

ANS Answers Multipart Inquiry on ANSI/ANS-8.14-2004 (R2016), *Use of Soluble Neutron Absorbers in Nuclear Facilities Outside Reactors*

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Part 1 Inquiry:

Does the scope of ANSI/ANS-8.14-2004 (R2016) apply to solids that, as part of normal processing, can be suspended in an aqueous solution?

Part 1 Response:

Yes. Neutron absorber solids that are easily dispersed in liquid or suspended in solution are within the scope of the standard. The standard applies to any neutron poison easily dispersed in liquid, solution, or suspension used specifically to reduce the reactivity of a system and for which reactivity credit is taken in the nuclear criticality safety evaluation of the system.

Part 2 Inquiry:

Does the scope of ANSI/ANS-8.14-2004 (R2016) apply to fissile material that is in a form where subcriticality is ensured due to the intrinsic material form that it is? Example: uranium ore with enrichment above the limits in ANSI/ANS-8.1-2014 (R2018)?

Part 2 Response:

No. The Introduction to ANSI/ANS-8.14-2004 (R2016) states that when soluble neutron absorbers are present, but are not required for nuclear criticality safety, their use is outside the scope of this standard. However, ANSI/ANS-8.1-2014 (R2018), *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, contains further guidance for ensuring subcriticality based on intrinsic material form. For example, large quantities of iron and other nonfissionable materials present in large waste tanks serve as diluents and reduce the effective fissile concentration to below subcritical limits.

Part 3 Inquiry:

Do soluble neutron absorbers apply to material that does not remain suspended without operator action?

Part 3 Response:

Yes. The term “soluble absorber” applies to material that does not remain suspended without operator action. Selection of a soluble absorber requires consideration of operating conditions that could affect the adequacy of the neutron absorbing capability prior to use and during the operational lifetime of the neutron absorber. This includes assurance that the actual distribution of the neutron absorber is consistent with the evaluation. For example, the process of generating tank waste did not ensure the form and distribution of nonfissile absorbers. It would, therefore, not be appropriate to assume homogeneous distribution of the absorber unless some follow-up processing (e.g., mixing and sampling) is performed.

Part 4 Inquiry:

Do soluble neutron absorbers include all materials that are not traditionally considered fissionable (e.g., Fe, Na, etc.)?

Part 4 Response:

Yes. Soluble neutron absorbers include any neutron poison (i.e., that reduces the neutron population via capture reactions) easily dispersed in liquid, solution, or suspension and used specifically to reduce the reactivity of a system. Materials traditionally considered fissionable or production capable via capture are not considered soluble neutron absorbers in the sense of the standard. Footnotes 2 and 4 in the standard clarify that the term “absorption” in the sense of this standard applies to neutron-induced reactions not leading to fission or other neutron production. Although large quantities of ^{238}U may be present in tank waste, ^{238}U cannot be considered a soluble neutron absorber in the sense of this standard. However, ANSI/ANS-8.1-2014 contains further guidance for ensuring subcriticality based on presence of fissionable isotopes.