



**Revised Draft Interim Staff Guidance (ISG)
FSME-ISG-01: *Evaluations of Uranium
Recovery Facility Surveys of Radon and
Radon Progeny in Air and Demonstrations of
Compliance with 10 CFR 20.1301***

**Duane Schmidt, CHP, Senior Health Physicist
FSME/DWMEP/DURLD**

duane.schmidt@nrc.gov, 301-415-6919

April 2, 2014

Background on public dose limit compliance (1)

- Licensees are required to operate their plants so as not to exceed the NRC public dose limit established at 100 millirem per year.
- NRC staff routinely inspects each licensee's effluent monitoring program and public dose compliance program as a part of the NRC's baseline inspection program and oversight process.
- The licensee must conduct radiological surveys/evaluations as required by its license and other applicable regulatory requirements.

Background on public dose limit compliance (2)

- Licensed uranium recovery facilities are required to account for all radioactivity released to the environment from their operations, including planned, and unplanned releases. Licensees must report each year the quantities of radioactivity released to unrestricted areas. Licensees must demonstrate that the public dose limit is met.
- NRC staff reviews environmental monitoring reports and other, related reports and submittals from uranium recovery licensees. These reports describe environmental radon monitoring results (among other results) and, in some cases, evaluations of compliance with the 10 CFR Part 20 public dose limit.

History—how we got here

- Staff presented to industry [industry and NRC workshops 12/2009, 1/2011, 4/2011, 5/2012]
- First draft of Interim Staff Guidance (ISG) issued as draft for public comment September 2011
- In developing the current revised draft, NRC staff considered public comments submitted on the 2011 draft.
- December 2013 – two public meetings with NMA:
 - NMA recommended holding a technical workshop, to discuss ISG and to focus on environmental radon in air measurement before staff finalizes the ISG.
 - Member of the public noted we have been working on this a long time and suggested the ISG should be issued as final.

ISG issued as revised draft

March 2014

- To provide opportunity for additional public and industry input
- Comment period is through May 27, 2014
- Comments must be submitted through the web or by mail as described in the Federal Register notice (79FR17194, March 27, 2014)
- Current revised draft ISG is based on existing guidance, when available. Also based on current methods used by licensees and issues seen with those methods.
- Reminder: It is the licensee's responsibility to demonstrate compliance. The ISG provides one acceptable method; other methods may be used with technical justification.

Focus of the ISG

- The ISG focuses on radon-222. (ISG uses “radon” for radon-222.) The ISG does not provide any detail regarding other radionuclides.
- But, licensees are responsible for addressing:
 - all other radionuclides released (e.g., particulates)
 - any direct gamma radiation
- The ISG focuses on compliance with the public dose limit of 10 CFR 20.1301/1302.
- Licensees are responsible for complying with other regulations:
 - 40.65 requires reporting quantities of radioactivity released
 - Part 40, Appendix A, re environmental monitoring program
 - Etc.

Changes to the ISG from September 2011 draft

- Summary of changes to develop revised draft:

NRC staff follow-up to ISG

- NRC staff is evaluating each licensee's methods for surveys and demonstrations of compliance (including 40.65 semiannual environmental monitoring reports and other submittals as appropriate)
- If licensee methods are insufficient or inadequately justified, NRC staff will send requests for additional information (RAIs)
- Once headquarters staff has agreed to the methods and approaches, inspections will address details and results of implementation.

ISG highlights: Licensees must account for radon progeny

- Dose in most cases is primarily due to radon progeny
- SOCs for 1991 Part 20 update are clear on need to account for progeny (also brings up difficulty and suggestions)*
- Staff evaluations of newest (February 2014) 40.65 reports: in some cases licensees are still comparing to incorrect Appendix B, Table 2, value which does not account for radon progeny dose.
- [ISG Section 4.11.1 and Appendix 1]

* “For uranium mills it will be necessary to show that the dose from radon and its daughters, when added to the dose calculated for 40 CFR Part 190 compliance, does not exceed 0.1 rem. [Emphasis added.]”

Two compliance methods

- Option 1: Compare concentrations in air to Appendix B, Table 2, value (10 CFR 20.1302(b)(2))
- Option 2: Dose assessment (10 CFR 20.1302(b)(1))
- [ISG Section 3, 4.10, 4.11, 4.12]

Compliance option 1: comparison to Part 20, Appendix B

- Must use Appendix B, Table 2, value for radon with daughters present, 0.1 pCi/L
- Monitoring locations must be at boundary of unrestricted area
- May adjust Appendix B value for equilibrium factor; need NRC staff approval
- Appendix B value relates to dose of 50 mrem for continual exposure for a year
- Not much flexibility when using this method.
- [ISG Section 3.1, 4.11]

Compliance option 2: dose assessment

- Dose limit is 100 mrem/yr, but must include dose from radon, particulates, direct gamma as appropriate
- Can account for equilibrium factor
- Can account for occupancy
- Depending on site-specific conditions (assuming equilibrium factor 0.5 or lower, little or no dose from direct gamma or particulates), effective limiting concentration might be ~0.3–0.4 pCi/L.
- Dose assessment compliance method provides additional flexibility. Importantly, do not have to compare concentrations to Appendix B, Table 2, value.
- [ISG Section 3.2, 4.12]

Compliance option 2: simple dose assessment method

- $Dose = DCF \sum_i C_i F_i T_i$
- Assume outdoor radon concentration (C) applies outdoors or to indoor residents
- Apply equilibrium factor F appropriate to conditions
- Apply occupancy factor T if determined for the specific people
- Apply “dose conversion factor” DCF to determine annual dose
- [ISG Section 4.12.2]

Equilibrium factor

- Equilibrium factor describes how much radon progeny are present, relative to radon. Ratio of progeny concentration to radon concentration, expressed as fraction of equilibrium.
- In some cases, releases from UR sites do not include progeny, but ingrowth of progeny happens with time (roughly $\frac{1}{2}$ hour effective half-life).
- Appendix B value assumes 100% equilibrium factor.
- Equilibrium factor provides flexibility for more realistic “limit” or dose assessment. Equilibrium factor can be used for Appendix B comparison (need specific NRC approval) or in dose assessments.
- ISG provides generally acceptable values.
- Site-specific values may be used; ISG provides caveats.
- [ISG Section 4.9]

Need to address indoor exposure for residents

- If highest exposed members of public are residents, need to address indoor (in addition to outdoor) exposure.
- Indoors, radon progeny builds up due to “hold up” time inside. This results in generally higher equilibrium factor than that calculated for outdoor travel time and must be accounted for.
- May apply to other receptors with indoor exposure.
- [ISG Sections 4, 4.2, 4.9.2]

Calculation of outdoor equilibrium factor

- Calculation of equilibrium factor for outdoor exposures can be based on straightforward physics of ingrowth of progeny as a function of time.
- The ISG specifically recommends that calculations may be used for this case of determining the equilibrium factor.
- Thus, NRC staff would consider such approaches and evaluate details of the approach.
- [ISG Section 4.9.3.1]

Address dose to highest exposed member of public

- Can determine which specific person is the highest exposed.
- Alternatively, determine dose or compliance for multiple potential highest exposed persons; show all are in compliance.
- [ISG Section 3.2, 4.7, 4.12.1]

Suggestions for improving sensitivity of measurements

- Devices commonly used by licensees have lower limit of detection:
 - 30 pCi-days/L, equivalent to 0.33 pCi/L for 90 days or 0.17 pCi/L for 180 day measurement periods.
 - Better sensitivity (costs extra) 6 pCi-days/L, equivalent to 0.07 pCi/L for 90 days or 0.03 pCi/L for 180 day measurement periods.
- ISG suggests consideration of using better sensitivity devices and/or using multiple devices (also reduces overall measurement uncertainty)
- [ISG Section 4.5]
- more info later today from industry

Background variability

- Some sites appear to have significant variability in background
- ISG suggests that variability be determined in preoperational monitoring
- ISG suggests considering extra (beyond RG 4.14) monitoring, to have solid basis to establish that true variability exists
- Otherwise, operational data may appear to indicate elevated radon when it is really background
- ISG suggests evaluating initial preop data and deciding if additional preop data would be useful
- [ISG Section 4.3]

Survey method and monitoring versus calculations

- The ISG describes 4 acceptable methods for surveys of radon and radon progeny to determine exposure concentration.
- Generally preferred method is to measure radon concentration outdoors at the boundary of the unrestricted area and/or at receptor locations. Equilibrium factors can be applied to determine progeny exposure.
 - Note that monitoring at receptor locations may not address 40.65 requirement to report effluent quantities released to unrestricted areas.
- Another method is to measure radon released from the facility and calculate radon concentrations at boundary of the unrestricted area and/or receptor locations. For this method, ISG recommends that measurements of radon in air should be made to validate the modeled/calculated concentrations.
- [ISG Section 4.4.2]

Measurements versus calculations (1)

- Regulation allows measurements or calculations for the surveys to evaluate exposure of members of the public.
- Public (and industry) comments: some described difficulty in making measurements at levels needed.
- A public (industry) comment preferred measurement over the use of modeling
- Existing guidance in RG 3.59 refers to NUREG-0859 for guidance on compliance with radiation protection standards, which includes the public dose limit.

Measurements versus calculations (2)

- Previous comments from industry have not described in detail what calculations are proposed to determine exposure. As of this time, no licensee has proposed specific calculations to determine exposure. NRC staff does not have a basis at this time to write guidance describing acceptable calculations for determining exposure.
- Thus, the ISG states the NRC staff preference that compliance be based on monitoring or calculations validated with monitoring.
- The ISG is only guidance; licensees must comply with the regulations. Methods and approaches different from those in the ISG will be acceptable if they provide a basis for concluding that the licensee operations are in compliance with NRC regulations.
- Industry discussions on difficulties and solutions later today.
- [ISG Section 4.2]

Questions/Comments/Discussion on the revised draft ISG?