Date: November 19, 2021

To: Radiation Safety Committee (RSC), D. Kim, C. Cutler, M. Davis, D. Schlyer, S. Pontieri, P. Sullivan

From: K. Yip (RSC Chair)

Subject: MIRP Cyclotron ASE & SAD


The ZOOM meeting started at 1 pm. Lee Hammons shared his screen in the ZOOM meeting and went through the Accelerator Safety Envelope (ASE) and Safety Assessment Document (SAD) for the MIRP (Medical Isotope Research and Production) Cyclotron facility and various attendees in the meeting made comments, suggestions and corrections. We started with ASE and ended with SAD. Lee actually already made some minor editorial changes before the meeting and we would not mention those here. Below I write down a list of corrections and areas that need to be addressed.

i. Near the end of the “Access Control System” in Section 2 of the ASE, people were not sure whether “high radiation is detected” means that it involves both the chipmunks and airborne detectors. (D. Kim confirmed to me after the meeting that they plan to have 5 radon detectors and would shut off the beam operation if they detect any radon.)

ii. For the part of “Shielding” in Section 2 of the ASE, Mo Benmerrouche pointed out that only the original Cyclotron shielding is mentioned but in reality, the current existing building structures (walls) are part of the shielding that we have taken credit for. We ought to also mention this part of shielding in the ASE as described in the SAD.

iii. In the same discussion, it was suggested that in Section 3 of the ASE, we should include the existing building structures as part of the configuration management that cannot be arbitrarily altered.

iv. Pat Sullivan was confused by the mentioning of “Access Control Systems” and “Access Control Interlocks”. It is agreed upon to change “Interlocks” to “Systems” in Section 3 and Section 4 of the ASE.

v. Chuck Schaefer answered to Pat’s question about the 15 months and said that certification
frequency of “15 months” is stated in the Radiological Control Manual and is deemed acceptable. But we should probably remove the sentence of “15 months” in Section 3 of the ASE.

vi. There was a discussion about the last paragraph in Section 3.9 of the SAD about radon monitoring. David Schlyer told us that the manufacturer has a specification for the HEPA filters at ~99% and we may be able to test. Chuck mentioned that charcoal can adsorb gas though HEPA cannot. At the end, we realized that this is just part of the defense-in-depth system, and it is used as a tertiary protection to assist moving radioactive air. Most importantly, we have the radon monitor to shut off the beam if we detect any radon and we do not really depend on HEPA filters and charcoal for radon prevention during beam operation.

vii. It is suggested that the paragraph of “C-AD installed interlocks” in Section 3.13 of the SAD may be moved to Section 3.12 (“Access Control”) so that it is clear that it is part of the C-AD Access Control Systems.

viii. I informed Lee that in the first paragraph under Section 3.15 of the SAD, on the second line, “3.7” and “3.8” should be replaced by “3.8” and “3.9” respectively. And in the next sentence, “10x” and “2x” should be replaced by “15x” and “3x” respectively. Similarly, “10 Times” in Fig. 3.8 and “2x” in Fig. 3.9 should be replaced by “15 Times” and “3x” respectively.

ix. In the second paragraph of Section 3.19 of the SAD, “12 pounds” should be “13 pounds”.

x. In Section 3.20 of the SAD, Mo asked why the paragraph under Fig. 3.17 discusses about Ac-225 and Ac-226 and ignore other isotopes such as Ac-224 etc. David explained that that paragraph is supposed to explain why we choose 10° holder to optimize the Ac-225 production. David and Lee agreed to improve that paragraph to make that intention clearer.

xi. In the last sentence of Section 3.22 of the SAD, I suggest we change “SOF” to the text of “Sum of Ratios” as this is the only place this term has been mentioned in the entire SAD and DOE-STD-1027 uses “SOR” instead of “SOF”.

xii. In Section 4.21 of the SAD, in the point of “Remote Target Operations:”, we should put an “and” in front of the word “they”.

xiii. For the Figure 4.3 of the SAD, Mo commented that Ac-227 should not be possible and should not exist in that plot. But after the meeting, when I checked the detailed outputs of my simulation works with my summer intern in 2018 ¹, I found that we did find a very small trace of Ac-227 at the end of the interrupted 40 hours (in 4 days) of bombardments (--- which was different from the continuous 40-hour mode quoted in the SAD), with the ratio of activity of Ac-225 to that of Ac-227 at 1.262 / 3.136×10⁻⁷ (or roughly 4 millions to 1). Looking at that Figure 4.3 (generated by Ed Lessard), the initial ratio of activity of

¹ https://technotes.bnl.gov/Home/ViewTechNote/207965
Ac-225 to that of Ac-227 is about a few millions to 1. Therefore, the presence of Ac-227 in Figure 4.3 seems reasonable theoretically (even though it may be experimentally challenging to extract in short time scales). From our discussion, David told me that the most likely route is $^{226}\text{Ra}(n,\gamma)^{227}\text{Ra} \rightarrow ^{227}\text{Ac}$ which one can also find in other references such as Wikipedia 2.

xiv. In Section 4.25 of the SAD, on top of p.52, the mentioning of 300 mR/hr does not seem to be consistent with Figure 4.4 and what are said in the first paragraph of Section 4.19 of the SAD.

The meeting was adjourned just before 3 pm.

Copy to:

W. Fischer
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2 https://en.wikipedia.org/wiki/Actinium