
NOSG phase 2 guidelines for designing instrument shielding for radiation safety

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1. PURPOSE

This document describes the methodology for delivering the design of the shielding of the neutron scattering instruments (beamlines) during the detailed engineering design phase (phase 2), to ensure that the ESS radiation safety requirements are met. For issues not addressed in this document, see the general ESS procedure for designing shielding for safety [1].

2. GENERAL GUIDELINES

The instrument shielding needs to ensure that the emitted radiation levels are low enough to allow a) the instrument halls to be operated as supervised areas, as defined in [2] and b) that the overall ESS dose limits for the public, as defined in [3] are not exceeded. The specific dose budget for the public are shown in [3] in appendix 1.

In accordance to [2], normal operation (H1) and likely accidents (H2) need to be assessed to verify the radiological zoning of a workspace. In order to do this, different H1 (normal operations and maintenance) and H2 (anticipated during the lifetime of the facility) events have to be investigated. The frequencies of these types of events are defined in [3]. The instrument teams have to demonstrate that their proposed shield design complies with requirements.

Scenarios to be considered include, but are not limited to:

H1:

- Full beam, with instrument components like a shutter, chopper, or slits being closed.
- Full beam hitting the beamstop/downstream end of the instrument cave.
- Full beam scattering of worst case sample environment equipment.
- Full beam scattering of a worst-case sample.

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H2:

- Misaligned sample environment equipment.
- Sheet of cadmium in the sample location.

The simulations also take into consideration the effect of components in the bunker on the radiation safety immediately outside of the bunker. Other potential H1 and H2 scenarios, which are relevant for the specific instrument, have to be identified and investigated.

3. LIST OF CRITERIA FOR REVIEW OF THE WORK

The proposed shielding solution will need to be submitted for review to the ESS NOSH. NOSH will check if the work on shielding of the instrument fulfils the following criteria:

1. The shielding geometry, materials definitions, particle sources and computing methods are well developed and documented. In particular, if Monte-Carlo variance reduction techniques are used, that they are appropriate and the evidence is provided to show that the results are not significantly biased.
2. The report on the work contains the information about the impact of the shielding design on the total dose in the areas of interest, for each of the above scenarios. This could be in the form of a dose map, for example.
3. The work shows that the radiation dose rates in all the areas mentioned above meet the limits defined by the ESS rules [1].
4. The report must contain information mentioned above as well as the information according to report structure as given in [1].

NOSH will review the report and may recommend additional work if required before submitting for approval.

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4. GLOSSARY

Term	Definition
NOSG	Neutron Optics and Shielding Group
ITS	Instrument Technologies

5. REFERENCES

- [1] [ESS-0019931] ESS Procedure for designing shielding for safety
- [2] [ESS-0001786] Definition of Supervised and Controlled Radiation Areas
- [3] [ESS-0000004] General Safety Objectives for ESS

DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue	Nataliia Cherkashyna Douglas DiJulio Stuart Ansell	2016-03-04
