**Comments on IAEA Draft Safety Guide "Criticality Safety for Facilities and Activities Handling Fissionable Material" (DS407)**

| COMMENTS BY REVIEWER<br><br>Reviewer: United States of America<br><br>Country/Organization: United States of America Date: Month Year | | | | RESOLUTION | | | |
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| 1 | 2.1 | Combine first two sentences to "Criticality safety should be ensured for all operational states and accident conditions within design basis accidents" | First sentence as written should be obvious, and is redundant with 1.1. | | | | |
| 2 | 2.1 | Replace "within the defined safety limit" in the last sentence with "below the defined upper subcritical limit" or some other unambiguous term. | The term "safety limit" is used to mean different things in different countries (and even within the same country). In the US, this typically means an analytical limit on a controlled parameter, but here it appears it may mean a limit on k-effective.<br><br>This term is not defined in the Definitions section. This term needs to be defined, unless it is defined in some other IAEA document, or another suitable term should be used. | | | | |
| 3 | 2.2 | Suggest moving the last 3 sentences of this section to the defense in depth discussion of chapter 3. | At this point in the document, the reader is not informed about what the levels of defense in depth mean, and thus this | | | | |

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| | | | material seems out of place. | | | | |
| 4 | 2.3 | Replace “which are” in the second sentence with “such as.” | The set of controlled parameters may not be complete according to all users. For example, it is unclear why “volume” has been removed from the list. Some have considered this to be a form of geometry control, but in the US, it is typically treated separately. Not mentioned are such parameters as heterogeneity and the physico-chemical form. Changing to “such as” allows for such differences in taxonomy. | | | | |
| 5 | 3.8 | Replace “simultaneous” with “concurrent” in the first sentence. | This will make the discussion consistent with the double contingency principle and discussion in Section 3.7. | | | | |
| 6 | 3.12 | Replace “manually initiated active engineered safety measures” in the third bullet with “enhanced administrative control.” | Such systems are generally regarded, at least in the US, as enhanced administrative controls rather than active engineered controls. If any part of the control system is administrative in nature, requiring human intervention, it should be | | | | |

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| | | | regarded as an administrative control. | | | | |
| 7 | 3.15 | Replace “passive safety” in the first sentence with “passive geometry.” | This section starts out by talking about the control type hierarchy (i.e., passive, active, and administrative), but this was discussed in Section 3.12. The bullets then switch to talking about what parameters should be used. It is therefore unclear whether the intent is to say what control types or what parameters should be preferred. If the intent is to discuss controlled parameters, then this section should start by stating that passive geometry is the preferable means of preventing criticality. | | | | |
| 8 | 3.17 | See Comment 3. | Lists of controlled parameters throughout the safety guide should be consistent. | | | | |
| 9 | 3.19 | Remove this section. | The statement is so broad and non-specific that it gives no useful guidance to the reader. | | | | |
| 10 | 3.20 | Move the fourth bullet, on heterogeneity, to another section. | While there is a strong connection between | | | | |

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| | | | isotopics and heterogeneous reactivity effects (e.g., heterogeneity is significant at low enrichments), this connection is not clearly made here. The discussion of heterogeneity is good guidance, but doesn't appear to be applicable to te discussion on isotopics, as currently worded. | | | | |
| 11 | 3.21 | Add a sentence after the 2nd sentence: "Low-atomic mass, low-neutron absorption materials (e.g., deuterium, beryllium), known as "special moderators," are less common but very effective moderators. | This section should introduce the concept of special moderators | | | | |
| 12 | 3.22 | Replace "estimate" with "approach" in the 4th sentence. | The term "estimate" is not a good replacement for the term "reach." Calculations can be said to "estimate" the k-effective value, but the subject of this verb appears to be the reflector "thickness," and not the "criticality safety assessments." Perhaps this can be rectified by a slight rewording of this sentence. | | | | |

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| | | | What appears to be meant is that as reflector thickness is increased, it asymptotically approaches the maximum k-effective. | | | | |
| 13 | 3.24 | Add a final sentence: "Solid, fixed neutron absorbers should be tested prior to first use in order to demonstrate the presence and uniformity of the absorber isotope (e.g. $^{10}B$)." | Neutron absorber testing is an important part of the criticality safety design of a fissionable material system that uses fixed neutron absorbers, and should be referenced in this section. | | | | |
| 14 | 3.25 | Replace "increase" with "change" in the next-to-last sentence. | It appears that the intent of the changes to this section were to clarify that nearby materials can either increase or decrease k-effective. This change is appropriate, but was made everywhere except in this sentence. | | | | |
| 15 | 3.30 | Replace "independently reviewed" with "independently reviewed by staff knowledgeable in criticality safety." | This new text is good, but is not clear on who has to do the review. The review should be by the criticality safety staff (as well as operations, etc.). | | | | |
| 16 | 4.20 | Rewrite the definition of verification (such as previously suggested). | The definition of model verification before the semicolon is good, but what follows the semicolon (following "that is"), does not | | | | |

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| | | | match this. Validating the model seems to be model-specific; it is confirming that whatever is being modeled is modeled correctly. The analyst does not in general have time, or the necessary expertise, to delve into the numerical algorithms and equations underlying the code. Instead, verification is usually accomplished by re-running previously modeled benchmarks and checking if they give the same answers as previously.<br><br>In addition, the discussion of "system code verification" refers to reviewing the source coding, but this is not typically done. Rather, these two types of verification are generally done together by the method described above. This does not reflect usual industry practice. | | | | |
| 17 | 4.25 | First bullet on page 27: Remove "(i.e., < 17 amu)." | Defining moderators as materials with A<17 seems to be arbitrary. This would | | | | |

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| | | | limit it to isotopes that are lighter than oxygen. While the most common moderating elements are H, Be, and C, all lighter than oxygen, in some cases other materials (e.g., silicon (A=28) in a low-density waste application) could be a moderator. | | | | |
| 18 | 5.41 | Change 5th sentence to "Taking credit for the burn-up of individual fuel assemblies *will* ~~may~~ increase the potential for misload accidents." | Moving from a system where the fresh fuel assumption is employed (no loading curve) to one where burnup is credited (loading curve) introduces the possibility of misload where none existed before. | | | | |
| 19 | 5.44 | 3rd bullet: "Note, the irradiation of fuel with burnable poisons ~~could~~ *will typically* result in increased reactivity early in its life. | This section should state this more definitively, as this effect is so common that criticality safety practitioners should expect increased reactivity with the use of burnable poisons. | | | | |
| 20 | 5.94 | 2nd sentence: "Particular challenges will be encountered in determining safe sub-critical masses of the materials *cited in 5.88*, as there are frequently no critical experiment benchmarks to validate criticality computations *with these materials*. | Should clarify that this section is talking about difficulties with special fissionable and non-fissionable materials. | | | | |

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| 21 | 6.22 | Suggest changing section heading to "*Evaluation of potential accidents*" | "*Pre-accident evaluation*" implies that we intend to have an accident. | | | | |
| 22 | REF | Review list of references for worldwide applicability and representativeness. | While there are a large number of DOE standards and documents represented, NRC documents (NUREGs, ISGs, etc.) applicable to commercial fuel criticality safety are not represented. This provides a skewed view of the US criticality safety community.<br><br>In addition, many of the included DOE standards are not of general interest to criticality safety practitioners world-wide, but are specific to DOE's regulatory environment. If these are to be included, then including a list of similar documents from many other nuclear countries would also need to be included, but this would be voluminous.<br><br>Suggestion is to scrub the list of references to only those having general | | | | |

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| | | | applicability to the technical aspects of criticality safety. | | | | |
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| The remaining comments are editorial and are being provided for consideration only. | | | | | | | |
| 23 | 1.2 | Remove “moderation” from the first sentence. | Minor editorial comment—moderation is listed twice. It is more appropriate to include under “other materials” rather than parameters related to fissionable material. | | | | |
| 24 | 5.13 | Change to “… absorber material (e.g., 240Pu).” | Minor editorial change | | | | |
| 25 | 5.29 | Change to “Fire risks in the fuel storage area should …” | Minor editorial change | | | | |
| 26 | 5.35 | Change last sentence to “… potential impact of such changes are considered in the criticality safety assessment.” | Minor editorial change | | | | |
| 27 | 5.40 | Change to “… should also be considered in the criticality safety assessment.” | Minor editorial change | | | | |