shielding should be considered.

a. Timing: Could the exposure period have reasonably been longer?

Example: An individual in the proximity of an unknown source of radiation receives an unplanned excessive exposure. Because of the duration of the exposure, no limits were exceeded; however, the individual could reasonably have stayed in proximity to the source long enough to be overexposed.

b. Source Strength: Could the radiation source have reasonably been stronger?

Example: An inadvertent release results from a worker venting the wrong waste gas decay tank. Although the release did not exceed Part 20 limits, the same mistake could have as easily resulted in venting a decay tank with enough activity to exceed the limits.

c. Distance: Could the person have reasonably been closer to the source?

Example: In the example in paragraph (a) above, the individual could have been overexposed by standing closer to the source of radiation.

d. Shielding: Could some unintended shielding have reasonably been removed?

Example: A radioactive source was accidently left in an office area. Shielding afforded by a desk prevented the overexposure of an individual worker in the office. However, nothing prevented the source from being left in an area of the office that would not have been shielded by the desk, such that the individual would likely have been overexposed.

03.04 Root Causes and Corrective Actions

Verify that the licensee directed sufficient management attention to the event to evaluate its significance. Verify that the licensee has provided reasonable assurance that the root causes have been identified and that corrective actions have been taken to prevent reoccurrence of the event. Note, in some cases, the licensee may curtail certain activities until full corrective

action can be implemented. The licensee may establish and implement immediate, interim, and long-term corrective actions.

Experience has shown that uncontrolled exposures have resulted from one or more of the following:

a. Poor hazards evaluation, including failure to survey or inappropriate surveys.

b. Inadequate instructions to the workers, including incomplete requirements or briefings.

c. Poor response to changing conditions by the Health Physics coverage.

d. Failure to follow procedures.

e. Lack of Supervisory involvement.

f. Lack of Management support.

g. Lack of effective communication between departments (e.g., radiation protection and operations).

These areas may be interrelated: any one of them may be a symptom of a deeper underlying cause. For example, the chronic failure to follow procedures or inadequate corrective actions for similar previous problems may be symptoms of lack of management support for the Radiation Protection Program and/or insufficient involvement in work activities by the first line supervisors.

83501-04 RESOURCE ESTIMATES

It is estimated that approximately 25-35 hours will be needed to complete the requirements of this procedure.

83501-05 REFERENCES

NUREG/CR 4884, “Interpretation of Bioassay Measurements”

Regulatory Guide 8.9, “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program”

Regulatory Guide 8.26, “Application of Bioassay for Fission and Activation Products”

Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses”

Regulatory Guide 8.38, “Control of Access to High and Very High Radiation Areas of Nuclear Plants”

NUREG/BR-0195, “NRC Enforcement Manual” (definition of substantial potential for overexposures)

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