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Re: Comments on Proposed Draft REGDOC 2.5.5 Physical Design or Industrial Radiography Facilities

Overall the format needs improvement. Suggest that the REGDOC is compared to the layout of a well written REGDOC 2.12.3 for Security**.** The sections need to be organized to provide clarity of information and details in an orderly fashion. The guide would also benefit from a review of the language and grammar used throughout the document.

Section	**Wording**
1.2	**1.2 Scope** The guidance provided applies to the design of industrial radiography installations for the use of sealed nuclear substances, including fixed (permanent) and temporary structures, and installations not under the direct control of the certified person(s) conducting the radiography operations.
Comments	It is very vague regarding "installations not under the direct control of the certified persons. There needs to be clarity on what this scope means. For example the installation (fixed facility) should always be under the control of the certified persons. Suggest removing wording "and installations not under the direct control of the certified person(s) conducting the radiography operations" "Temporary structures" is also very vague. This needs to be clarified.

Section	**Wording**
1.2	**1.2 Scope** REGDOC-2.5.5 addresses design features that enhance nuclear safety and security. Other health, safety, and environmental considerations may dictate adherence to additional guiding principles.
Comments	This wording should be moved to Section 1.1 purpose. Suggest removing wording "REGDOC-2.5.5" as this is repeated. Reword as This guide addresses design features that enhance nuclear safety and radiation protection to the general public.

Section	Wording
1.3	**1.3 Relevant legislation**
Comments	Only the applicable regulations need to be listed. Do not see any need to provide all the wording from each of the regulations in detail. Suggest removing wording and listing only the applicable regulations and sections

Section	Wording
2	**2. General Design**
Comments	The second and third paragraph are poorly worded and very lengthy. Should be condensed. Suggested wording; The design of a radiography installation should include specific factors to minimize radiation exposure. The workload, structural, and accessibility should be considered in the design of the radiography installation. Thorough evaluation of these factors will contribute to ensuring that the installation will protect the workers and the public during gamma radiographic operations. Radiation exposure can be minimized through use of engineered controls (e.g., shielding, location) and administrative controls (e.g., limiting nuclear substance sealed source activity, restricting access and time in proximity to the installation). Engineering controls should be the first level of protection, and administrative controls, as the second level of protection. Engineering controls should include consideration of: • Location of the installation • Type of nuclear substances that will be used • Consideration for size and type of products examined, and equipment used for radiography • Distance to other occupied areas • Control of access due to roadways, sidewalks, or walkways (fence, gate, doors) • Type and thickness of shielding to reduce radiation levels to safe levels • Consideration of scatter radiation (skyshine) • Structural design of the walls, roof, floor and access to control radiation levels and safe access to and from the installation • Design that will prevent any extraneous radiation due to openings or poor shielded areas. • Services such as lighting, heating, plumbing or power if required. • Security measures to prevent loss during use if required. Administrative controls should include: • Specific documented written procedure complete with drawings for use and implementation of the installation

	• Limiting the nuclear substance activity or type • Control of occupancy activity around the installation (restrictions or access) • Control of occupancy of surrounding areas • Controlling workload (including time of day considerations) • Limiting the position and direction of the source within the installation • Monitoring for human presence prior to exposures • Use of signs, notices, barriers, or warning systems such as lights or alarms

Section	**Wording**
3.	**3. Engineered Controls** The design of the radiography installation should incorporate the following engineered controls to ensure that the prescribed exposure limits will be respected and that all exposures are kept consistent with the ALARA principle.
Comments	The first paragraph of this section should expand on the radiation protection limits to non-nuclear energy workers (public) Suggest wording: "The design of the radiography installation should incorporate the following engineered controls to ensure that the prescribed radiation exposure limits will be As Low As Reasonably Achievable (ALARA). Three basic principles of ALARA are time, distance and shielding. The guide covers Distance and shielding, but does not cover "Time" The Time section should include occupancy factor and wording to reduce time of the exposures, or reducing time of the persons in any occupied areas. It might also include specific times of when radiography is carried out.

Section	**Wording**
3.1.1 Second paragraph	**3. 1.1 Distance** The design of the installation should also facilitate the ability to use the full length of the control cable for each exposure device being used and should not compromise or restrict the use of long-handled tools that may be needed to respond to emergencies, such as source recovery operations.
Comments	This statement is not clear or concise. Suggest wording: "The design of the installation should facilitate the ability to use the radiographic equipment safely, and should not compromise or restrict the use of any emergency equipment that may be needed in the case of an emergency such as a source retrieval situation."

Section	Wording
Table 1	**Table 1** Gamma Ray constants.
Comments	It would be beneficial to have the imperial dose rates for gamma constants in millrem / hour per curie at 1 meter.

Section	Wording
3.2.2	**3.2.2 Services** The design of the radiography installation should take into account current and future provision of services that may be required. These include:
Comments	It should state “may” include. I see no benefit to list all the items. Simply state that services such as lighting, heating, plumbing, water or power may be required.

Section	Wording
3.3	**3.3.1 Size and weight of exposure devices** The design of the installation should account for the physical characteristics of the exposure device expected to be used. Because of their smaller size, devices that use iridium-192 and selenium-75 are less likely to require special design considerations than larger and heavier cobalt-60 exposure devices. If an exposure device is difficult to manipulate or move, the design of the installation should include measures such as wider corridors to allow for movement and turning of the device. The installation design should also allow for radiation source changes, including the additional containers or other packages that may be required to undertake the source change. If it is not feasible or possible to remove the exposure device to change the sealed source, then the design of the installation should allow for a new source in a shielded container or other package to be brought into the installation, safely opened, and exchanged with the old source while minimizing potential exposures to any nearby person. If it is not possible to design the installation to accommodate a variety of exposure devices that may be used, it may be necessary for the radiography installation owner to limit the nuclear substances used, the quantity of a specific isotope, or the size of the exposure device.

Comments	I do not believe all this detail regarding exposure devices or source changes is required. I suggest wording states: "The design of the installation should consider the size and types of radiographic exposure devices and equipment used". Source changes is irrelevant to this section and should be omitted. Maybe source changes could be mentioned in the type of use section.

Section	**Wording**
3.4	**3.4 Security** The exposure devices used inside radiography installations often contain high-risk Category 1 or 2 radioactive sealed sources. Although the radiography installation itself is not subject to requirements of REGDOC-2.12.3,
Comments	REGDOC 2.12.3 does not apply to a radiography installation. I suggest wording states: "If radioactive materials are to stored in the installation, then the design needs to meet REGDOC 2.12.3 for specific Security measures". Also add: During the use of exposure devices within the installation the exposure device operators must maintain security of the device at all times. Delete Table 2. This is redundant and there should only be reference to REGDOC 2.12.3.

Section	**Wording**
4	**Administrative controls** Because administrative controls depend on persons to respect and adhere to them, they should supplement but not replace engineered controls.
Comments	Poorly worded. I suggest wording states: "The administrative controls are intended to supplement the engineering controls. The following measures will assist in controlling and reducing the radiation dose and dose rates outside the installation".

Section	Wording
4.2.2 Paragraph 2	**Controlling Occupancy of surrounding areas** The occupancy factor (T) for each location is the fraction of total time during which a radiation field is present at a particular location, for which any one individual would reasonably be expected to be present there. This factor (≤1) is multiplied by the total radiation dose at that location, to derive the maximum personal dose any single person would be expected to receive. Examples of occupancy factors are provided in table 3, which may be used as a guide in the absence of adequate occupancy data. The information provided is adapted from ANSI N43.3-2008, *Installations Using Non-Medical X-Ray and Sealed Gamma Ray Sources, Energies Up To 10 MeV* [5].
Comments	Missing critical element regarding the frequency of exposure. The Guide is missing the critical information regarding the frequency of the exposure. During radiography the source is not exposed for 100% of the work shift. It may only be a partial amount of time. The other time is spent in setting up equipment, moving parts, preparation of the technique. For example, if a vault is in use 12 hours per day, it may be determined that the cumulative time the beam is energized or the source is exposed is 2 hours. The frequency of exposure would therefore be 0.17. Suggest that this is added to the guide.

Section	Wording
Bullet 4 Paragraph 3	**Appendix A** The second method is a mathematical approach that relies on the known physical properties of the nuclear substances being used, the distances to each occupied area and the shielding properties and thickness of the building materials. This method may be useful when designing a radiography installation.
Comments	The mathematical approach is not as good as actual dosimetry measurements over a specific longer period of time. For example to place area dosimeters at specific regions of occupancy provides a much more accurate method than calculations. I suggest deleting the complete mathematical approach. The formulas are much too complex and do not measure the reality of shielding and types of materials. There is also an increased margin for error. I suggest adding method for utilizing area dosimeters to determine dose at specific regions of occupancy as follows:

Area Monitoring With Thermoluminescent Area Dosimeters

a) The advantage of using area monitors is that actual dosages will be recorded over a longer period of time. It will gather more correct data over a defined period.
b) This analysis is also required at different locations to determine the maximum value. Areas of maximum dose rate are of concern but areas of high occupancy factor must also be considered. The procedure and calculation is as follows:
   - Measure the cumulative dose (CD) in the area of the installation evaluation for a period of time (T). The longer the time, the greater the accuracy of the calculation.
   - Determine the occupancy factor (OF) for the areas near the installation. The cumulative dose rate is for one particular location but the area considered in determining the occupancy factor.

The annual dose rate (DR) is calculated as follows where 8760 equals the number of hours in a calendar year:

Dose Rate (mSv / year) = (CD x OF / T) x 8760 hrs

For example:

CD = 0.5 mSv

OF = 0.06

T = 1 month (720 hrs)

(0.5 x 0.06 / 720) x 8760 = Dose rate

Dose Rate = 0.365 mSv / year

c) All data, drawings, and results will be recorded
d) If dosages are over the maximum allowable scheduled dosages to meet the dose rate limit of 0.1 mSv/week or 0.5 mSv/year.
e) then remedial measures must be taken to reduce the dosage amounts.

If you have any questions or concerns you can contact me at tlevey@acuren.com or 780-490-2448.

Sincerely,

Thomas A. Levey
Corporate Radiation Safety Director