**Public Consultation**
**Draft REGDOC-2.5.5, *Design of Industrial Radiography Installations***
March 9 – July 28, 2017

| # | Reviewer | Section | Comment and/or suggested change | CNSC Staff Response |
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| 1. | Acuren, Team Industrial Services | General | Overall the format needs improvement. We suggest that the REGDOC is compared to the layout for example, of 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. | Comment noted. No changes to format.<br>Structure is similar to REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources*. |
| 2. | Team Industrial Services | General | The main comment we would like to make is that temporary structures should be removed from the scope of this document. Or, that the expectations for temporary structures are clearly defined. We need to assure that requirements for temporary installations are not as prescribed or regulated as far as design. Especially when the main purpose is to simply provide extra shielding on an as needed, temporary basis, and that the general, security and RPR regulation requirements are already being applied. | Comment noted. However, this document is only guidance. Removal of "temporary" structures from the scope may allow users to circumvent this guidance by claiming structures are only temporary. |
| 3. | Bruce Power | General | The purpose of this letter is to provide feedback on this draft Regulatory Document, which offers concise, well-written guidance on the design of industrial radiography installations.<br>As always, Bruce Power appreciates the CNSC's efforts to seek stakeholder input. Following a collaborative review of this draft with our industry peers at Ontario Power Generation, New Brunswick Power and Canadian Nuclear Laboratories, we found this document to be properly written at a guidance level and in a manner truly helpful to radiation protection experts. While pleased with the overall quality of this draft, which could serve as an example of how other Regulatory Documents should be written, our collective review did generate some suggestions and requests for clarification as detailed in Attachment A. | Comment noted, with thanks. |

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| 4. | Bruce Power, Canadian Nuclear Association (CNA), Canadian Nuclear Laboratories (CNL), New Brunswick Power (NB Power), Ontario Power Generation (OPG) | Preface and Glossary | ***Major***<br><br>Inclusion of locations not specifically designed for radiography imposes requirements for radiography type shielding for areas not designed for radiography.<br><br>Radiography may be performed in locations that were not designed as radiography installations. These locations may have shielding (e.g. structural walls) even though they were not designed for the purpose of radiography. The scope of this document should not be so general as to include such locations. The scope of this document needs to be more clearly defined. The definition used to describe a radiography installation is too general and is not consistent with current industry practice.<br><br>Suggested change:<br><br>Define 'radiography installation' to exclude locations which are not specifically designed for radiography, by revising:<br><br>- Preface, 3rd paragraph, 1st sentence, *"A radiography installation.....cell or vault specifically designed for radiography, where...."*<br><br>- Glossary definition,<br><br>**"***radiography installation*<br><br>*A shielded enclosure....cell or vault specifically designed for radiography, where..."* | Agreed, text has been revised. The revised definition will be reviewed by CNSC staff for the next revision of REGDOC-3.6 Glossary of CNSC Terminology. |
| 5. | Alberta Labour | Preface and Introduction | • [1] In the Preface it states that: *"A radiography installation is any shielded enclosure, cell or vault where radiography is performed."*<br>• In the Introduction states: *"Whether a radiography installation is temporarily or permanently installed, all of the design principles described in the following sections apply."*<br>• [2] These statements could be confusing to readers who think of a temporary installation as *"open area radiography"*, having to meet the requirements for a *"temporary job site"* as described in Health Canada's Safety Code 34: *Radiation Protection and Safety for Industrial X-ray Equipment*, which is harmonized with the CNSC's General Nuclear Safety and Control Regulations. | Disagree that there would be confusion between temporary structures and open areas. However, the text radiography has been modified as a result of comment 4. The reference to permanent/temporary structures has been deleted is response to comment 8.<br><br>[1] The radiography installations are clearly defined in the Preface as being any shielded enclosure, so a temporary installation should not be interpreted as an open area.<br><br>[2] The scope of REGDOC-2.5.5 does not include industrial X-ray radiography. |

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| 6. | Bruce Power, CNA, CNL, NB Power, OPG | Introduction – last sentence of 4th paragraph | ***Clarification***<br>Not all CNSC regulatory requirements apply to uses of nuclear substances and radiation devices within a radiography installation.<br>Remove sentence *"All CNSC regulatory requirements, including those specific to radiography, apply to all uses of nuclear substances and radiation devices within a radiography installation."* | Agree. The sentence has been deleted. |
| 7. | Alberta Labour | Section 1.2 Scope | - This section states: *"The provinces and territories regulate the use of x-ray generators for industrial radiography. The design of installations for their use is outside the scope of this document."*<br>- As one of the contributors to Safety Code 34, we went to great lengths to ensure that the "*permanent installation*" criteria were harmonized with the CNSC's Nuclear Substances and Radiation Devices Regulations. Perhaps that could be reflected here. | Noted. No change to text.<br>However, this information does not necessitate changes to the scope section.<br>Reference to Safety Code 34 has been added. |
| 8. | Acuren | Section 1.2 Scope | ***Clarification***<br>1) 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.<br>Suggest removing wording "and installations not under the direct control of the certified person(s) conducting the radiography operations"<br>2) "Temporary structures" is also very vague. This needs to be clarified. | 1) Disagree. No change to text.<br>The scope of this document includes companies who want to build a radiography installation, but have the radiography work contracted out to a CEDO. Furthermore, CEDOs are certified to operate the exposure device, not to run the installation.<br>2) The reference to temporary and permanent structures has been deleted since the guidance applies to all structures and the reference caused confusion. |
| 9. | Acuren | Section 1.2 Scope | ***Clarification***<br>"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."<br>This wording should be moved to Section 1.1 purpose.<br>Suggest removing wording "REGDOC-2.5.5" as this is repeated.<br>Reword as "This guide addresses design features that enhance nuclear safety and radiation protection to the general public." | Disagree. No change to text.<br>The referenced text is scoping information. The guidance provided in the document is focused on nuclear safety and security. Building codes and other requirements are outside the scope of this REGDOC. |

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| 10. | Acuren | Section 1.3 Relevant Legislation | 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.<br><br>Suggest removing wording and listing only the applicable regulations and sections. | Comment noted. No change to text.<br><br>This is a standard section in CNSC regulatory documents.<br><br>For non licensees, this will save them the time needed to look up the references. |
| 11. | Acuren | Section 2 General Design Principles | 1) The second and third paragraphs are poorly worded and very lengthy. Should be condensed.<br><br>Suggested wording;<br><br>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.<br><br>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). | 1) Agreed. Suggested text incorporated with changes. |
| | | | 2) Engineering controls should be the first level of protection, and administrative controls, as the second level of protection.<br><br>Engineering controls should include consideration of:<br>• Location of the installation<br>• Type of nuclear substances that will be used<br>• Consideration for size and type of products examined, and equipment used for radiography<br>• Distance to other occupied areas<br>• Control of access due to roadways, sidewalks, or walkways (fence, gate, doors)<br>• Type and thickness of shielding to reduce radiation levels to safe levels<br>• Consideration of scatter radiation (skyshine)<br>• Structural design of the walls, roof, floor and access to control radiation levels and safe access to and from the installation<br>• Design that will prevent any extraneous radiation due to openings or poorshielded areas.<br>• Services such as lighting, heating, plumbing or power if required.<br>• Security measures to prevent loss during use if required.<br><br>Administrative controls should include: | Noted. However, no change to the list in the document. All of the items are addressed in the document.<br><br>Additional text has been added under Administrative Controls to address the suggestion for documented work policies and procedures. |

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| | | | • Specific documented written procedure complete with drawings for use and implementation of the installation<br>• Limiting the nuclear substance activity or type<br>• Control of occupancy activity around the installation (restrictions or access)<br>• Control of occupancy of surrounding areas<br>• Controlling workload (including time of day considerations)<br>• Limiting the position and direction of the source within the installation<br>• Monitoring for human presence prior to exposures<br>• Use of signs, notices, barriers, or warning systems such as lights or alarms | |
| 12. | Bruce Power, CNA, CNL, NB Power, OPG | Section 2,<br>General Design Principles | ***Clarification***<br>Fourth paragraph currently reads: *"Engineered controls include: radiation exposure controls – distance, shielding, skyshine . .."*<br>Skyshine is an outcome of the level of shielding, not an engineered control. Skyshine is a component of exposure that can be managed or reduced via implementation of engineered controls.<br>Remove skyshine from list of engineered radiation exposure controls. | Agree. The text has been deleted. |
| 13. | Bruce Power, CNA, CNL, NB Power, OPG | Section 2 | **Major**<br>May lead some Licensees who have not experience failure in the engineered controls, e.g. interlock not working as expected, to believe that engineered controls are foolproof, which is not the case.<br>The following statement has not always been observed, *"The design of a radiography installation should give preference to the use of engineered controls where ever possible, which are always functional"*.<br>Remove, *"which are always functional"*, and replace with wording suggestive of high reliability. | Agree. The text "*which are always functional"* has been deleted. |

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| 14. | Acuren | Section 3., Engineered Controls | Current wording: "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."<br><br>The first paragraph of this section should expand on the radiation protection limits to non-nuclear energy workers (public)<br><br>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.<br><br>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. | Disagree. No change to text.<br><br>"Time" is dealt with in sections:<br><br>- *4.2 Restricting use of areas adjacent to the radiography installation*<br>- *4.2.1 Adjusting workload*<br>- *4.2.2 Controlling occupancy of surrounding areas* |
| 15. | Acuren | Section 3.1.1,<br><br>Second Paragraph | Current wording: "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."<br><br>This statement is not clear or concise.<br><br>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." | Agree, with changes. The suggested text has been revised. |
| 16. | Bruce Power, CNA, CNL, NB Power, OPG | Section 3.1.2, shielding | ***Clarification***<br><br>Page 5, second paragraph currently reads: *"For any given nuclear substance, the relationship between radiation dose and the activity of the source is directly proportional*<br><br>Suggesting being specific about the proportional relationship by relating dose rate, to activity. Dose is an inferred consequence. | Agree. The text has been revised as per suggestion. |
| 17. | Acuren | Section 3.1.2,<br><br>Table 1 | It would be beneficial to have the imperial dose rates for gamma constants in millrem/hour per curie at 1 meter. | Comment noted. No change to text.<br><br>CNSC policy is to use SI units. Including non-SI units may lead to errors in calculations when the wrong column is used. |

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| 18. | Bruce Power, CNA, CNL, NB Power, OPG | Section 3.1.2 | ***Clarification***<br>Consistency needed relative to other references in the document with respect to high and low energy gamma.<br>Add "may" to 4th sentence of paragraph to read *"...radiography may emit high-energy gamma..."* | Agree. The text has been revised as per suggestion. |
| 19. | Bruce Power, CNA, CNL, NB Power, OPG | Section 3.1.2, shielding | **Major**<br>Document could be misinterpreted and could be overly restrictive beyond the existing regulations if the suggested addition is not made. This regulatory requirement only applies to non-NEWs.<br>Page 6, third paragraph, first sentence currently reads *"If the design does not or cannot provide enough shielding to meet the dose rate limit of 0.1 mSv/week or 0.5 mSv/year, as well as demonstrate . . ."*<br>Add the words "to non-NEWs" after 0.5 mSv/year. The sentence should then read: *"If the design does not or cannot provide enough shielding to meet the dose rate limit of 0.1 mSv/week or 0.5 mSv/year to non-NEWs, as well as demonstrate . . ."* | Noted. Text has been added as footnote.<br>However, this document is guidance. Radiography activities at NPPs are in a controlled environment. The focus of this guidance is protection of members of the public. |
| 20. | Acuren | Section 3.2.2, Services | [1] Current wording: "The design of the radiography installation should take into account current and future provision of services that may be required. These include:"<br>It should state "may" include.<br>[2] I see no benefit to list all the items. Simply state that services such as lighting, heating, plumbing, water or power may be required. | [1] Agree. The text has been modified.<br>[2] No change to the list, because the details could be helpful to members of the public. |
| 21. | Acuren | Section 3.3.1 | I do not believe all this detail regarding exposure devices or source changes is required.<br>I suggest wording states: "The design of the installation should consider the size and types of radiographic exposure devices and equipment used".<br>2) Source changes is irrelevant to this section and should be omitted. Maybe source changes could be mentioned in the type of use section. | 1) Disagree. The amount of detail in this document is appropriate for the broad audience of licensees, CEDOs and members of the public.<br>2) Suggested text has been incorporate. However the reference to source changes remains because it is a factor to be considered along with the size of the exposure device. This document is guidance and users should be aware of all situations that may require consideration. |

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| 22. | Acuren | Section 3.4, Security | [1] Current text: "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,"<br><br>REGDOC 2.12.3 does not apply to a radiography installation.<br><br>I suggest wording states: "If radioactive materials are to store in the installation, then the design needs to meet REGDOC 2.12.3 for specific Security measures".<br><br>[2] Also add: During the use of exposure devices within the installation the exposure device operators must maintain security of the device at all times.<br><br>[3] Delete Table 2. This is redundant and there should only be reference to REGDOC- 2.12.3. | [1] Agree, with changes. The text has been modified as per suggested.<br><br>[2] Agree. The text has been modified.<br><br>[3] Disagree. Table 2 has not been deleted. Il is helpful to have the relevant security guidance from 2.12.3, *Security of Nuclear Substances: Sealed Sources* in this document. |
| 23. | Acuren | Section 4., Administrative Controls | Current text: "Because administrative controls depend on persons to respect and adhere to them, they should supplement but not replace engineered controls."<br><br>Poorly worded.<br><br>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." | Agree. The text "*The following measures assist in minimizing radiation exposure outside the installation.*" has been added |
| 24. | Bruce Power, CNA, CNL, NB Power, OPG | Section 4.2, Restricting use of areas adjacent to the radiography installation | ***Clarification***<br><br>Fourth paragraph, first sentence reads *"All locations adjacent to the radiography installation should be clearly marked on a plan of the installation*<br><br>Please clarify on what is meant by the plan (design layout, approval documentation, operating procedures). | Agree. *Plan of the installation* has been revised to *Design layout*. |

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| 25. | Bruce Power, CNA, CNL, NB Power, OPG | Section 4.2, Restricting use of areas adjacent to the radiography installation | ***Clarification***<br>Fifth paragraph, first sentence reads *"Based on the exposure potential for areas adjacent to the radiography installation, the Certified Exposure Device Operator (CEDO) should monitor exposures in these areas to ensure that radiation doses are not exceeded."*<br>Clarification from CNSC to licensees on these points is needed in order to ensure implementation of radiation controls at radiography installations meets the regulatory requirements.<br>The use of the term exposure appears to be intentional, in that it is recognized that as the source transitions from the shielded location to the collimator, the dose rates may be greater than the prescribed limits (0.1 mSv/h or 25µSv/h), even if the dose is well below the limits for non-news at those locations.<br>Clarification is required with respect to the design requirements for short duration high field transients evaluated to be within the dose limits, but greater than the dose rate limits. | Agree, with change. The text has been modified.<br>Text has been revised as follows:<br>"Based on the exposure potential for areas adjacent to the radiography installation, the CEDO should monitor exposures in these areas to verify that radiation doses to persons occupying areas are not potentially exceeded. Radiation warning signs must be posted in accordance with the requirements of the *Radiation Protection Regulations* and the *Nuclear Substances and Radiation Devices Regulations."* |
| 26. | Bruce Power, CNA, CNL, NB Power, OPG | Section 4.2, last paragraph | ***Clarification***<br>First sentence regarding exposure potential for areas adjacent to the radiography installation, incorrectly refers to *"radiation doses are not exceeded",* and should be corrected to reference dose rate limits.<br>Change to:<br>*"...ensure that radiation dose rate limits are not exceeded".* | Agree. The text has been modified. |
| 27. | Bruce Power, CNA, CNL, NB Power, OPG | Section 4.2.1 | ***Clarification***<br>Workload should be calculated using a conservative estimate of the maximum total exposure time, not necessarily the maximum time per shot x # of shots. Clarify that there are other appropriately conservative assumptions. Note – Appendix A uses the average time per shot (not max).<br>Add sentence to end of 2nd paragraph:<br>*"Other appropriately conservative assumptions can also be used. For example, Appendix A provides an example of dose calculations using the average time per shot."* | Agree. The suggested text has been added. |

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| 28. | Acuren | Section 4.2.2, Paragraph 2 | **Controlling Occupancy of surrounding areas**<br><br>Current text: "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]."<br><br>Missing critical element regarding the frequency of exposure.<br><br>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.<br><br>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.<br><br>Suggest that this is added to the guide. | Disagree. No change to text.<br><br>Exposure time is addressed under Section 4.2.1 *Adjusting workloa*d. |
| 29. | Bruce Power, CNA, CNL, NB Power, OPG | Section 4.2.2,<br><br>3rd paragraph | ***Clarification***<br><br>CEDOs should only be required to verify the occupancy of adjacent areas that will be impacted by the radiography. If radiography installation has sufficient shielding, adjacent areas will not be impacted and their occupancy does not need to be verified.<br><br>Add sentence to end of paragraph:<br><br>*"If radiography installation has sufficient shielding, adjacent areas will not be impacted and their occupancy does not need to be verified."* | Agree. The text has been modified. Verification is covered in Sections 6 and 7. |

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| 30. | Alberta Labour | Section 4.3, Monitoring for human presence prior to exposure | - Section 2: General Design Principles states: "The design of a radiography installation should give preference to the use of engineered controls where ever possible." Section 4.3 identifies the following as administrative controls:<br>- Remote monitoring of the interior of the radiography installation i.e. video camera<br>- Alarm or stop buttons on the interior of the radiography installation<br>I would consider these to be engineered controls.<br>Alberta Labour recommends harmonization (where applicable) with Safety Code 34. Section 3.3.1 of the Safety Code provides the following engineered controls for a radiography installation:<br>- a **radiation control station** that<br>(i) is suitably designed and positioned external to the permanent installation,<br>(ii) contains the ionizing radiation source control console,<br>(iii) provides for the operator direct visual or electronic surveillance of the interior of the permanent installation during radiography, and<br>(iv) facilitates real-time imaging display and assessment capabilities;<br>- **two independent interlocks that are affixed on the main door** which is nearest the control console and which provides whole-body entry to the permanent installation, and they shall be designed in such a manner that, when activated, they shall promptly terminate x-ray production and require a manual reset at the control console to resume x-radiation generation;<br>- **one interlock,** which trips a safety relay thereby removing power from the x-ray generator, **shall be affixed on all remaining doors** that provide whole-body entry to the installation, including any panel that permits partial-body entry to the permanent installation;<br>- clearly visible **red radiation-on warning indicators** that are failsafe and that illuminate when x-radiation is generated: one indicator shall be prominently positioned inside the permanent installation on a fixed vertical structure at a height of 2 metres above the installation floor and, at least one indicator on the outside of the permanent installation, near each entry door or panel that provides access to the interior of that installation;<br>- clearly visible **yellow or amber stand-by warning indicators** that illuminate when ionizing radiation is not generated: one indicator shall be prominently positioned inside the permanent installation on a fixed vertical structure at a height of 2 metres above the installation floor and, at least one indicator on the outside of the permanent installation, near each entry door or panel that provides access to the interior of the permanent installation;<br>- inside the permanent installation, an **audible warning signal** that<br>(i) is distinct and loud enough to gain the attention of an individual, and<br>(ii) is initiated for at least 5 seconds preceding ionizing radiation generation; | Disagree. No changes to text.<br>Remote monitoring and stop buttons are not engineered controls as they require a human interface to operate properly.<br>Industrial radiography does not require the same control interface as an x-ray generator. The most common form of exposure device is not electromechanically operated and cannot be interfaced with the proposed approach. |

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| 31. | Bruce Power, CNA, CNL, NB Power, OPG | Section 4.3,<br>last paragraph | ***Clarification***<br>Clarify that the last paragraph is for radiography licensees to consult with applicable fire codes, and is not intended to add any additional requirements for a radiography installation.<br>Remove from the paragraph "*In all cases,"* | Agree. The text has been deleted. |
| 32. | Bruce Power, CNA, CNL, NB Power, OPG | Glossary | ***Clarification***<br>Definition of industrial radiography currently reads "*The use of certified exposure devices to conduct the non-destructive examination of the structure of welds, castings and building components. Also called gamma radiography"*<br>The definition is too restrictive. What if a radioactive source is used to do radiography of plants, samples or nuclear forensics items?<br>Radiography should be broad enough to mean "taking pictures" and not specify the media that the pictures are being taken of. The radiographs can also be film or digital. Industrial radiography should only exclude medical purposes and should technically cover neutron radiography (because neutron radiography is used for industrial but non-medical purposes).<br>Suggestion is to make the definition broader so that it matches up with the NSRDR's definition of an exposure device. A definition of industrial radiography that would work (for example is): "*the use of an exposure device containing a nuclear substance to carry out non-destructive examination of items for industrial purposes; not used for medical diagnostic purposes; also called gamma radiography."* | The following revised definition will be proposed for the next revision of REGDOC-3.6, Glossary of CNSC Terminology<br>industrial radiography: "*The use of certified exposure devices for industrial purposes to conduct the non-destructive examination of the structure of welds, castings, building components and other materials. Also called gamma radiography"*<br>Neutron radiography is out of scope for this document. The definition for neutron radiography could be added to REGDOC-3.6 in a future revision.<br>Radiography of plants, samples or nuclear forensics items is not considered industrial radiography, since X-ray equipment typically used. |
| 33. | Bruce Power, CNA, CNL, NB Power, OPG | Glossary | ***Clarification***<br>The term "workload" is not defined.<br>Add the definition for "Workload" as it applies in this document to the glossary. | Agree. The definition has been added. |

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| 34. | Acuren | Appendix A,<br><br>4. Estimate the radiation dose rates produced in each potentially occupied area, | Current text: "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."<br>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.<br>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.<br>I suggest adding method for utilizing area dosimeters to determine dose at specific regions of occupancy as follows:<br><u>Area Monitoring With Thermoluminescent Area Dosimeters</u><br>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.<br>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:<br>• 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.<br>• 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.<br>The annual dose rate (DR) is calculated as follows where 8760 equals the number of hours in a calendar year:<br>Dose Rate (mSv / year) = (CD x OF / T ) x 8760 hrs<br>*For example:*<br>CD = 0.5 mSv<br>OF = 0.06<br>T = 1 month (720 hrs)<br>(0.5 x 0.06 / 720) x 8760 = Dose rate<br>Dose Rate = 0.365 mSv / year<br>c) All data, drawings, and results will be recorded 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.<br>d) then remedial must be taken to reduce the dosage amounts. | Agree. Guidance on area dosimeters has been added to Appendix A.<br><br>The mathematical approach has not been removed, since it could also be useful when designing a radiography installation. |

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| 35. | Bruce Power, CNA, CNL, NB Power, OPG | Appendix A | ***Clarification***<br>Provide consistent wording throughout to correctly define TVL. TVL reduces dose rate to 1/10 – not by 1/10.<br>Change A.1, Step 4:<br>- 5th paragraph, last sentence to read *"TVL1 is....reduce the dose rate to one tenth."*<br>- scenario 3 TVL2 definition to read "*is the thickness....dose rate to another one tenth*". | Agree. The text has been modified as suggested. |