Demonstrating Compliance with 40CFR190 in PWR Annual Reports, RG 1.21

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Purpose of Presentation

Review of the 2012 Annual Radiological Effluent Release Reports (RERRs) for PWRs indicates substantial variations on the methods of demonstrating compliance with 40CFR190. This presentation

- Highlights the requirements for documenting this information in the RERR
- Shows where the Industry is today in implementing this requirement
- Provides some suggestions for improvements

Why just looking at PWRs

- Rad Protection at BWRs is generally already involved in evaluations for the Rx and Turbine Buildings, so there is history and protocol (especially at older BWRs).

- The RG 1.21 report is generally owned by Chemistry, not necessarily someone with a lot of experience with direct shine dose modeling.

- It appears that there has not been a lot of benchmarking or attempts at standardization with regard to what to report, and how to present the data.

RG 1.21 reports are now very public

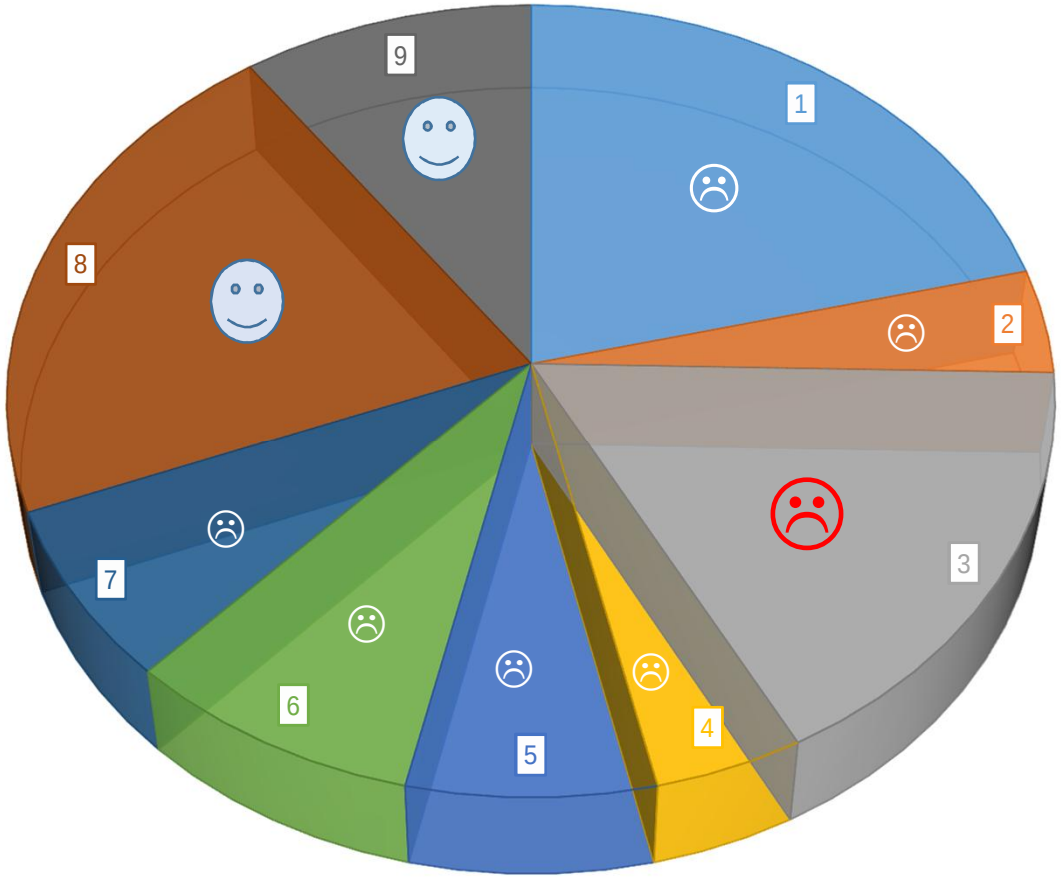
- Yes, they were always public, but GW, C-14, and other political issues have helped drive the NRC to make a very easy and effective interfacing web page for the general public to see these reports.

http://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html

- Even a Chemist (or an engineer?????) can look at this data and see some issues.

Group	# of Rx	Description of Issue
1	15	No mention of Direct Shine, 40CFR190 limits, or proximity to them.
2	3	Details of 40CFR190 dose measurements are in the AREOR.
3	12	Same as Group 1, but physically quoted 1301's rule of "not required".
4	3	Talks about 40CFR190 dose to a "max indiv" instead of a "real indiv".
5	5	Lists requirements of 40CFR190 but does not show direct shine dose.
6	6	Included design spec values, not actual measured values.
7	5	Reports dose in relation to 40CFR190, but no details re: how derived.
8	15	Generally complete (acceptable)
9	7	Excellent: Millstone, South Texas, San Onofre, Watts Bar, Sequoyah, TMI, Zion

STATUS OF US PWR RG 1.21 REPORTS RE: 40CFR190



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5) 40CFR190 requirements are listed, but direct shine dose is not shown.

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Greatest Hits

" There were no releases from ISFSI"

" There are no U Fuel Cycle Plants within 5 miles"

One plant is defueled, SD, nothing left but ISFSI, and 1301 rule is quoted.

ICRP 2 Effluents vs 40CFR190

- These issues are well known and under review.
- 40CFR190 updates have actually been distributed for review.
- Effluents is still “maximum individual” for the vast majority of plants.
- 40CFR190 direct shine is supposed to be a real dose.
- BWRs are usually very experienced with direct shine
- PWRs used to have a few sources of small amounts of direct shine (radwaste storage, outside tanks)
- ISFSI is a game changer. Typically, no other source of direct shine compares with it in PWRs, and the REAL dose at the SB is now a much more obvious and predictable parameter. Therefore …..

NUREG 1301 Total Dose

3/4.11.4 TOTAL DOSE

CONTROLS

3.11.4 In accordance with [plant name] TS 6.8.4.g.11), the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to less than or equal to 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

APPLICABILITY: At all times.

ACTION:

a. With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Control 3.11.1.2a., 3.11.1.2b., 3.11.2.2a., 3.11.2.2b., 3.11.2.3a., or 3.11.2.3b., calculations shall be made including direct radiation contributions from the units (including outside storage tanks etc.) to determine whether the above limits of Control 3.11.4 have been exceeded. If such is the case, prepare and submit to the Commission within 30 days, pursuant to Control 6.9.2, a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits and includes the schedule for achieving conformance with the above limits. This Special Report, as defined in 10 CFR 20.405(c), shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels

Reg Guide 1.21, Rev 1

Appendix B - EFFLUENT AND WASTE DISPOSAL REPORT

E. RADIOLOGICAL IMPACT ON MAN

Potential doses to individuals and populations should be calculated using measured effluent and meteorological data. A semiannual summary report should be submitted containing the following information:

4. Total body doses to individuals and populations in unrestricted areas from direct radiation from the facility.

Reg Guide 1.21, Rev 2

5. Dose Assessments for Individual Members of the Public

The regulation in 10 CFR 20.1301 establishes dose limits for individual members of the public. The regulations referenced in Regulatory Positions 5.4 through 5.6 contain both dose limits and design objectives that the licensee demonstrates compliance with through calculations. Table 1 summarizes the fundamental parameters associated with the dose calculations. Regulatory Positions 5.7 and 5.8 present important concepts for these calculations. Because of differences between NRC and EPA regulations, only demonstrating compliance with radiological effluent technical specifications (based on Appendix I to 10 CFR Part 50) does not necessarily ensure compliance with EPA's 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations" (Ref. 35), particularly if there is a direct radiation component (e.g., from BWR shine, ISFSI, or radioactive materials storage).

Table 1. Parameters Associated with Dose Calculations

	10 CFR Part 50, Appendix I	10 CFR 20.1301(e) (EPA 40 CFR Part 190)
Dose	Whole Body, Max of Any Organ, Gamma Air, and Beta Air	Whole Body, Thyroid, and Max of Any Organ
Basis	ICRP-2	EPA 40 CFR Part 190
Where	Unrestricted Area	Unrestricted Area
Individual Receptor	Real Person/Exposure Pathway (nearest real residence, real garden, real dairy/meat animal)	Real Person/Exposure Pathway (nearest real residence, real garden, real dairy/meat animal)
Origin	Liquid and Gas Radioactive Waste	Liquid and Gas Radioactive Waste Direct Radiation (e.g., shine, nitrogen-16, ISFSI, radioactive materials storage, outside tanks) Accumulated Radioactive Material (e.g., tritium in lake water) Not Already Included in Dose Estimates
Radioactive Material	Licensed Only	Licensed and Unlicensed
When	Current year	Current and Prior Years' Operation

RG 1.21, Rev 2 allows ‘bounding assessments, with caveat

5.1 Bounding Assessments

Bounding assessments may be useful in those circumstances where compliance can be readily demonstrated using conservative assumptions. For purposes of this document, the term “bounding assessment” means that the reported value is unlikely to be substantially underestimated (see 10 CFR 50 Appendix I, Section III). Bounding assessments for the current year do not imply the absolute bounds for future conditions. For example, licensees may use conservative bounding dose assessments in lieu of site-specific dose assessments of the maximum dose to individual members of the public. Instead of assessing dose from ground level effluent releases to a real individual member of the public located 2 miles from the site boundary, a conservative bounding dose assessment can be performed for a hypothetical individual located at the site boundary. If bounding assumptions are made, the radioactive effluent release report should state such and should annotate the assumptions. Hypothetical exposure pathways and locations are sometimes used for bounding dose assessments (or hazard evaluations done in accordance with 10 CFR 20.1501).

See the definition of “hypothetical exposure pathway” in the glossary.

RG 1.21, Rev 2 Members of the Public

5.2 Individual Members of the Public

Individual members of the public reside in the unrestricted area but at times may enter the controlled area of a commercial nuclear power plant. Each licensee is responsible for classifying individuals (by location) as either members of the public or as occupational workers. (See definition of “members of the public” in 10 CFR Part 20.) The annual dose limits for members of the public in the unrestricted area are 25 millirem (mrem) whole body and 75 mrem to the thyroid and 25 mrem to any other organ in accordance with the EPA regulations in 40 CFR Part 190; the limits are 100 mrem in accordance with 10 CFR 20.1301. In effect, annual dose limits to members of the public while in the unrestricted area are the EPA limits of 25 mrem whole body and 75 mrem to the thyroid and 25 mrem to any other organ; whereas the annual dose limit for a member of the public in the licensee’s controlled area is the NRC’s total effective dose equivalent limit of 100 mrem.

RG 1.21, Rev 2 Members of the Public

continued

If bounding assessments are not used, licensees should perform evaluations to determine the dose to a real, maximum exposed member of the public, regardless of whether the individual is in an unrestricted area or a controlled area. If no member of the public is allowed in the controlled area, the evaluation need consider only members of the public in the unrestricted area. A member of the public is typically a real individual in a designated location where there is a real exposure pathway (e.g., a real garden, real cow, real goat, or actual drinking water supply) and is typically not a fictitious fencepost resident or an exposure pathway that includes a virtual goat or cow. Licensees are encouraged (but not required) to use real individual members of the public when performing dose assessments for radioactive discharges. Table 1 in Regulatory Guide 1.109 allows a dose evaluation to be performed at a location where an exposure pathway and dose receptor actually existed at the time of licensing.

5.3 Occupancy Factors

For members of the public in the unrestricted area, occupancy factors should be assumed to be 100 percent at locations identified in the land use census, unless site-specific information indicates otherwise.

Occupancy factors may be applied inside the controlled area based on estimated hours spent in the controlled area.

RG 1.21, Rev 2 improvement with regard to direct shine requirements

5.8 Dose Assessments for 10 CFR 20.1301(e)

5.8.2 One means of demonstrating compliance with 40 CFR Part 190 is listed in the *Federal Register* (42 FR 2859), (Ref. 38), which states the following:

"In the case of light water reactors, … demonstrating conformance with Appendix I of 10 CFR 50 are generally adequate for demonstrating compliance with [EPA 40 CFR Part 190]."

As a result, a licensee who (1) can demonstrate that external sources of direct radiation are indistinguishable from background and who (2) demonstrates compliance with the numerical dose guidance of 10 CFR Part 50, Appendix I, may cite the above reference as the basis for demonstrating compliance with 40 CFR Part 190.

However, licensees who (1) have external sources of direct radiation that are above background and (2) demonstrate compliance with the numerical dose guidance of 10 CFR Part 50, Appendix I, must also include sources of direct radiation from uranium fuel cycle operations (e.g., including direct radiation from the licensed facility as well as co-located or nearby nuclear power facilities if appropriate).

Direct Shine Dose Methods of Calculations or Estimates

5.8.3 The dose contributions from direct radiation may be estimated based on either

(1) direct radiation measurements (e.g., thermoluminescent dosimeters, optically stimulated devices, or integrating pressurized ion chambers),
(2) calculations, or
(3) a combination of measurements and calculations.

When direct radiation dose is determined by measurement, estimates of background levels of radiation may be subtracted based on selected control locations. The doses measured from control and indicator locations should be taken from the same time period. When choosing the appropriate control location(s), licensees should consider the historical variability in doses measured at the control and indicator locations…Methods of determining dose from direct radiation to the maximum exposed individual member of the public may also include extrapolation methods.

Instead of relying on control locations, the NRC now realizes it is more appropriate to use “historical readings” of comparing control and indicator locations. This is referenced in the new ANSI and NRC method.

Analysis Methods

- ANSI N545 offers 2 methods
  1. Comparing control and indicator stations
  2. Comparing each location to itself
- Actual experience – several problematic issues
  1. Plants are reporting data without analysis, reporting high and low values
  2. Doing analysis incorrectly (reporting gross data or subtracting entire control dosimeters or “average” control stations)
  3. Average of inner rings “mask” any individual results
  4. Changing dosimetry types without adequate explanation

Good Examples of Direct Shine Determination & Reporting

See previous presentations from some of these organizations as to their methods

- Millstone
- South Texas
- San Onofre
- Watts Bar
- Sequoyah
- TMI
- Zion

Explanation of pre-operational TLDs and BKGD data

Analysis of SB and/or ISFSI fence line TLDs

Some extrapolated out to SB with Micro Sky Shine

Dose to a Real Individual is modeled for easy updating when more casks are moved onto the pad (from the source term of each cask, or fence line TLDs, mrem)

Complete analysis of current load on ISFSI pad, SB dose, showing a summation with effluents (including C-14) and proximity to 40CFR190 limits.

Requirements

- You are likely to be asked by the stakeholders (NRC, INPO, ANI, or others) to explain why you are evaluating direct shine.
- You need to have a good method to show how you've looked at it.
- If you try to use the 1301 exemption (<2*the App I limits) without any documented evidence of no impact from direct shine, you have potential issues from all four.
- Why risk any issues??? Therefore, clearly one of the main and best reasons for following Reg Guide 1.21, Rev 2.

Summary

- Need to review your methods of demonstrating compliance
- Need to review ANSI N13.37 and Regulatory Guide 4.13 draft versions
- Talk to RP dosimetrists and obtain their help in analyzing data
- Develop methods to extrapolate data (“microshield”, “micro skyshine”)– if necessary
- Enter any deficiencies in the CAP program (self-identified deficiencies)

Suggestion

- RG 1.21 Rev 1 has required inclusion of the WB dose in the unrestricted area from direct shine.
- Rev 2 can be used to guide some improvements:
  - Section 5 clearly states now that App I no longer assures compliance w/40CFR190 when direct shine > background.
  - While ‘bounding assessments’ are acceptable, there are caveats:
    - State your assumptions in the ARERR. This may involve a lot of technical work, and greatly complicate the effectiveness of this ‘public’ document.
    - Friends and neighbors will get comfortable with numbers like <25 mrem, and start quoting this value, when they should be quoting numbers more like 6.5 mrem. For this reason, a good argument could be made to AVOID using bounding assessments for political, if not scientific reasons.
  - If bounding assessments are NOT used, you should determine a max REAL dose (Section 5.8).

Suggestion

The best method of determining the actual dose may still be under review. At a couple of previous workshops there have been presentations on some very impressive methods. It may involve SB TLDs and/or an algorithm (MicroSkyShine) from ISFSI fence-line (and radwaste storage blds, RWSTs, ...) TLDs (better statistics), extrapolated to a max REAL individual.

Regardless, for best results, the ARERR should include:

- a discussion of 40CFR190 requirements
- a given mrem to WB and “maximum organ” from direct shine
- a depiction of direct shine values added to C-14 and the rest of effluents
- a total mrem to max REAL individual demonstrated to be < 25/75 mrem

Suggestion

- Usually, since Chem owns this report, and RP (dosimetrists) handles dose measurement of direct shine, RP should own and deliver an annual summary of the direct shine (to Chemistry) specifically for inclusion in this report.
- It may become critical that RP own/manage this job, such that any questions regarding raw data or final conclusions are directed to the appropriate source.
- Working through the CAP to get these inputs will serve to help other departments prepare and load their schedules such that this input is received in March, for example, instead of April 30.

Questions?


STOP