Dose budget allocation and freely accessible areas close to bunker

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1. SCOPE

This document describes:

a) The areas that are required to be freely accessible around instruments close to the bunker whilst the proton beam is on, consistent with a Supervised Zone
b) The allocation of dose budget between bunker and instruments in those areas

2. CONTRIBUTORS

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3. ISSUING ORGANISATION

Neutron Instruments Division, Science Directorate, ESS

4. INTRODUCTION

In order to set the boundary conditions for the bunker design, requirements of zoning and accessibility to areas affected by the bunker design need to be defined. Furthermore, the allowable relative contributions from the bunker and the instruments to the overall radiation dose need to be specified.

5. CONTEXT (ASSUMPTIONS)

It is assumed that:

- the experimental halls are to be maintained as Supervised Zones, with a permitted maximum dose rate of 3 micro-Sv/hr.
- non-routine operations will be allowed to exceed these dose rates with appropriate planning and supervision.
- the only significant contributors to radiation dose in the experimental halls are the bunker and the instruments.

6. FREELY ACCESSIBLE AREAS

The current zoning of the experimental halls has no height limit. In practice, the working areas will be limited in height and so we define 3 zones that are required to be freely accessible as per a Supervised Zone:

a) Inner zone
    a. 15 m < R < 20 m.
    b. H < TCS + 1.4m
b) Intermediate zone

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   a. 20 m < R < 40 m
   b. H < TCS + 3.8 m

c) Outer zone
   a. R > 40 m
   b. No height restriction

The first two areas are shown shaded in Figure 1 which shows the LoKI design as of 2017-09-22. This is considered to be the limiting case amongst the current instrument designs. The zones are defined to allow a person to access the top of the LoKI instrument cave without additional controls beyond those defined for a Supervised Zone. It is not anticipated that access to the top of the instrument front end (collimators etc.) will be required as routine operation and hence a lower height limit is set. This takes into account other instrument designs which may allow personnel access close to the bunker on raised areas.

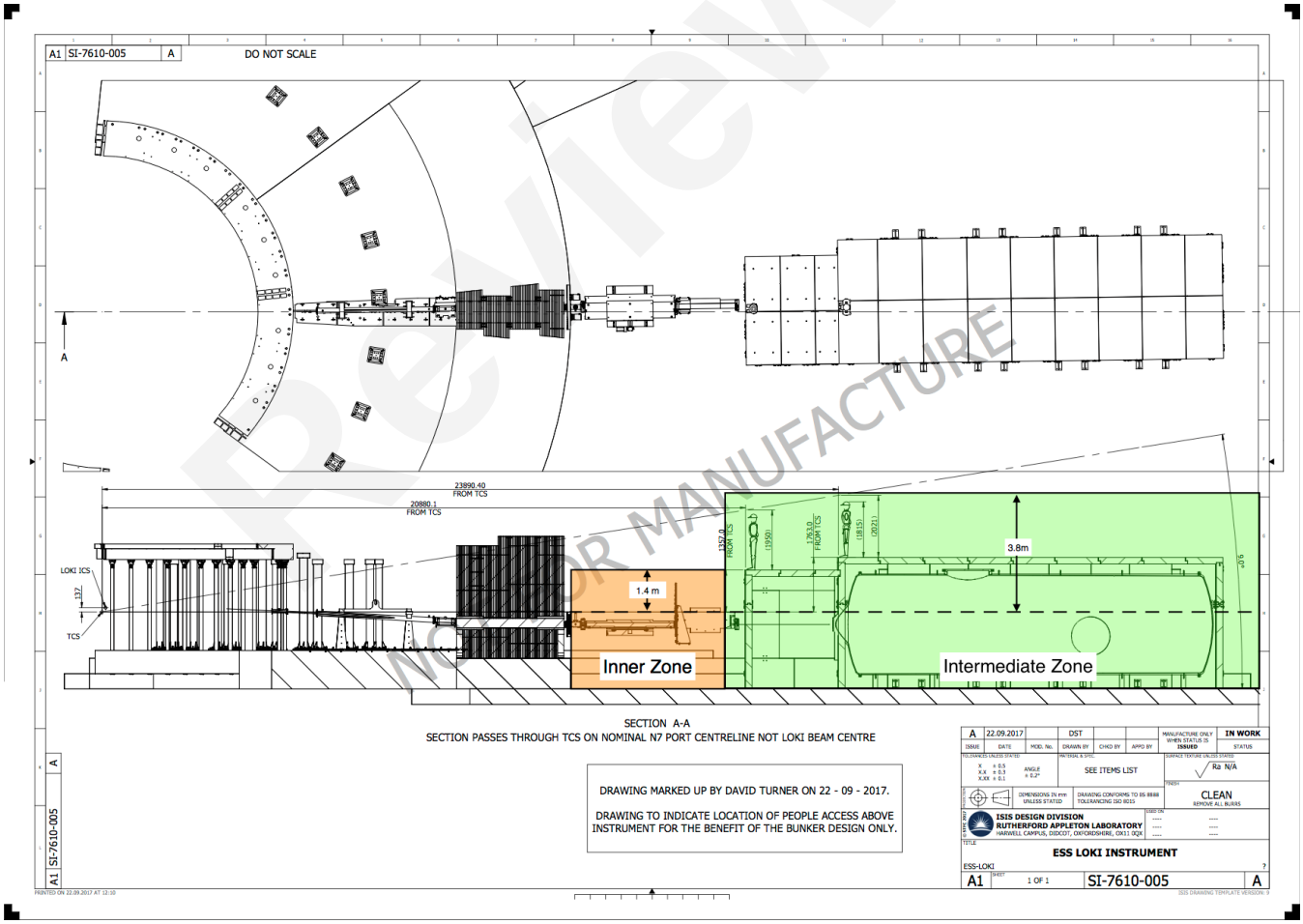

Figure 1 : Freely Accessible Zones Close to Bunker

7. DOSE BUDGET ALLOCATION

In order to design the required shielding, the allowable dose from each contributor must be defined.

The bunker wall dose will decay approximately exponentially from the bunker wall face outwards. We approximate this by the following dose allocations in the three zones:

a) Inner zone
    a. Bunker : 1 micro-Sv/hr
    b. Instrument : 2 micro-Sv/hr
b) Intermediate zone
    a. Bunker : 0.5 micro-Sv/hr
    b. Instrument : 2.5 micro-Sv/hr
c) Outer zone
    a. Bunker : 0 micro-Sv/hr
    b. Instrument : 3 micro-Sv/hr

8. CONCLUSIONS AND RECOMMENDATIONS

The combination of the freely accessible areas and the dose budget allocation allows for effective operation of the neutron instruments and provides a set of requirements for the neutronic design of the bunker and instruments.

DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue	Andrew Jackson	2017-09-22
2	Updates from KHA	Andrew Jackson	2017-09-25
3	Fix intermediate zone dose values	Andrew Jackson	2017-09-25
4	Update intermediate zone dose values	Andrew Jackson	2017-10-04
5	Update reviewer/approver chain	Andrew Jackson	2017-10-06

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