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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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NON-POWER PRODUCTION AND UTILIZATION FACILITIES

SUBCOMMITTEE

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FRIDAY, MAY 6, 2022

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The Subcommittee met via Video-Teleconference, at 8:30 a.m. EDT, Ronald G. Ballinger, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

VICKI M. BIER, Member

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

WALTER L. KIRCHNER, Member

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DAVID A. PETTI, Member

JOY L. REMPE, Chairman

MATTHEW W. SUNSERI, Member

ACRS CONSULTANTS:

DENNIS BLEY

KEN CZERWINSKI

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

C-O-N-T-E-N-T-S

P-R-O-C-E-E-D-I-N-G-S

8:30 a.m.

CHAIR BALLINGER: The meeting will now come to order. This is a meeting of the SHINE Subcommittee of the Advisory Committee on Reactor Safeguards. I'm Ron Ballinger, chairman of today's Subcommittee meeting.

ACRS members in attendance are Charlie Brown, Greg Halnon, Vicki Bier, Walt Kirchner, myself, Joy Rempe, Chairman Rempe, Matthew Sunseri, Jose March-Leuba, Dave Petti, and I believe Vesna Dimitrijevic is on the line and present. We may have Dennis Bley and/or Steve Schultz present. I don't know. I can't see them --

DR. BLEY: Dennis Bley is here.

CHAIR BALLINGER: Bingo. Thank you very much.

DR. SCHULTZ: Dave Schultz is here.

CHAIR BALLINGER: Derek Widmayer of the ACRS Staff is the Designated Federal Official for this morning. I might add additionally that we now have our a consultant Ken Czerwinski onboard to help us with chemistry and the like. He may or may not be -- we went him an invitation, but it's very early in Las Vegas.

During today's meeting the Subcommittee will receive a briefing from the NRC Staff on SHINE medical isotopes. The Subcommittee will hear presentations by and hold discussions with the NRC Staff, SHINE representatives and other interested persons regarding Chapters 3, 8, 9, and 11. Note that Section 3.1 will not be presented today; it will be presented in July.

As part of the presentation by the Applicant and the NRC Staff presentations by the Applicant and NRC Staff may be closed in order to discuss information that is proprietary. Right now we have some issues on Chapters 9 and 11 which may be proprietary. Attendance at the meeting that deals with such information will be limited to the NRC Staff and its consultants, SHINE and those individuals and organizations who have entered into an appropriate confidentiality agreement with them. Consequently we need to confirm that we have only eligible observers and participants when we do the closed part of the meeting.

The rules for participation in all ACRS meetings including today's were announced in the Federal Register on June the 13th, 2019. The ACRS section of the U.S. NRC public website provides our charter, bylaws, agendas, letter reports, and full transcripts of all Full and Subcommittee meetings including slides presented there.

The meeting notice and the agenda for this meeting were posted there.

We have received no written statements or requests to make an oral statement from the public.

The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for the deliberation by the Full Committee. The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register.

Today's meeting is being held in person and also over Microsoft Teams. A telephone bridge line allowing participation of the public over their computer using Teams or by phone was made available. Additionally, we have made an MS Teams link available on the published agenda. A transcript of today's meeting is being kept, therefore we request that meeting participants on Teams and on the Teams call-in line identify themselves when they speak and to speak with sufficient clarity and volume so that they may be readily heard.

Likewise, we request that meeting participants keep their computer and/or telephone lines on mute when not speaking to minimize disruptions. We'll get a lot of feedback if we don't adhere to this. The chat feature on the Teams should not be used for any technical exchanges.

At this time I ask Teams attendees to make sure that they are muted so we can commence the meeting.

We'll now proceed. And I guess I'm going to call Josh Borromeo, Branch Chief, NRR, for opening remarks. Is that correct?

MR. BORROMEO: That's correct.

CHAIR BALLINGER: Thank you. Go ahead.

MR. BORROMEO: Yes, so good morning. My name is Josh Borromeo. I'm Chief of the Non-Power Production and Utilization Facility, or NPUF Licensing Branch in NRR. As Member Ballinger mentioned, this is a Subcommittee meeting for the SHINE operating license, one in a series of Subcommittee meetings.

And first I want to express the Staff's appreciation for ACRS using the process of using -- issuing interim letters after each one of these Subcommittee meetings. We feel that is an efficient way to both identify and address issues as we work our way through the review and we look forward to using this process as we continue to work our way through the remainder of the chapters.

So, as mentioned, the Staff and SHINE will be presenting information on Chapter 3, Design of Structure Systems and Components; Chapter 8, Electrical Power Systems; Chapter 9, Auxiliary Systems; and Chapter 11, Radiation Protection.

I want to thank both the Staff and SHINE for their efforts in the development and the preparation for the material ACRS will hear today and I also want to thank ACRS for the time and continued support of the SHINE Operating License Review and we look forward to the conversation today.

And with that, if there are no questions, I'll turn it over to SHINE.

CHAIR BALLINGER: Yes, before we start I need to make a clarification. With respect to memos and letters we have agreement that unless there's an issue that needs additional resolution, our procedure will be to write individual memos on chapters unless we have an issue, at which point we might write what you were calling an interim letter. There's a big difference between the two, so let's be clear about that.

MR. BORROMEO: Yes, sorry for the

confusion, but the process that we're using is good and I want to continue to do it.

(Laughter.)

CHAIR BALLINGER: Okay.

MR. BORROMEO: Thanks.

CHAIR BALLINGER: All right. Are the SHINE folks on?

MR. BARTELME: Yes, SHINE is here, and Marc Anderson for Chapter 3 is here as well.

CHAIR BALLINGER: Okay. So let's proceed.

MR. BARTELME: Thanks. Go ahead, Marc.

MR. ANDERSON: Okay. Good morning, everyone. My name is Marc Anderson. I'm the Structural Engineering Manager at Sargent & Lundy. I've been deeply involved with the design of the main production facility structure since the beginning of the detailed design phase in 2018. Very much appreciate the opportunity to discuss the design approach and answer any questions that you might have, so please feel free to stop me at any point if something is unclear.

I'll give a brief outline. So this morning's presentation is going to focus on the main production facility primarily. At the end we'll talk about the nitrogen purge system structure, but for the main production facility structure we're going to discuss meteorological damage, water damage, seismic damage, and also damage from external hazards. And I'll talk about the ways we've addressed the potential damage.

Just briefly I'd first like to give an overview of the main production facility structure. What you see here is a screenshot of the 3D model of the facility. Really it's comprised of two separate buildings. One is a safety-related building and one that is entirely non-safety-related. And I'll get into that in a little bit more detail here in the next few slides.

As we talk about the different aspects of the facility structure, it's convenient I guess to establish a plant coordinate system. So just for everyone's benefit the way that we're looking at the building here is from the southwest corner looking northeast. So this SHINE logo that you see is kind of is in the southwest corner of the building. So as I describe various aspects of the facility -- and that's the plant coordinate system just for clarification. So as I describe various aspects of the facility, that's kind of a good way to establish which direction you're looking, I guess.

Okay. Next slide, please, Jeff?

Okay. So as I mentioned, there's really two separate buildings, all part of the same main production facility structure. The first building is highlighted here in red, and I'll attempt to clarify what you're looking at. The red building is the safety-related Seismic Category 1 structure. There's an RCA building, which is the taller building here, and then there's the non-RCA structure, which is the shorter building to the sort of upper left, or west, northwest. As you can see from the slide they share a common MAT foundation which extends also under a portion of the non-safety-related building sort of at the southwest corner of the safety-related structure.

It's predominantly robust reinforced concrete construction, 6,000 psi compressive strength concrete. There are some structural steel elements. The mat slab is three foot and it's thickened around the perimeter underneath the main sheer walls. As you're looking at the building here you can imagine this is sort of a giant box or -- for the RCA and then another giant box for the non-RCA. And there's a big sheer wall that runs underneath where you see the roof kind of comes to a peak. So it's like three parallel bays, three rectangles that are just -- it's a big open box. And underneath each of those main sheer walls the mat slab is thickened to four-and-a-half feet thick.

Just to give a sense of dimensions, it's approximately 212 feet long in the north-south direction and 158 feet long in the east-west direction. This is the RCA. The roof is at its high point 56 feet tall and at its low point 45 feet tall. The main sheer walls of the RCA are two feet thick. The roof is a one foot thick slab that's supported by steel trusses which span the short dimension of these -- of the rectangles essentially. So the trusses span in the east-west direction.

There is an eight inch thick concrete slab on metal deck mezzanine and the southeast corner of the RCA, and that's at elevation 22. It covers approximately one-sixth of the floor area of the RCA.

The non-RCA Seismic Category 1 building has a one foot, eight inch thick roof slab and its walls are two foot, four inches thick reinforced concrete.

I wanted to highlight here that there's a red line drawn at the interface between the Seismic Category 1 building and the non-Seismic Category 1 building to the south and to the west. And that will be a little bit more clear on the next slide, but this red line is meant to represent the seismic gap. As you're looking at the 3D model it looks like this is one integrated building. In reality these are two separate buildings with an engineered seismic gap between them that's sized and designed to accommodate the anticipated seismic movements of the two buildings.

DR. BLEY: Marc?

MR. ANDERSON: Yes?

DR. BLEY: This is Dennis Bley. You've talked several times about the seismic gap and I was thinking back to a nuclear power plant quite a few years ago that was designed with such a gap. There had always been a concern in the seismic area that maybe you fall off a cliff once you get past the design-basis and all of a sudden everything starts to fail. The only place I ever saw that happen; we were doing risk assessments at the time, was a plant that had a gap that was I guess you could say just set to the design-basis. If the earthquake went a little above the design-basis, the buildings interacted and you had substantial problems developing.

I don't think you're doing a seismic risk assessment, but if you look a little beyond the design-basis, do you have any idea about whether those gaps begin to close?

MR. ANDERSON: It's not a situation that we've analyzed. The way we sized the gap is we've checked the maximum displacements of the safety-related structure and we added that --

DR. BLEY: For the design-basis earthquake, I assume?

MR. ANDERSON: That's correct. And the maximum displacements of the non-safety-related structure for the -- for its design-basis earthquake, which is simply the ASCE 7/IBC sort of commercial design earthquake. And we've added those two displacements together and included some margin on top of that to make sure that they're --

(Simultaneous speaking.)

DR. BLEY: Can you say anything about the margin?

MR. ANDERSON: So the seismic gap is approximately one inch wide and the margin is about 25 percent.

CHAIR BALLINGER: This is Ron Ballinger. If we get into anything that looks like it's going to be proprietary, we need to be careful that we know that so that we can take this back up in a closed session if need be. So I'm assuming that your numbers are not proprietary.

MR. BARTELME: Right, these numbers are not proprietary. If we feel we're getting kind of close there, we'll kind of just wave a flag and save that for a closed session discussion.

CHAIR BALLINGER: Thank you.

DR. BLEY: Thanks.

MR. ANDERSON: Are there any additional questions related to that?

DR. BLEY: Not yet.

MR. ANDERSON: Okay.

MEMBER KIRCHNER: No, I have -- this is Walt Kirchner. I have a question.

So you mentioned earlier the mat thicknesses underneath. I'm just trying to -- so when you said for the design-basis earthquake, I'm presuming for the safety-related structure you used the safe shutdown earthquake equivalent?

MR. ANDERSON: That's correct.

MEMBER KIRCHNER: Right. And then how much different in terms of expected displacement do you get for the safety-related building versus the non-safety-related building using a different earthquake design-basis? Is it substantial or is it

-- you've already worked the numbers and your one inch provides plenty of margin?

MR. ANDERSON: We have not analyzed the displacement of the non-safety building for the SSC earthquake.

MEMBER KIRCHNER: Okay. Thank you.

MR. ANDERSON: Are there any other questions?

(No response.)

MR. ANDERSON: Okay. I did want to highlight as we're speaking about the seismic gap there is a small portion of the non-safety-related building that sits on top of the safety-related mat foundation in the -- if you're -- again as you're looking at this figure, it's the south of the non-RCA Seismic Category 1 building.

This building is included in the seismic model of the Seismic Category 1 facility and so the effects of the earthquake that this building might have on the foundation are analyzed and the seismic gap around this little portion of the building has been designed so that it doesn't interface with the adjacent Seismic Category 1 buildings. So it's really isolated from the rest of the non-safety-related building as well as the safety-related buildings next to it with the exception of the foundation that it sits on.

Okay. If you'd mind going to the next slide? Okay. So this is the non-safety-related building. As you can see its predominantly on the south end of the safety-related building and it sort of wraps a little bit around the west side of the building. This is a two-story structural steel building that's founded on reinforced concrete spread footings.

The second story at the interior of the building is a five inch thick slab on metal deck. It's approximately 77 feet long in the north-south direction and 150 feet in the east-west direction. The lower roof elevation is at 22 feet. It matches the roof elevation of the -- I'm sorry, is there a question?

(No audible response.)

MR. ANDERSON: It matches the roof elevation of the non-RCA Seismic Category 1 building and the higher roof elevation is 40 feet tall.

MEMBER BROWN: I had a question.

MR. ANDERSON: Yes, please.

MEMBER BROWN: This is Charlie Brown. I was looking going between 4 and 5 and it looked like the part where those little caret signs are on the bottom floor, that part is shown in the safety-related on the previous slide and here it's non-safety. I believe based on the figures that they just --

MR. ANDERSON: Yes, let me clarify that. So I'm not sure it's depicted very clearly in my sketch here, but --

MEMBER BROWN: Well, they were labs. That's why I asked the question.

MR. ANDERSON: Sure. If you can imagine there's a continuous three foot thick -- as I mentioned earlier there were some exceptions -- mat slab that's -- it's a big rectangle, so it's from -- and I don't think I have a -- I can't show with my cursor on the screen, but if you look at on the southwest corner of the -- what looks like the red highlighted -- there you go. Thank you, Jeff.

There is this little rectangular structure. I wanted to highlight that because it's actually -- there's a non-safety-related building there that sits on a safety-related -- on a continuous safety-related mat slab. So the mat slab --

MEMBER BROWN: Is that the lower right-hand corner? Is that the lower right-hand corner you're talking about where the little conference room looks like it is?

MR. ANDERSON: Yes. Yes, sort of at the near corner of the picture here.

MEMBER BROWN: Where the hand was?

MR. ANDERSON: Yes.

MEMBER BROWN: Okay. I was on the other end.

MR. ANDERSON: Okay.

MEMBER BROWN: Well, go ahead.

MR. ANDERSON: Yes, so the mat slab is continuous underneath. It's a large rectangular mat slab. We did not -- it was beneficial to the design of the structure to keep it as a rectangle. And so we have a small portion of this non-safety-related building that sits on a portion of the safety-related mat slab. And it's isolated -- a portion of the non-safety-related building is isolated both from the safety-related building and the non-safety-related building.

Okay. All right. So now I'll just go through the meteorological damage and the various design aspects that were considered for the safety-related portions of the building. If you have questions about the non-safety-related portions building, please feel free to stop me and I'm happy to answer them, but I'm largely going to address the safety-related portions.

So the wind loading is determined using ASCE 7-05. We utilized analytical procedure instead of simplified procedure or the wind tunnel testing method. And the way that we've accounted for the sort of importance of the building is by utilizing the Code's importance factor of 1.15 and adjusting the wind speed so that rather than designing for the 50-year mean recurrence interval that the Code defaults to, we've modified it with a factor so that we're designing for the 100-year mean recurrence interval wind speed.

We used the same procedure for tornado loading. We use Reg Guide 1.76, Region I design requirements and we use the same procedure, the ASCE 7-05 analytical procedure equations: 230 mile per hour winds and importance factor of 1.15. We do account for the differential pressure and tornado missile spectrum in conjunction with the design wind pressure. Are there any questions about that?

(No response.)

MR. ANDERSON: Okay. Next slide, please. We also account for snow, ice, and rain loading as necessary. There are some flat roofs and some sloped roofs and ASCE 7 requires different considerations depending on the type of roof you have. For snow loads we've again modified the standard default ASCE 7 loading from the 50-year mean recurrence interval to the 100-year mean recurrence interval by increasing the loads by 22 percent.

We've also considered unbalanced snow loads and any drift loading that the Code requires us to consider. Are there any questions about that?

(No response.)

MR. ANDERSON: Okay. Jeff, next slide, please. Okay. In terms of water damage the design-basis flood level; and this is described in Section -- in Chapter 2, from the local probable maximum flood event, creates a water level approximately 50 feet below grade. And there is a precipitation event again defined in Chapter 2, the design-basis rainfall and that creates a water level of approximately grade elevation. So in order to address these water levels the lowest portion of the structure is essentially above the design-basis flood level and the top of the mat slab is at least four inches above grade in all locations. So we've essentially attempted to address these water levels by raising the structure above them.

There are some internal floods considered as a result of various incidents. There are a series of berms and ramps that are designed at the top of the mat slab that are intended to contain and capture any internal flood water and any water-sensitive safety-related equipment is raised off the floor above the prescribed internal flood levels.

MEMBER HALNON: This is Greg Halnon. Just a quick question on the flood. You mention on that first bullet lowest portion of the structure. I assume that's external of the structure, not internal?

MR. ANDERSON: That's correct.

MEMBER HALNON: Is there any below that grade of any conduit penetrations and/or piping penetrations that have an opportunity to leak if there's a flood level?

MR. ANDERSON: There's not. So all of the penetrations are above -- well, I should -- all of the penetrations come through the mat slab, which is at least four inches above grade.

MEMBER HALNON: Okay. Thank you.

MEMBER BIER: Another quick question. This is Vicki Bier. What was the historic basis of the external flooding level and is there any reason to believe that that might be changing due to climate change? I know Wisconsin has experienced unusual flooding recently.

MR. ANDERSON: Yes, those -- the probabilistic maximum flood event is based on another chapter of the FSAR and I'm not an expert on that.

Jeff, I don't know if you have any feedback we can offer there.

MR. BARTELME: No, we've got that detail in (audio interference) go back and pull that.

MEMBER BIER: That's fine. We can certainly defer that.

MEMBER REMPE: I'm sorry, but the person who responded back, a few of us at least couldn't quite interpret what was said because of an echo. Could you say what your last response was again, please, about the flooding?

MR. BARTELME: This is Jeff Bartelme. Just to clarify that the maximum precipitation basis is in Chapter 2. We have to go back and pull that. It's just not --

MEMBER REMPE: Thank you. Thank you. That was much clearer. I wasn't sure what was lost in that echo.

MEMBER HALNON: Yes, this is Greg. If my memory serves us right, I think you did not apply climate change just because of the uncertainty, that you have just stayed strictly with the Code requirements. I think we asked that during the Chapter 2 visit.

MEMBER REMPE: And actually I think that was -- wasn't that a decision made as part of the construction permit versus the operating license, too?

MEMBER HALNON: Yes, that was back in the very first --

MEMBER REMPE: So water under the bridge, so to speak.

MR. ANDERSON: Okay. Are there any other questions?

(No response.)

MR. ANDERSON: Okay. Jeff, would you go to the next slide, please? Thank you.

Now I'll discuss seismic damage. The maximum ground acceleration, or I should say the design response spectra is taken from Reg Guide 1.60 with a maximum ground acceleration of 0.2 Gs. We created synthetic acceleration time histories. We generated those in an attempt to envelope the design response spectra from Reg Guide 1.60 and we used Approach 2, Option 1 of NUREG-800, Section 371 to do that. And we designed the -- we ran the response spectra for all the critical damping values described in 1-1 of Reg Guide 161.

We then performed a soil/structure interaction analysis using a program called SASSI2010. We used an equivalent linear elastic basis for three different soil conditions: the best estimate, the upper-bound, and the lower-bound soil properties which were derived specifically for the site based on the geotechnical investigations at the site and the free field site response analysis.

We performed a separate structural seismic qualification analysis of the facility. Once we had performed the in-structure response spectra we used the accelerations from that analysis and performed separate seismic qualification of the facility using a program called SAP2000, a comprehensive 3D model. And then we combined the earthquake components using Section 2.1 of Reg Guide 192 and also performed a stability evaluation according to ASCE 43-05 and NUREG-800, Section 385.

Are there any questions about that?

(No response.)

MR. ANDERSON: Okay. And just to emphasize the seismic analysis of the facility was -- used load combinations and designed the facility in accordance with ACI 349-13 and the steel elements were designed according to AISC N690-12. So those are the codes of record for the structural design of the safety-related aspects of the facility.

I briefly just want to talk about the various seismic qualifications and classifications in the facility. So there's as we've discussed Seismic Category 1 structures which we've defined as structures that must perform their safety functions after an SSE. There's also non-seismic structures which are not required to perform any safety functions. And then there are Category 2 SSEs which we've defined as being collocated with Seismic Category 1 SSCs and must maintain their integrity in the event of an SSE to prevent unacceptable interactions between Seismic Category 1 SSEs and non-seismic SSEs. And these Category 2 SSCs are not required to remain functional after the SSE.

Any questions about that?

(No response.)

MR. ANDERSON: Okay. I'll briefly touch on the aircraft impact analysis that was performed. So a critical aircraft was selected utilizing the nearby airport records. And then we used some industry documents to determine governing horizontal and vertical velocities at impact for those critical aircrafts that were selected, and we analyzed the building utilizing the standard DOE Standard 3014-2006. And so we've accounted for both local and global impact responses in the event that an aircraft accidentally impacts the facility.

For a global response we've considered the ductility limits of ACI 349 and AISC N690 and we've essentially evaluated every available surface of the structure for perpendicular impacts both at the center of those surfaces and at critical locations near edges and corners that we thought might pose a risk. And we tracked that these -- that no aspects of the aircrafts can penetrate or perforate the building envelope and potentially cause damage to safety-related SSCs.

CHAIR BALLINGER: This is Ron Ballinger. The two aircraft that you selected, neither one of them is manufactured anymore. Are we sure that going forward there aren't any other aircraft that would frequent the airport that are outside the envelope of those two aircraft?

MR. ANDERSON: Since the initial design was performed we have not gone back and reevaluated the records from the airport. I can't say for certain if there are other aircraft available today that would be described as critical, but the aircraft that we had chosen at the time were from among a large array or a large number of various types of aircraft and they were critical just because of their size and weight. Essentially those are the sort of critical aspects of them that we needed to consider.

MEMBER HALNON: Yes, this is Greg. I believe in the construction portion it was a class of aircraft and they chose that as representative of that class that was most representative.

I had a question about -- looks like the impact of an aircraft relative to the structures is well covered. This is a question I asked earlier in the other Chapter 2 also. The ensuing fire or the ensuing consequences of an aircraft -- notwithstanding that we were told that no analysis has been done, but do you -- are you concerned at all with the potential degradation of the concrete and degradation of structures based on potential high heat from a fire or whatever the case may be for an extended period of time?

MR. ANDERSON: It is not a scenario that we've evaluated, so --

MEMBER HALNON: Okay.

MEMBER HALNON: The other question, just

to put it on the record, was that -- the other question is that if a large area fire did ensue from an aircraft impact, what impact on the ventilation systems, the environmental systems inside the plant would there be? So that would be the next logical question beyond what I just asked as well.

MR. ANDERSON: Yes, so the ventilation systems are -- I guess they have not been addressed. We are planning to -- we are going to design missile barriers around the outside of the facility that will harden the penetrations through the building envelope to ensure that they will remain functional as necessary under various external events.

MEMBER HALNON: Okay. Thanks.

MR. ANDERSON: Are there any other questions?

(No response.)

MR. ANDERSON: Okay. I'll briefly talk about the nitrogen purge system structure then. This is a small safety-related Seismic Category 1 building. And that's on the east side of the facility near the entries into the facility.

Next slide, please, Jeff. This little facility is essentially designed -- same criteria as the main production facility structure. I guess I just wanted to highlight the exception associated with meteorological damage. Rather than doing sort of a comprehensive snow loading analysis conservatively a 60 psf snow loading has been applied, and that's been shown to bound the 100-year mean recurrence interval snow load.

I also wanted to highlight that the aircraft impact has been addressed qualitatively on this structure because its location relative to the main facility and to any off-site power structures -- essentially it could not be struck at the same time as the main facility or the off-site power structures that need to provide backup systems to the facility under an aircraft impact scenario.

Are there any questions about that?

(No response.)

MR. ANDERSON: Okay. That concludes my presentation. Are there any general questions or specific questions on any of the slides we've seen now that you've had a chance to see them all?

CHAIR BALLINGER: Okay. If there aren't any questions, I think we're -- thank you very much. We now need to transition to the Staff. Who's the presenter on the Staff?

MR. PRINARIS: It's Andrew Prinaris.

CHAIR BALLINGER: Ah, okay. Andrew. Okay. You've got the slides coming up.

MR. PRINARIS: Yes, thank you. Good morning, Chairman and members of the ACRS. My name is Andrew Prinaris. I'm a staff engineer from the Office of Nuclear Reactor Regulation, or NRR.

We're here today to discuss the Staff's safety review of the SHINE Medical Technologies' operating license application as documented in the safety evaluation report. Joining me today are other members of the technical staff, project management, and management including Joe Colaccino, Chief of Structural Civil Geotechnical Engineering Branch, Division of Engineering and External Hazards, Office of Nuclear Reactor Regulation.

Next slide, please. We will begin today's presentation with an overview of selected Chapter 3 technical areas that we believe are of interest to the ACRS before sharing the findings of Staff's safety review. In this review particular attention was paid to the effects of potential aircraft impact on the facility and to the effects of radiation on safety-significant SSCs.

For the aircraft impact, the Staff also examined the effects of impact on certain safety SSCs such as those of crane systems.

Next slide, please. The Staff, in its review, verified the sufficiency of the SHINE facility design that there is a reasonable assurance it is adequate for the facility to remain safe during operation and capable of safe shutdown as defined in 10 CFR 50.2 during environmental events and accident conditions. The Staff paid special attention to facility SSC designs and operating characteristics that have unusual or novel design features to ensure that they remain safe and functional so that they fulfill their intended function during facility operation.

The applicable regulatory requirements for the evaluation of SHINE OLA, or operating license application, its facility and its SSCs designs are as follows: 10 CFR 50.34, Contents of Applications Technical Information, Paragraph B, Final Safety Analysis Report; 10 CFR 50.40, Common Standards; 10 CFR 50.57, Issuance of Operating License.

Applicable regulatory body (audio interference), but I'm not so sure. Can you hear me well?

CHAIR BALLINGER: You broke up a bit ago, so --

MR. PRINARIS: Yes, applicable -- can you hear me now?

CHAIR BALLINGER: Yes.

MR. PRINARIS: Okay. Great. There is some echo in the background and I'm not so sure is affecting the transmission. I probably -- yes, I'd appreciate --

(Simultaneous speaking.)

MR. PRINARIS: Yes. Applicable regulatory body that was followed in Applicant's design and Staff's review included mandatory and voluntary guidance and standards. For example, for mandatory guidance the Applicant and Staff focused on NUREG-1537, Part 1, Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors Format and Content, and NUREG-1537, Part 2, Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactor Standard Review Plan and Acceptance Criteria, their ISGs final Interim Staff Guidance augmenting NUREG-1537, Part 1 and Part 2.

Other NRC Regulatory Guidance included several Regulatory Guide standards and codes such as Regulatory Guide 1.142, Safety-Related Concrete Structures for Nuclear Power Plants Other than Nuclear

Reactor Vessels and Containments; NUREG-CR-7171, A Review of the Effects of Radiation on Micro Structures and Properties of Concrete Used in Nuclear Power Plants; National Codes and Standards; ASC 7-05, Minimum Design Loads for Buildings and Other Structures; CMA 70, which is Crane Manufacturer Association of America Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes; that's a mouthful; ASME, or American Society of Mechanical Engineers Nog-1, Rules for Construction of Overhead and Gantry Cranes, Top Running Bridge and Multiple Girder; and U.S. Department of Energy, DOE Standard 3014, Accident Analysis for Aircraft Crash into Hazardous Facilities; and local building codes as applicable.

Next slide, please. The NRC Staff evaluated the sufficiency of the facility design features for systems and components as described in SHINE FSAR Section 3.5. For environmental and abnormal loading effects on facility potential damage, Staff's review used the guidance and acceptance criteria from Section 3.5, Systems and Components of NUREG-1537, Part 2, and the ISG augmenting NUREG-1537, Part 2. In addition, the Staff also used the guidance of other Chapter 3 sections as presented in follow-up slides to ensure facility safety and protection of the public.

Next slide, please. The NRC Staff reviewed the FSAR layout and its safety-related SSCs in the irradiation facility, radioisotope production facility, the non-radiologically-controlled seismic area, and a non-safety-related area. Staff's review included safety-related and non-safety-related SSCs. The review of STR's structural SSCs, or elements, structural elements that is, included the foundation mat, mezzanine floor, roof slab, and sheer walls.

Some review details included the review of the steel roof truss and the concrete roof slab of the irradiation facility and radioisotope production facility, the mezzanine floor, which is made of reinforced concrete on metal deck, and a large section of the basement in the RPF, which is recessed below grade to accommodate a series of tanks, valves, pits, and other mechanical systems.

Additionally, reviews included facility SSCs and equipment such as an exhaust stack, supercells, below-grade reinforced concrete vaults, tanks, and some SSCs found in other FSAR chapters.

The N2PS, which is a stage-2 structure, is built on the FSTR basement. It contains a portion of the N2PS system, which is a high-pressure nitrogen gas system. The N2PS structure seismic design is based on an equivalent static load method with an amplification factor of 1.5. This design methodology provides a conservative seismic response that accounts for possible cell structure interaction effects between FSTR and the N2PS structure. In general it has an ability to conservatively resist lateral loads.

DR. BLEY: Could I ask you a question here, Andrew?

MR. PRINARIS: Absolutely.

DR. BLEY: This is Dennis Bley. And it's the same question I raised with SHINE, and it's based on a couple of things historically that I remember, the idea of some good design practice having unintended effects.

At one nuclear plant quite a few years ago it was found that the gap between two of the buildings was such that if the earthquake was not a whole lot above the design-basis earthquake you could get interactions with -- between the buildings and actually collapse of those buildings, or at least the first walls of them.

Also back in 2011 the Mineral, Virginia earthquake affected the North Anna Power Plant and I remember a -- you can get this from the theory as well, but I remember a public meeting between the Commission and the North Anna people, Dominion people and EPRI. And they discussed that given the standard methodology and the assumed uncertainty distributions of -- that approach leaves about a 16 percent probability of an earthquake acceleration beyond the design-basis earthquake so that the high acceleration that was noticed at Mineral wasn't -- shouldn't have been a great surprise.

I'm not sure at all -- I'm pretty sure that their -- SHINE's calculated one inch gap to allow for displacement in the two buildings is probably a very good estimate. I don't have a very good idea at all about how much their margin gets us away from this idea of a seismic cliff, that something just beyond the design-basis could lead these buildings to interact and cause a problem.

Did you folks look at that? And if you did not, I'm curious as to why not.

MR. PRINARIS: We engaged with SHINE, and in particular with Sargent & Lundy on this particular question regarding the seismic isolation and I believe Marc Anderson in the previous presentation addressed the seismic gap. And it was the same examination that you are asking and we were asking. And as far as the North Anna earthquake, or the Mineral -- I don't recall the exact name --

DR. BLEY: Mineral, Virginia. Yes.

MR. PRINARIS: Yes, the Mineral, Virginia earthquake. The geologic structure of the two areas are different. I'm not a geologist to address this in detail.

DR. BLEY: Well, that part is not the issue I'm raising. It's the issue there was -- and we have the same design approach; you can tell us where, is that it isn't trying to assure you never have an earthquake with accelerations above the design-basis. It's to ensure you have a really good chance of that. And as they pointed out, that methodology leaves about a 16 percent chance you go above it.

So the question was really if you have an earthquake that goes above it --

MR. PRINARIS: I did look -- the USGS --

DR. BLEY: -- do you get a split --

(Simultaneous speaking.)

MR. PRINARIS: Yes, I did look at USGS material on this.

DR. BLEY: Yes.

MR. PRINARIS: And I think there are newer maps of available. In our review, the Staff's review -- it's not only me -- we looked at those maps and we couldn't see the acceleration beyond what we already -- I mean, the Applicant already designed for. And that's what we -- in our evaluation, in our review, in our verification that's what we focused on. There was not on record something that we could take us beyond that.

DR. BLEY: Okay. But there is uncertainty in that. This idea that there might be a cliff there just beyond the design-basis is one that's troubled people for a long time. Most places where you look you can assure yourself that's not a problem. Here I'm not sure because I don't -- Marc told us that they had about a 25 percent margin, which might be plenty to cover that uncertainty, but he didn't tell us how they picked it or why that was enough. And you're not quite telling us that either. So I'm just not sure about it.

MR. PRINARIS: And again we're looking for reasonable assurance in our safety determination.

(Simultaneous speaking.)

DR. BLEY: Go ahead.

MR. PRINARIS: Yes, I'm a little bit -- where were we? Did I finish the slides, the scope of review?

DR. BLEY: No, you were about half way through, somewhere in there.

MR. PRINARIS: I think I did cover the N2PS. Okay. The following -- let's go to the next slide. Then you're going to get pretty much what we did in our reviews for safety determination. And again we're looking for reasonable assurance.

Thank you for the next slide. Consistent with the review procedures of NUREG-1537, Part 2, Section 3.2, Other Applicable Regulatory Guidance, the Staff considered the site meteorology to ensure that all SSCs that could suffer meteorological damage as presented in SHINE FSAR Section 3.2 and 3.6 and other relevant chapters of the FSAR were addressed.

Next slide, please. By the way I want to mention one thing. I don't mind if you want to stop me some place to ask a question, just like the previous ACRS member did.

So let me go on for the time being. I think there will be adequate time at the time also to ask questions. Similarly, consistent with the review procedures of NUREG-1537, Part 2, Section 3.3, the Staff considered flooding to ensure that all SSCs that could suffer water damage are considered as presented in SHINE FSAR Section 3.3 and 3.6 and in other relevant chapters of the FSAR.

Next slide, please. Consistent with the review procedures of NUREG-1537, Part 2, Section 3.4, the Staff considered seismic effects to ensure that all facility SSCs that could suffer seismic damage as presented in SHINE FSAR Section 3.4 and 3.6 and other relevant chapters of the FSAR are considered. Staff verified the design response spectra discussed in FSAR Section 3.41 provides information for the peak ground acceleration for the safe shutdown earthquake SSC, its design response spectra, synthetic time histories for SSI, or soil structure interaction analysis, and critical damping values for structural components. The Staff verified that this approach follows Section 3.71 of NUREG-0800 and other regulatory guidance as applicable.

Next slide, please.

MEMBER KIRCHNER: Andrew, this is Walt Kirchner. Just a quick question on this El Centro earthquake as a reference. It's a little bit different than we've been seeing from your reviews of other facilities, typically where they'll use a spectrum. Is the El Centro one tied to the Wisconsin siting, or is that tied to the 1537?

MR. PRINARIS: I'm going to request --

MEMBER KIRCHNER: NUREG-1537.

MR. PRINARIS: Yes, a colleague of mine addressed this specific point and I'd like to turn it over to him.

Amit, are you available to discuss that?

MR. GHOSH: Good morning. My name is Amit Ghosh and I can't answer this questions right now, so we'll take it back and respond to it.

MR. KWON: This Sean Kwon from Sargent & Lundy. So, this El Centro earthquake was used as a seed time history to generate the response spectrum consistent time history, so I don't think we need this one in the slide.

This is just a seed time history; we did not have anything so you can use El Centro earthquake time history, or let's say, Taft earthquake or Northridge earthquake, you can use any time history as seed and then you just modify the time history to make the synthetic time history consistent with our response spectrum. So this is not necessary to address on the slide.

DR. BLEY: I missed a few words in your answer, I think what you said is, it's essentially an arbitrarily picked time history that you used as a starting point and then you vary it according to what you know about the actual site conditions. Is that what you were saying?

MR. KWON: Not related to site condition. So, yeah, you pick real time history, I cannot make, like, a synthetic time history from nowhere, so you pick existing, actual time history data and then you modify that time history to make it consistent with our response spectrum, the .2g anchored NRC Reg Guide 1.60 response spectrum.

So you can pick, let's say, other time history, you have Northridge earthquake time history, or Virginia time history, or Taft earthquake time history, but we did, like, many tries and then El Centro earthquake time history -- synthetic time history based on El Centro time history showed better match than others.

DR. BLEY: Okay --

PARTICIPANT: Why not (inaudible) a bunch of them and then you pick the one that you can adjust to best fit.

MR. KWON: Right, that's correct. That's the correct statement. So it's misleading, so I don't think we need that one on the slide.

MEMBER BIER: One other follow up question to make sure I'm understanding -- this is Vicki Bier again -- when you start with the El Centro and then modify it, does that lead to a single new synthetic time history or does that lead to a bunch of different, randomly generated time histories that are used in some kind of, like, Monte Carlo simulation or whatever?

MR. KWON: No, this is, NRC NUREG 3.7.2 allow to use of one set of time history instead of, like, 30 or 60 sets of time history. So we, based on the real time history, we generated one set of time history, so north, south direction, east, west direction, and north, south direction, and then those generated time history meet all the requirement described in SRP 3.7.2.

MEMBER BIER: Okay --

(Simultaneous speaking.)

MR. KWON: So the generated response spectrum should meet that response spectrum shape and also, like, there are many other requirements. The strong motion duration should be longer than six or seven seconds, and then power spectrum density should be, like, distributed well, instead of, like, random picky here and there. And then there are some other requirement, so we met all the SRP requirement.

DR. BLEY: I forgot your initial introduction of yourself, you're with the Staff?

MR. KWON: I'm at Sargent & Lundy.

DR. BLEY: Sargent & Lundy, okay. And the Staff then does agree with this, Andrew?

MR. PRINARIS: Sir, the information that came to us that the seed was the El Centro, and I believe I've heard this in the discussion, that was the best fit in generating the synthetics. This is where we are.

What exactly are the exact methodology that Sargent & Lundy followed, I believe they just outlined, and if there are other questions we'll be happy to take them back and come back and respond to you.

MR. COLACCINO: Andrew, if I may. This is Joe Colaccino, I'm the chief of the structural, civil, and geotechnical engineering branch, ACRS members have asked a reasonable question here about how the Staff utilized this in their review, and as Amit said, I think this is a question, because it's clear here since we don't have a good answer for you, how we utilized this in our review right now.

So that's on us, we'll take that back and we'll work with the Staff and get you the right answer. Thank you --

MR. GHOSH: Joe, I can answer this part of the question because development of the synthetic time history was done in chapter two, reviewed by a seismologist. I reviewed that, and as the previous speaker from Sargent & Lundry said, in section 3.7.2 gives several criteria to seed the generated time history, and the spectrum, sir, have all those characteristics, we checked that. Six seconds strong motion, ground motion, independent between X, Y, and Z, and all those things we checked.

So we verified everything and we fully agree with what Sargent & Lundry said, there's a procedure given in 3.7.2 and we've verified that in our review.

MR. COLACCINO: Amit, this is Joe Colaccino again, thank you very much. Does that satisfy the member's question?

MEMBER KIRCHNER: I think I started this off, so yes, thank you. Walt Kirchner speaking.

MR. GHOSH: Thank you.

MR. PRINARIS: Is there any other question regarding this slide?

(No response.)

MR. PRINARIS: Thank you. May we go to

the next slide, please? Staff verified methodologies for modeling and analysis performed for the FSDR, for example, with SASSI2010, SAP2000, finite element analysis codes. Applied loads to the structure, for example, dead, live, including those from a meteorological crane, fluid, soil, pressure, and seismic.

The structural response to multi-directional seismic input, structural seismic stability, etcetera, are consistent with regulatory guidance, national codes and standards, and industry accepted practices.

The finite element analysis code selected for analysis are commercially available and have been used excessively in the nuclear power industry. Next slide, please.

Staff verified that strain-dependent soil properties were determined from geotechnical investigations and pre-filled site response and analysis using Shake 2000 program. The pre-filled site response analysis is performed using the min-BET, or best estimate, the upper bound and the lower bound soil properties to represent potential variations of the in situ soil conditions.

Staff finds the methodology used to

determine the bounding in-structure response spectra acceptable. Staff also finds, the analysis followed the NRC guidance documents and satisfies NUREG-0800 3.7.2 section. Next slide, please.

Staff's review included effects of radiation, structural support system and components, for example, beams, for the Neutron Driver Assembly System, or NDAS, and those in the sub-critical assembly, SASS.

Staff verified that safety-related austenitic stainless steel substructural component in the irradiation unit cells have adequate ductility and strength to resist anticipated transients and abnormal loads with stainless steel tested for radiation and corrosion at the Oak Ridge National Laboratories.

Staff's review also included the structural performance of irradiated concrete and structural steel affected by radiation exposure. In its review, the Staff considered the threshold limits of NUREG/CR-7171 and ACI 349.3, which is Report on Evaluation and Repair of Existing Nuclear Safety-Related Concrete Structures.

Staff verified that crane structural components and loadings were evaluated in accordance with ASME NOG-1, ASME B30.2, and CMAA 70. Staff also verified that the crane purchased specifications included environmental additions for design of structural components to account for seismic loads, fracture toughness, and radiation hardening as applicable per ASME NOG-1.

Staff verified that, for crane loading, there was conservatism in the building design consistent overall with ASC-705 or IBC-1607 Building Codes and Requirements.

Staff verified that the irradiation unit structure and its light water pool submerged, or semi-submerged, safety-related SSCs or equipment are designed for hydrodynamic loads, consistent with applicable national standard, for example, ASC-498, ACI-350.3, and AISC N690-12. Next slide, please.

Staff verified that SHINE used this FY screening approach, detailing US DOE standard 3014 Accident Analysis for Aircraft Crash into Hazardous Facilities to programmatically reduce the risk for facility damage and to eliminate the need to further examine consequences of elevated temperatures due to aircraft impact generated fires of the safety-related FSDR structural steel SSCs.

Staff verified that the consequences of elevated temperatures to FSDR structural steel from postulated aircraft crash external to the facility and those fires of that type would be minimal, if any, and that the facility would continue to maintain its defense-in-depth.

Staff also verified that the SHINE, through several aircraft impact scenarios on the FSDR external envelope, ensured the design adequacy of the FSDR and its safety-related SSCs to aircraft impacts.

In summary, Staff verified that seismic design robustness is equally applicable to the design for external hazards, and in this case, external hazard meaning, the aircraft impact and we'll be following up with another external hazard slides. Next slide, please.

MEMBER HALNON: Before you go on on the impact -- and this Greg Halnon -- the DOE standard that you cite talks a lot about secondary effects, and analysis looking taking credit or non-credit for certain systems, not taking credit for active fire protection systems or even suppression systems of other types.

I still don't see any analysis and/or verbiage in the, either, SAR or the FSAR, that tells me that this was looked at in any kind of detail according to that standard.

There's a whole section, Section 7, that talks about it, there's Section 5.5 that talks about it, where is that analysis that shows that last bullet is true?

MR. PRINARIS: Well when SHINE did the approach of strengthening the walls by increasing the size of the walls, that eliminated the risk of an aircraft or its power plants penetrating the facility envelope.

As such, the fires would be external and I believe, in the SCR, or the draft SCR, as it may be, addresses that in part and in fact discusses fire protection and mitigation standards, and fire brigades, and so on and so forth, I don't recall the exact place in the -- where we discussed this thing but I do recall that we referenced other chapters of the FSAR, or other reviews that the Staff performed regarding fires.

One thing that concerned me was, if the envelope was to be penetrated then what would be the effects on the structural steel, and we did have an interaction with SHINE, or Sargent & Lundy, to this effect and then the reduction in risk for penetration was accomplished by increasing the size of the walls, so there wouldn't be any effect for penetration as such.

We also looked at the labyrinth, and I believe SHINE discussed potential impacts at the corners of the facility. We discussed that with the Applicant extensively, we were concerned potential missiles may get into the labyrinth, but the way the labyrinth are constructed is to minimize those.

Our aim in the review was to make sure that safety-related system structures and components would not be affected by an aircraft impact. And I'll take you one step further, a concern was on the cranes which are non-safety-related systems, whether an impact to the walls would be dethrone, so to speak, the cranes.

SHINE shared with us the design and how it was constructed to minimize, if any -- the way they built it, it seemed like it was highly unlikely for the rails or the systems of the cranes to come detached and cause problems to safety-related component.

MEMBER HALNON: Okay. I think I already gave you the credit for good impact analysis, I'm really looking for some more words on the secondary analysis, not just what the standard requires but just the practicality of it.

I just haven't seen where that last bullet is substantiated by any verbiage in the SCR or the FSAR, so if you find where that -- I can issue --

(Simultaneous speaking.)

MR. PRINARIS: Sure.

MR. COLACCINO: So, Andrew, if I could -- this is Joe Colaccino again, I think that's a takeaway for us that we could do that --

(Simultaneous speaking.)

MR. PRINARIS: Well, let me respond, Joe --

MR. COLACCINO: If we could, Andrew, please --

MR. PRINARIS: Yes, sir.

MR. COLACCINO: We could do a takeaway on that so that we can keep everything morning forward.

MR. PRINARIS: Well, I was about to respond -- I was about to respond to ACRS, if you permit me.

I'm looking at, and help me out here, Michael Balazik, if you have -- I'm reading here from our draft, to ensure that the consequences of elevated temperatures to FSDR structural steel would be minimal, if any, from postulated aircraft crash fires.

And B, the facility would continue to

maintain its defense-in-depth and exceed the DOE standard limits to active fire and/or suppression system, following such events has been considered, the NRC Staff reviewed FSAR Section 982.3 and we requested, through an RAI 9.5, regarding these fires and I can --

MR. BALAZIK: Yeah, this is -- go ahead, Andrew.

MR. PRINARIS: Yeah, I can go into the RAI 9.5 that clarifies the basis for the fire barrier ratings --

MEMBER HALNON: This is Greg, again, that's not necessary, just citing it would be good. We haven't done Chapter 9 yet, so I'll go look at that and if I have continuing questions I'll bring it back up.

MR. PRINARIS: Absolutely. And also, sir, if you do go to our writing, and Michael can perhaps help to this effect on what page, I think we're looking at page 17 of --

MR. BALAZIK: This is Mike Balazik, the NRC project manager for SHINE. So we have a dedicated subcommittee meeting related to fire protection, which we plan to present to the members in the July time frame.

So, yes, fire protection is part of SCE Chapter 9, but again, we're having a focused discussion down the road.

MEMBER HALNON: Yeah, and this is Greg, I can we wait for that and I'll do a little bit of research to make sure that I have a, you know, succinct question, if there's still one.

MR. BALAZIK: Yes, sir. Thank you.

CHAIR BALLINGER: This is Ron Ballinger, in the meantime can we get RAI 9.5 and transmit it?

MR. BALAZIK: This is Mike Balazik, project manager for SHINE, yes, I will transmit you the RAI.

CHAIR BALLINGER: Thank you.

MR. PRINARIS: Again, this question is to the SCRS, do you wish us at this point to respond, or you'll be waiting for the engagement you'll have, July time frame?

MEMBER HALNON: I can wait. Again, I have a little research to do myself, to be fair, so I -- maybe go look at that stuff.

MR. PRINARIS: But we did address your concern, and this was one of the concerns that we looked at the impact on the skidding on the roof, and we also looked at additional material that you probably are aware of the background of Chris Kimura (phonetic) that looked at risks of decelerating aircraft, as well as accelerating, decelerating to landing, that means they're not accelerating, and thankfully the document, this particular document, has the challenger aircraft in there and describes all kinds of velocity approaches, and so on and so forth.

I'm going to leave it there, so I'm going to go on and I would like to take to the next slide, if I may.

Staff verified that SHINE followed the methodology described in Reg Guide 1.91, Revision 2, Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes Near Nuclear Power Plants, to determine that potential explosions would not have adverse effects on facility operations or prevent a safe shutdown of the facility.

Staff also verified that potential explosive materials are located at a safe distance from the FSDR and that those that are located closer have a minimal explosion incident rate of 10 to the -6 per year.

Staff further verified that externally located liquid nitrogen tanks are designed in accordance with ASME Boiler and Pressure Vessel Code

Section 8, Division 1, to prevent their accidental explosion and fragmentation.

The Staff finds that these approaches, based on the guidance of Reg Guide 1.91, Revision 2, and national codes and standards are consistent with NUREG 1537 and therefore acceptable.

The next slide brings us to our findings, are there any questions of any of the previous slides, before I take you to the findings?

(No response.)

MR. PRINARIS: If you could go to the next slide, please. Our findings, this means the Staff findings. Staff verified the FSDR N2PS designs are adequately protect SSCs against potential mineralogical, water, and seismic or external hazard damages and the release of radioactive materials, provide reasonable assurance that SSCs would continue to perform the required safety functions and that incurred damages, if any, would not cause unsafe facility operation and would not prevent safe shutdown of the facility, and provide adequate levels for defense-in-depth against uncontrolled release of radioactive material to the environment.

This concludes our discussion of Chapter 3, and I'd like to open again the floor for further questions and discussions.

CHAIR BALLINGER: Questions from the members? I have one. Dennis, before we finish this, has your concern or your comment been adequately articulated?

DR. BLEY: Not for me. I don't think either Andrew or Mark explained to us the basis for the 25 percent margin, and if there's a way to know that kind of ensures we don't have a cliff edge on the buildings coming together in an earthquake with accelerations above the design basis earthquake.

CHAIR BALLINGER: Thanks --

(Simultaneous speaking.)

DR. BLEY: They kind of said, that's not their business; as long as they've done it by the rules, everything's perfect.

CHAIR BALLINGER: So I guess my next question is, should we pursue this a little further and get feedback from the Staff and/or SHINE on this?

DR. BLEY: Well, the Committee might want to talk about it. I guess the idea that there's a cliff edge and we're safe up to a point, not much beyond it, is an uncomfortable one. It's been shown not to exist for most kinds of equipment, but this kind of seismic gap thing is a place where, at least once in the past, it was clear that it wasn't enough.

And I just think some convincing argument about why the margin they've left is enough to cover for earthquakes a bit beyond the design basis makes sense, because, yeah, there's reasonable assurance but you really don't want the world to fall apart just a little beyond where you looked.

MEMBER KIRCHNER: Dennis, this is Walt, you know, this TRIAL Reg Guide 1.252 on Seismic Isolation technologies actually deals with this, I can't by memory recite how they tell you to address this margin.

But, for that Reg Guide, they were worried about the same thing, about if you had an isolated mat, there's a gap between the mat, and, I'll call it a moat, around it -- there is a section in there, that might be worth looking at it, on this, a way to give yourself confidence that you have enough margin. But I can't reconstruct the methodology from memory here in real time.

DR. BLEY: Yeah, I got that sitting in the corner but I'm in the same boat you are, and I don't think either, the Applicant or the Staff, cited that document.

CHAIR BALLINGER: This is Ron Ballinger

again, what I would like to be sure of is that we don't have a situation where there's been an inadequate analysis that runs counter to the rules, versus the importance of having a discussion that would be useful beyond the finding of adequate protection.

DR. BLEY: Well, yeah, I know what you'd like, Ron, but the idea -- I mean the Staff has decided this provides adequate protection, I don't know that they've looked at the issue in particular and that they've addressed it with confidence.

And, for me, if there's a cliff edge it doesn't smell adequate. Of course, that's a Commission decision in the end, but -- so I can't go further than that, I think Walt's point gives the Staff a place of their own to work from but, you know, it's a weird kind of case. But it's always been a worry. It's been shown not to be a problem in most cases; this is a particular case where that's not as clear.

CHAIR BALLINGER: Okay, thanks. I guess I'm still a little confused, so to speak. Okay. Thank you.

MR. BALAZIK: This is Mike Balazik, NRC project manager for the SHINE facility, one thing I would like to add, back in the March 17 subcommittee meeting, a member asked on applicability of 5054hh1 which requires a licensee to develop and implement and maintain procedures if they're notified of a potential aircraft threat.

I did go back and look at the statements of consideration for that regulation and upon my review, you know, I've come to the conclusion that this applies only to nuclear power reactors and not the SHINE facility.

I also asked our general counsel to take an independent look at it and they come up with the same conclusion that that regulation does not apply to the SHINE facility, so I just wanted to add that, I don't know if there's any questions on it.

MEMBER HALNON: This is Greg Halnon, I asked the question. Thanks. If you have any documentation of that I would appreciate it because I don't see that, but I didn't look at the statements of considerations and I'll go back and look at that. Thank you.

MR. BALAZIK: Yep, appreciate it.

CHAIR BALLINGER: Other questions from the members?

(No response.)

CHAIR BALLINGER: Okay, we are at -- well, we're a little bit behind schedule. But not that much, 15 minutes. We scheduled for a break from 9:45 to 10:00 o'clock, but we're already beyond that, so let's take a break until -- what times is it -- until 10:15. Thank you.

(Whereupon, the above-entitled matter went off the record at 10:00 a.m. and resumed at 10:15 a.m.)

CHAIR BALLINGER: Okay, we're back online. Just to make a clarification, the chapter order today will be 8, 9, and 11. So, I was not playing with a full deck, and I've got the revised schedule.

So, Chapter 8 is next up, and is SHINE ready to go?

MR. BARTELME: Yes. Just to clarify, after Chapter 8 we're going to be doing the public session of Chapter 11, correct?

CHAIR BALLINGER: No, we're doing Chapter 9. Public, Chapter 8, public, Chapter 9, Chapter 11.

MR. BALAZIK: Yes, this is Mike Balazik, Project Manager, NRC Project Manager. Yes, so according to the agenda that's on the ACRS website, it's Chapter 8, then Chapter 11, then Chapter 9.

CHAIR BALLINGER: That's what I was

dealing with this morning, but then there's a revised schedule so I don't particularly care, it's just as long as we know what we're doing.

MEMBER REMPE: Larry, can you weigh in that it's okay since this is a subcommittee meeting, to do what works fine with you, or with the subcommittee chairman?

MR. BURKHART: I'm sorry, repeat the question again?

MEMBER REMPE: Okay, so this is a subcommittee, not a full committee. So even though something's been published on the website, with the Federal Register notices where they're pointing people to on the ACRS external website, is it okay, I believe it is okay for the subcommittee chairman to make changes, as long as the Applicant and the Staff can accommodate it.

Is that true?

MR. BURKHART: That is true. Yes, that is true.

I also just wanted to make a comment to you all that our consultant had joined the meeting during the break, Ron, okay?

CHAIR BALLINGER: Oh, very good. Thank you very much. Hello, Ken, how are you?

DR. CZERWINSKI: Very well, Ron, good to hear from you.

CHAIR BALLINGER: Good, I don't want to see your picture. I don't want to be surprised. I look just as old as you.

(Laughter.)

CHAIR BALLINGER: Okay, so we have a meeting scheduled early next week anyway, so we'll be, we'll bring you up to speed then.

DR. CZERWINSKI: Very good, so I'm obviously not going to be on the entire meeting, but I'm going to get as much information as I can.

CHAIR BALLINGER: Sure enough, thanks a lot. Okay, we'll we're okay with Chapter 8 now, so let's do Chapter 8. And then -- well, let's do Chapter 8 and then Chapter 9. Because one of our members has a bit of a conflict that we need to address. Is that okay with everybody?

MR. BARTELME: SHINE has the Chapter 11 resources lined up.

CHAIR BALLINGER: Okay.

MR. BARTELME: After Chapter 8, we have the flexibility to shift resources but I'm not sure we can accommodate that but we'll.

CHAIR BALLINGER: Okay, if you can do it

that would be fine. If not, we'll just stick with the original schedule.

MEMBER REMPE: But just to be clear, no matter how you do these open sessions, the closed sessions will be at the end.

So, you know, right, everybody?

CHAIR BALLINGER: That's always been the case.

MEMBER REMPE: Okay.

CHAIR BALLINGER: Okay, so let's proceed. And we have a hard stop at 11:30, so we need to be careful. Okay, let's go.

MR. BARTELME: All right, can everyone see the Chapter 8 slides?

CHAIR BALLINGER: We can see them fine.

MR. BARTELME: Okay, great. I'm Jeff Bartelme, I'm SHINE's Director of Licensing. I'm going to be presenting on Chapter 8 of the FSAR electrical power systems, and the presentation will be supported by Roger Thomas, SHINE's Lead Electrical Engineer.

Today's presentation, SHINE will provide an overview on the electrical power systems, including a description of the normal electrical power supply system, or NPSS, and describe the emergency electrical power systems, which includes the safety-related, uninterruptible electrical power supply system, or UPSS, and the non-safety-related standby generator system, or SGS.

Here's where the overview, SHINE has provided a simplified one-line diagram of the electrical power systems, at the SHINE facility.

The diagram includes the normal electrical power system through the top half of the figure you see there.

The safety-related uninterruptible electrical power supply system, the bottom half you see there under the dashed line, as well as the standby generator here in the center.

A single overall electrical power system serves the main production facility, as well as the outbuildings and the site electrical loads.

The SHINE facility is connected to a few power circuits from the local utility, Alliant Energy. The two power circuits stage 5 local outdoor transformers, you see there towards the top of the figure.

The 12 KB Feeders originate from the Alliant Energy trip road substation, about 2.8 circuit miles from the SHINE site. And the Alliant Energy

Venture substation, about 2.3 circuit miles from the SHINE facility.

Each division of the -- one of the inter-related uninterruptible electrical power supply systems that are normally powered by a 480-volt transfer buss, and the normal electrical power supply system via division specific memory charger, you can see those interconnections here, for division alpha; here for division bravo.

These 480-volt transfer busses can also be powered via the standby generator system, providing an alternate source of power to the uninterruptible electrical power supply system.

(Audio interference.)

MR. BARTELME: Is there any portion -- is this any better? I got a little closer to the microphone.

CHAIR BALLINGER: It's like you're getting feedback from behind you somewhere, that's, that was the point. That's what I'm hearing.

MR. BARTELME: Okay. Looking at the Normal Electrical Power Supply System, the NPSS consists of the normal power service entrances from the local utility, as well as the distribution equipment providing the three identifying utilization voltages.

The power facility load --

MEMBER BROWN: Can we go back? This is Charlie Brown. I had a -- we popped up and we were muted. So, I had some questions on the figures.

MR. BARTELME: Sure.

MEMBER BROWN: If you don't mind. I'm looking down at the UPSS part of this, and the feeds from the transfer or whatever it's called, the transfer buss switch gears.

And I guess I'm noticing that the busses, the 125-volt busses A, B, and C, are all tied together totally. In other words, they're operating in conjunction with each other.

And the batteries, the battery chargers, are feeding down from the independent transfer busses, but then they go into these, the UPSS A, B, and C, and then feed the batteries.

So, those two battery chargers are operating in parallel, continuously. And that's normally not a real good idea unless there's some way to balance, and not put all the load on one of those just based on voltage differences when you're doing battery charging.

MR. THOMAS: Yes, this is Roger Thomas,

the Lead Electrical Engineer for SHINE.

This is simplified. Those are not a solid connection between those 125-volt busses.

MEMBER BROWN: Okay.

MR. THOMAS: What you're seeing there is actually just a diode, you know, the auctioneered power supply on the DC side. So, there's diodes that would prevent any buss connection, and it's a pretty limited --

MEMBER BROWN: Well, the diodes out of the chargers, I would expect. It's the connections below between A, B, and C. You say those, those are just figuratively speaking, there's actually, they're not, how are they connected?

Just, you see it has to be connected to something otherwise it can't supply DC loads. But a connection between, you know, A, B, and C all solid doesn't make sense. The other --

MR. THOMAS: Correct. So, let me start with the AC connection, that's easiest to explain. That is the transfer switch. The power is either from A or from B.

MEMBER BROWN: Where are you on the diagram?

MR. THOMAS: I'm at the very bottom where it says AC UPSS C.

MEMBER BROWN: Yes, I got that.

DR. BLEY: Charlie, they're straight lines, but apparently there are breakers in there.

MEMBER BROWN: Yes, I guess.

MR. THOMAS: It's a transfer switch.

DR. BLEY: Okay, I just.

MR. THOMAS: Yes, there's no -- in the transfer switch, there's no way to connect the two incoming sides of the transfer switch. It chooses either between one side or the other. And then --

MEMBER BROWN: Hold on a minute. We've got an omission down here. I can't see part of the diagram.

DR. BLEY: Charlie, it's showing up on mine. I see the whole bottom and --

MEMBER BROWN: Yes, but I've got a microphone and hands and the phone. There it goes.

All right, now please start over again. I see the AC, the three AC busses, they're all connected.

MR. THOMAS: Right, and so --

MEMBER BROWN: And parallel it looks like.

MR. THOMAS: What that AC UPSS C actually is, is a transfer switch. So, power is either from A or from B.

MEMBER BROWN: Okay, all right, I got that.

MR. THOMAS: And, yes, and you can't interconnect A or B at that point.

MEMBER BROWN: Yes, I agree. You can't operate those in parallel, that would be a disaster.

DR. BLEY: So either A or B is supplying all three of those loads down there?

MEMBER BROWN: No, it's just A or the power is coming either to A and C, or B and C. C is transferred between either the right hand B buss, or the A buss.

Is that correct, SHINE?

MR. THOMAS: That is correct.

MEMBER BROWN: Okay.

MR. THOMAS: And then let me go up to the DC buss there.

MEMBER BROWN: Yes.

MR. THOMAS: It's what's commonly called an auctioneered power. So, this would be very similar to a dual-corded power supply on a server. You would have the ability to either share power, or well, one with the other but it's all blocked by diodes from interconnecting them, the A and C, A and B.

MEMBER BROWN: Okay, let me work on that one again.

MR. THOMAS: Okay.

MEMBER BROWN: I'm not looking at the charger, right now, okay?

MR. THOMAS: Right, correct.

MEMBER BROWN: Right now the charger independently feeds if I'm listening to you correctly, charger A feeds buss A?

MR. THOMAS: Correct.

MEMBER BROWN: And the battery associated with that. And it is isolated from the USS, UPSS buss B and it's charger. They are, that battery B is being charged independently?

MR. THOMAS: Correct.

MEMBER BROWN: And the loads on C are then auctioneered between A or B. Is that correct, or is that a transfer switch also?

MR. THOMAS: No, it's auctioneered between the two.

MEMBER BROWN: So, there's effectively a diode feeding out of A and B, to C, and they, those DC loads are then auctioneered from C?

MR. THOMAS: Correct. Yes.

MEMBER BROWN: All right, I got that.

MR. THOMAS: So, yes. So, it's power coming from A would have a diode blocking it from ever getting to the B buss. And the same the other way.

MEMBER BROWN: Okay. One last question on this. Let me get my brain unwired here for a minute.

I didn't look totally at chapter 7 yet. I mean is started that, but normally the safety loads would be split between either the A DC buss and the B DC buss, and whatever you'd want to put.

But if you want them set, powered from separate sources to maintain if you lost something, you'd still maintain part of the safety-related system.

And I presume that's similar for, it doesn't show up here, but that's something we would see when we looked at chapter 7 distribution, and what their sources are?

MR. THOMAS: Correct.

MEMBER BROWN: No -- okay, I got it.

Okay, you answered my question.

The one last question on this is up on the DT breaker 1 and 2. Those are, obviously you do not want those closed at the same time.

Are they interlocked? There was no interlock called out in this section, that's why I asked the question.

MR. THOMAS: I'm sorry, so DT 1 and DT 2 can be closed at the same time, but they cannot be closed with the UP breaker 2, or UP breaker 1.

So, there's an interlock that says you can only close three --

MEMBER BROWN: Okay, that's what the dashed line shows you?

MR. THOMAS: Correct, yes, that's --

(Simultaneous speaking.)

MEMBER BROWN: Okay, all right.

MR. THOMAS: You can fill all the two utility transformers.

MEMBER BROWN: Okay, I got that then. All right, thank you.

You can go on. Yes, my next questions come later.

MR. THOMAS: So, the normal electrical power supply system, the NPSS consists of the normal power surge to the roving utility, as well as distribution equipment providing the three identified utilization voltages, to power facility loads.

SHINE provides physical separation between safety-related and non-safety-related circuits, in accordance with applicable protection of IEEE 384.

Application of these applicable sections of IEEE 384, supports satisfying the SHINE design Criterion 27 requirement for independence.

MEMBER BROWN: Okay, I'll ask my question now, is that okay?

MR. THOMAS: Sure.

MEMBER BROWN: I just realized -- I apologize. You listed three or four different voltage levels. The 480-277, which is pretty standard. The 400-230, and the 208-120. Those are all fairly standard supply. But on the diagram, I only saw the 480-277. Is there -- unless I didn't read the diagram correctly?

MR. THOMAS: No, you read it correctly. That was a simplified diagram. The 480 is European voltage. The 400-230 is just for some specific pieces of equipment --

MEMBER BROWN: Okay, yes, that --

(Simultaneous speaking.)

MEMBER BROWN: I got the European connection.

MR. THOMAS: Great.

MEMBER BROWN: All right, so those are I was correct, you don't really break down the voltage levels on where those applied lower down in the electrical power system?

MR. THOMAS: Correct, correct.

MEMBER BROWN: Okay, thank you.

MR. THOMAS: Well, that was Mr. Thomas, this is me, Roger Thomas. I apologize.

MEMBER BROWN: Then that was me, Charlie Brown, talking. I apologize I didn't give you my name. Okay.

MR. BARTELME: This is Jeff Bartelme, picking the presentation back up.

Surge protection provided at each electrical service entrance, to limit voltage spikes and electrical noise. When the electrical service exceeds prescribed limits, it's ability is disconnected from the building to prevent damage.

NPSS branch is automatically physically disconnect from the local utility on the loss of phase. It is reversal or sustained over voltage or under voltage, as detected by protection relays on each utility transformer.

The NPSS contains redundant safety-related breakers that provide power to certain plan equipment, that does not perform an active safety function. The safety function of these breakers is to disconnect power, to prevent actions that could initiate or increase the consequences of an accident. Redundant breakers are provided to ensure that safety function can still be performed, in the event of a single act of failure.

These safety-related breakers in the NPSS include two safety-related breakers for each instance of the NDAS, or the Neutron Driver Assembly System. They provide the redundant ability to disconnect power from the accelerator. And two safety-related breakers per vacuum pump provide the redundant ability to disconnect power from each vacuum pump in the VTS, or the vacuum transfer system.

Two safety-related breakers per extraction feed pump, provide the redundant ability to disconnect power from each of the three extraction feed pumps in the MEPS, the Minimum Extraction Purification System.

And two safety-related breakers provide the redundant ability to disconnect power from the radiological ventilation zone 1 exhaust fans, radiological ventilation zone 2 exhaust fans, and the radiological ventilation zone 2 supply air handling units.

MEMBER BROWN: This is Charlie Brown again.

Are you finished with this slide or did I interrupt you too soon?

MR. BARTELME: That's the end of this slide.

MEMBER BROWN: I forgot to ask one other question, but you don't have to go back to the other slide yet. The diagram slide.

Your power comes from Alliant, and you show two different feeds coming out of a little box. So, effectively if you lose Alliant, you lose all AC power.

You don't have, there are not two sources, independent grid sources, or do these come from different substations? Or have you all figured that out yet?

MR. THOMAS: Yes, this is Roger Thomas from SHINE. If you would, that riser diagram says that it would come actually from two different substations. One is the Trip substation, and what's the other?

MR. BARTELME: Venture.

MR. THOMAS: The Venture substation, yes.

So yes, the circuits originate from two different substations but your, here's the major grid failure within all the other substations, you will not have power from Alliant.

MEMBER BROWN: Yes, okay. Obviously, the feed has to come singly somewhere, but you try to back it up as best you can, so you did.

There will be an ancillary question relative to that. If you do have a total loss of all AC like that for a period of time, your SGS starts. But if it fails, your UPS system is based on reading the other times?

I couldn't figure out how long your UPS systems would maintain yourself, the critical systems in monitoring, while some additional power was brought in somehow. Or they recovered the grid.

MR. THOMAS: Actually, if we have that total loss of power and go into plant shutdown and the UPSS applies, you acquire them for safe shut down of the plant.

MEMBER BROWN: Say that again? Because you garbled, that's why I ask you to.

MR. THOMAS: I'm sorry. If we have, you know, a major power outage that shuts down both of those substations.

MEMBER BROWN: Yes.

MR. THOMAS: We go into plant shutdown. We don't try to keep operating. So, the UPS system provides enough power to safely shut down the plant.

MEMBER BROWN: Okay, and by meaning to shut down just to clarify, that means you turn everything off, the building goes dark, all the systems that are doing anything shut down, and you've got times, you had a table of times to do that, in Chapter 8.

At that point, the whole facility is dark but you're safe. Is that correct?

MR. THOMAS: Correct.

MEMBER BROWN: Okay, so you don't need power to all the systems, even if you were in the middle of a process?

MR. THOMAS: Correct.

MEMBER BROWN: Okay, the shutdown times cover that closing out those processes?

MR. THOMAS: Correct, yes.

MEMBER BROWN: Okay. All right.

I also didn't notice on the SGS, you did not, I presume you have onsite gas, or is it, are you depending on a site feed as opposed to a site storage?

MR. THOMAS: We'll get to that in a later slide but --

(Simultaneous speaking.)

MEMBER BROWN: Okay, all right, that's fine.

MR. THOMAS: -- yes, the quick answer would be just rely on utility gas. We do not have an onsite gas piece.

MEMBER BROWN: Okay.

MR. THOMAS: But it's a non-safety system so again, it's not required for safe plant shut down.

MEMBER BROWN: Yes, I understand that now. Okay, it's not, no onsite source. Strictly used utility. That's fine.

Thank you.

MR. BARTELME: Moving on discussion of the UPSS, uninterruptible electrical power supply system.

UPSS provides a reliable source of safety-related power, to the redundant divisions of AC and DC components on the safety-related power busses.

UPSS provides the safety-related power to equipment required to ensure and maintain the safe facility shutdown, and to prevent or mitigate the consequences of design basis events.

Each UPSS consists of a 125-volt DC battery substation, inverters, battery chargers, IPASS transformers, distribution panels, and other distribution equipment necessary to feed safety-related AC and DC loads, and select non-safety-related AC and DC loads.

Redundant divisions of the UPSS batteries, their size per the guidance of applicable sections of IEEE 485, and the sizing, the UPSS battery sizing considers margin to account for variations in procured equipment, and capacity margin for future needs.

Additional SHINE specific consideration for battery sizing, including run time are discussed on the next slide.

DR. BLEY: All right, this is Dennis Bley.

I was just curious. Do the ventilation and lighting circuits keep power longer than, after you've shut down all the processes? How long can you keep those going for?

MR. THOMAS: Well, so there's if the generator, I'm sorry, let me start things. Roger Thomas again, from SHINE.

If the generator starts, as long as we have utility, gas, you can keep things powered with emergency lighting, and things like that.

DR. BLEY: Okay.

MR. THOMAS: But in general, the lighting is, you know, if you have battery backup for 90 minutes, provides lighting.

There's a lot of other battery backup systems, like the fire alarm is going to have battery backup for 24 hours, and stuff.

I'm not sure I can list all of them adequately, but hopefully that answered your question.

DR. BLEY: He's got some prioritized list of things that need power that we, you would like to have power to the longest.

So, that's kind of what I was asking about.

MR. THOMAS: Correct.

DR. BLEY: Thanks.

MEMBER BROWN: There was a table in there that showed 3 minutes, 5 minutes, et cetera, et cetera, and I, so the time to put those in a safe condition is not real long.

MR. BARTELME: Correct.

MEMBER BROWN: Is that correct? Yes, okay, thank you.

MEMBER DIMITRIJEVIC: Hi, this is Vesna Dimitrijevic.

I'm sorry I had a total failure with the internet my house. So, I try to listen on the phone to repair the internet, so I only heard couple of Charlie's questions.

But I had the questions on the, I have some questions on this, you know, and location separation ventilation. But also, I had this same question that your internal slide on the page 3?

You know, there was a lot of question which I, you know, how you treat the, the loss of power actually before the, you dump the solution in PCM dump tank.

There is a three-minute delay on the loss of the cooling from PCLS, right? You are aware that the loss of power that is, of the loss of PCL it could be PCLS flow will be lost, because it's not supplied from the standby generator. There is a three-minute delay before you say that their creation will be resulting in PSC dump valve to open, right?

MR. BARTELME: Yes.

MEMBER DIMITRIJEVIC: Okay, so what my question is, say if the three-minute, if the PCS, PCLS flowing is restore, this will not happen, right? And my question for you is how do you restore if you have outside power? What is the minimum time you can restore offsite power to those, you know, the MDAS loads?

MS. RADEL: This is Tracy Radel, with SHINE. So, the cooling, primary cooling, closest cooling system pumps, are not on the generator, the backup generator. We don't intend to, you know, run the facility on the generators.

MEMBER DIMITRIJEVIC: I understand that.

My question was because you can get offsite power back in one minute, right? But your circuit breakers are tripping. How long it will take to connect the loads back to the offsite power, if you get power back in the show time? How do you recover offsite power if the power is back in show time?

MR. THOMAS: So, this is Roger Thomas with SHINE. Maybe a little clarification?

MEMBER DIMITRIJEVIC: Okay.

MR. THOMAS: Are you asking if we lose power --

MEMBER DIMITRIJEVIC: Yes.

MR. THOMAS: So until the utility power comes back on --

MEMBER DIMITRIJEVIC: Yes. Very short.

MR. THOMAS: -- how long could --

(Simultaneous speaking.)

MEMBER DIMITRIJEVIC: Yes.

MR. THOMAS: All right, are you asking is there a limit for the solution because --

MEMBER DIMITRIJEVIC: No. Okay, my question is you must have some procedure for this restoration to upload the switch gap busses back, right, close those breakers, load them back? I was just wondering how long it takes. I mean, do you have any feeling, can you actually restore utility power back within 3 minutes?

MR. THOMAS: So, these breakers can be remote. The main breakers on the switch board, can be remotely operated from the control room. So, if the operators can assess what's going on, they would have the ability to pretty quickly reconnect the breakers upon return of power.

MEMBER DIMITRIJEVIC: Okay. Do you have some prioritization of which routes would be loaded? I was always curious, you know, even in the nuclear powers, how fast these procedure of restoring power, especially here because you have a limit before you dump, you know, solutions, so.

I was wondering did you consider this fast restoration of utility power? I mean when you set this 3-minute delay on the dumping the solution, so.

MR. THOMAS: Okay.

MEMBER BROWN: Can I amplify that a little bit, Vesna? I guess my question, based on what you said, is there once you shut down and all the power is gone, and now you get power back, is there a sequence that you have to follow in order to ensure you maintain safe shut down capability and margin? Or can you just have power pop back on everywhere simultaneously?

MR. THOMAS: This is again Roger Thomas, from SHINE. I'm going to break that up into two answers.

If we have a fairly momentary interruption of power, I'm going to say like 30 seconds, our intent will be to pick up production before that 3 minutes is up or anything.

But we have some timing relays in our UPS, we have some. If we have gone for like 3 minutes on the UPS, the UPS suffers some discharge and so the timing relays don't advance the.

If we were to start back up after 30 seconds, for instance a 5 minute timing relays will now be at 4 minutes and 30 seconds to shut off power to equipment, to make sure that we do not challenge the UPS batteries from an unstable grid that's on and off, on and off, on and off.

It can only be manually reset by the operators, after they feel comfortable that the grid is stable.

Beyond that sort of that 3-minute window is the solution gets dumped. Then there's a whole, and it's not really electrical but there's a whole procedure about how they would restart a process.

There's this, and I would have to defer to those entities about the whole thing, but it's my understanding it's about a 12-hour process to bring up the first ones back online.

MS. RADEL: Yes, this is --

(Simultaneous speaking.)

MEMBER BROWN: That answers my question, now I don't know whether that covers Vesna's questions or not. I'm sorry, Vesna, go ahead.

MEMBER DIMITRIJEVIC: No, it pretty much covers my question.

My second question was about this UPS separation. So you have two dimensions and you stated they're located in different fire areas, right? And that they're also cable routings are separated for at least okay it's a nice to look on the picture because my question is what's located in this fire areas?

Are your battery chargers? So, the UPS passes the battery chargers, inverters. What is located in each of those fire areas? What would be located?

Is it the battery chargers there? Are the inverters there? Is that also AC UPS loads there?

MR. THOMAS: The separate fire areas, for instance the battery, I'm sorry, this is Roger Thomas.

The batteries are in a separate fire area.

MEMBER DIMITRIJEVIC: All right.

MR. THOMAS: The charger, I'm just going to describe Division A.

MEMBER DIMITRIJEVIC: Okay.

MR. THOMAS: Division A battery is in a separate fire area. Division A charger, inverter, bypass transformer, is going to be, and part of the distribution is the main 125-volt DC buss.

MEMBER DIMITRIJEVIC: Okay.

MR. THOMAS: Is in a separate fire area.

MEMBER DIMITRIJEVIC: All right.

MR. THOMAS: And, then --

(Simultaneous speaking.)

MR. THOMAS: Yes, and then the distribution panels are, and it's generally in separate fire areas. There is some more control centers that are in separate spatially, within one fire area.

Not sure, I hope that answers that question, but there is the UPS C division that you see there, those transfer pieces of equipment?

MEMBER DIMITRIJEVIC: Right.

MR. THOMAS: Those are in a different fire area. They happen to be in the facility control room.

MEMBER DIMITRIJEVIC: So, you have a A, C, and B are in different fire areas?

MR. THOMAS: Correct.

MEMBER DIMITRIJEVIC: Okay, so my concern here why I ask this question is because if this, you know, in my practice I saw that this areas where the battery charger inverters are, they usually heat up very fast during the operation, you know.

So, and, you know, and I know that you elementarily qualify all your safety agreement, right?

So, did you ever like the heat up of those areas after you lose ventilation? Because there is a subbase on your battery, you know, base of your table.

So if the battery loads, I saw the, I mean you have sometimes need to, you know, to operate the monitors and things like, that for 6 hours.

Did you analyze how fast those areas heat up, or loss of ventilation?

MS. RADEL: So, let me repeat your question and making sure I understood it.

MEMBER DIMITRIJEVIC: All right.

MR. THOMAS: You're asking if there is a heat up calculation for the batteries, and for the UPS rooms on the upper ventilation?

MEMBER DIMITRIJEVIC: Yes.

MR. THOMAS: Yes, there is.

MEMBER DIMITRIJEVIC: Okay, and you don't reach that qualification temperatures in that, in the 6 hours?

MR. THOMAS: Correct.

MEMBER DIMITRIJEVIC: Okay, all right.

MR. BARTELME: Jeff Bartelme, picking up the presentation.

Let's just touch on there. SHINE's located redundant trains in the UPSS separate fire areas, within the safety-related seismic portion of the main production facility.

And again, we cut SHINE powers both safety-related and non-safety-related loads from the UPSS. Non-safety-related loads are isolated from the safety-related loads by breakers or isolating fuses, meeting the required and applicable sections by IEEE for ensuring a failure of the non-safety-related loads, does not impact safety-related loads.

Similarly, the distribution of wiring in each division of the UPSS, is isolated and separated from the other division, for the applicable --

MEMBER BROWN: Hello? We were muted and

I didn't get to ask my question. This is Charlie Brown again. I apologize.

On the batteries, have you -- you did not identify the type of batteries you all were contemplating using. Are they lead acid? Or they're going to be lithium? Are the --, have you gotten into that?

MR. THOMAS: Yes, this is Roger Thomas again. Yes, they are lead acid batteries.

MEMBER BROWN: Okay.

MR. THOMAS: So, standard within the industry.

MEMBER BROWN: So you're going to have the hydrogen protection systems in place, for the charging process for those as well then?

MR. THOMAS: Correct.

MEMBER BROWN: I didn't -- okay, I didn't see. I might have missed that when I read the chapter. I'm sorry if I did. Okay, you answered my question. Thank you.

MR. BARTELME: Picking back up, the UPSS is designed and sized for run time requirements, the required loads. There are really three things that run time requirements.

First, equipment required to prevent

hydrogen deflagration. Adequate flow of the nitrogen power system, and equipment relied on to minimize transient effects on the facility due to short duration power loss, or power for five minutes.

Equipment to provide alerts to facility personnel, and monitor the status of the facility during immediate recovery efforts. That's powered for two hours. And equipment to monitor and reduce the tritium source term. And the tritium confinement is powered for six hours. Here we --

MR. MARCH-LEUBA: This is Jose. Can you go back to the previous slide?

MR. BARTELME: Sure.

MEMBER MARCH-LEUBA: Hydrogen production doesn't stop after you shut down. Even on the down time, you continue to have the heat, right? Within the five minutes?

MS. RADEL: This is Tracy Radel with SHINE. So, following the run time of those TOGS floors on the UPSS batteries, the nitrogen purge system is sufficient to mitigate the hydrogen being generated --

MR. MARCH-LEUBA: So, are you -- you kind of have an echo or something, can you speak slower? I'm sorry. It's just hard to hear you.

MS. RADEL: Okay, I'll repeat that. So, following the run time of the TOGS blowers on the UPSS batteries, the nitrogen purge system is sufficient to mitigate the hydrogen generated by the decay heat in the solution.

MR. MARCH-LEUBA: But if you're in the dump tank, you don't have access to the TOGS anymore, to the overhouse system. So, the hydrogen will accumulate on the top of the dump tank. Or are you saying --

MS. RADEL: The TSV dump tank is ventilated by the TSV off-gas system.

MR. MARCH-LEUBA: Okay, maybe we'll ask that question during chapter 13 when we talk about deflagration, and all those things. Thank you.

MEMBER HALNON: This is Greg Halnon, just a quick question on this slide.

The UPSS, the tech specs allow one train to be out for 72 hours. Are we talking that the run time requirements are able to be met with just one train in the UPSS?

MR. THOMAS: Yes, this is Roger Thomas. Yes.

MEMBER HALNON: Okay, so they're totally redundant, 100 percent redundant to each other for safe operation, is that correct?

MR. THOMAS: Correct.

MEMBER HALNON: Okay, thank you.

MR. BARTELME: All right, so, here is trying to provide a list below that's powered by the UPSS, including safety-related INT systems, CTRPS, and SFAS there. The TSV reactivity protection system, and the engineering safety features actuation system. As well as various process radiation monitors.

The UPSS provides safety-related power to the identified loads, to ensure to maintain safe facility shut down, prevent or mitigate the consequences of design basis events.

In addition to the identified safety-related loads, non-safety-related loads, important to providing alerts to facility personnel, monitoring the status of the facility, and reducing the tritium source term in the facility, which is the defense in depth function are connected to the safety-related busses and the UPSS, and are isolated from the safety-related portion of the busses by isolation over current devices.

And lastly, a slide on the standby generator system. Standby generator system consists of a natural gas driven generator, 4A switch gear, and transfer switches.

The natural gas fired generator automatically starts, provides power to the 4A volt transfer busses, and the normal electrical power supply system.

The standby generator system provides a temporary source of non-safety-related alternate power to the UPSS, and selected loads for operational convenience and defense in depth, including emergency lighting and detectors in the radiation area monitoring system. And a RAMS and a continuous air monitoring system, CAMS.

And then as stated on the slide, operation of the standby generator system is not required for any safety function at the SHINE facility.

MEMBER DIMITRIJEVIC: I'd like to in the Jose, support of the Jose question, the standby generator can supply TOGS, right?

MR. THOMAS: Yes. So if the facility loses power and the standby generator starts, it provides power to the UPS, which then can continue providing power to the TOGS systems.

MEMBER DIMITRIJEVIC: Okay, thanks.

MEMBER KIRCHNER: Can I ask you a question? This is Walt Kirchner.

Is the nitrogen purge system then passive, or does it have its own power supply?

MR. THOMAS: It is passive.

MEMBER KIRCHNER: Okay.

MR. THOMAS: It's, I don't know, what is it six or eight tanks. But it's under pressure and at the lowest I think it's supposed to go for like five days, and like four days.

MEMBER KIRCHNER: Thank you.

MR. THOMAS: A thoroughly passive system.

MEMBER DIMITRIJEVIC: Well, you need the power to open the valve, right?

MR. THOMAS: Correct, just controlling the valves for instance, needs power.

MR. BARTELME: Any other questions on Chapter 8? Okay, questions from the members? If not, we can transition to the Staff, please.

And, just there was a bit of confusion on the schedule. Again, we do have a hard stop at 11:30, and so we'll modify the schedule, I guess. We'll do the NRC, the Staff's Chapter 8, and then we'll I'm sure it will be 11:30 and that's probably where we'll break for lunch.

So, is the Staff ready to go?

MR. CINTRON-RIVERA: Good morning, yes,

this is Jorge Cintron, and I'm ready.

CHAIR BALLINGER: Thank you.

MR. CINTRON-RIVERA: Good morning, my name is Jorge Cintron, I'm an electrical engineer from the long term operations and organization branch in the NRR. And today we'll be discussing the Staff evaluation for Chapter 8 electrical power systems.

Next slide, please. Joining me today for this presentation is Mike Balazik, he's the Project Manager for SHINE; Steve Wyman, the Acting Branch Chief for the long term operations and organization branch; myself, and Sheila Ray, she's my peer reviewer, and technical reviewer from the electrical engineering branch in the NRR.

Next slide. The regulatory basis and acceptance criteria. Regulatory basis for SHINE, the Staff used AT-34 content of the application technical information from paragraph B.

Final safety analysis report, which requires in part that the Applicant should include information that describe the facility, present the design basis on limited information, safety and analysis of the structure, systems and components of the facility as a whole.

For the acceptance criteria, the Staff

used Chapter 8 of NUREG 1537 part 1 and 2.

Next slide, please. NUREG 1537 part 2, Chapter 8, electrical power system, is divided in two. Section 8.1 provides normal power electrical power systems, which provides the acceptance criteria for the design, safe preparation and shut down of non-power reactors, and to provide the reactors use.

The specific areas of review are that the design should be functional, they should be commensurate with the design basis. They should have a dedicated substation to provide safety reactor shut down, and provide isolation of electrical systems to, including the technical specifications.

Section 8.2 the emergency electrical power systems, provide the acceptance criteria for emergency electrical power systems. Upon the acceptance criteria is that the electrical power is required to maintain safety shut down, for operation of recurring safety features, and to protect the public from release of radioactive materials.

Next slide, please. SHINE's normal electrical power system as described in the representation is describing 8a2.1 of the FSAR, normal electrical power systems.

The FSAR provides a description with a

normal electrical power systems of both the irradiation facility, and the irradiation production facility. And the normal power supply system operates at five separate branches, usually receiving utility power of 480-277 volts. The branch is automatically physical disconnect from the utility by opening the associated utility power breaker, supply breaker, upon loss of face, face sustained over voltage or under voltage, as detected by protection relays where each utility as former.

The design of the NPSS is based on Criterion 37, electrical power systems, and Criterion 28, inspection and testing of electrical power system of the SHINE designs criteria. Design SHINE criteria is described in section 3.1.

Next slide. SHINE follows the National Protection Association's 70, 2017. This is the national electrical code, as well as other portions of IEEE standards applicable for the facility of the design of the normal power systems.

The normal power supply system provide power to the following situated equipment. Two redundant safety breakers for the NDAS to provide the ability to disconnect power. Two redundant safety breakers for the VTS, as well for the MEPS and the RBS

1 and 2.

Next slide, please. The Staff reviewed, the Staff evaluated the technical information presented in Chapter 8, of the SHINE FSAR as supplemented by responses of two RAIs to assess the sufficient and the preliminary design and performance of SHINE normal electrical power systems in super operations of the operating license.

The Staff considered design criteria, design basis, and the normal power descriptions, and design and operating categories to provide reasonable assurance that the final design will conform to the design basis.

The areas of review of this section included the functional cross-studies conducted on the normal power supply systems should be commensurate with the design basis, evaluation of the normal power supply system substations, the capacity and capability of providing a safe shut down, and the isolation of electrical systems, and the technical specifications.

Next slide, please. SHINE emergency power supply system, section 8a2.2 provides SHINE's emergency electrical power system description. The FSAR provides a description for emergency power for both irradiation facility and the RPF as well.

The emergency electrical power system of the SHINE facility consists of the UPSS, the non-safety-related standby safety system, standby generator system, and the normal related local power supplies and unique batteries.

The UPSS is the only power source of the emergency electrical power system, that is classified as safety-related.

Next slide, please. The purpose of the UPSS is to provide safety-related source of power to equipment, to require to ensure and maintain safety shut down, and prevent or mitigate the consequences of the design basis.

The UPSS is designed based on Criterion 27 and 28 the SHINE design criteria. It consists of 125 volts of recurrent batteries, subsystems, inverters, bypass conformers, distribution panels, and other distribution equipment necessary to fix safety-related AC and DC loads, on selected non-safety-related AC and DC loads.

Next slide, please. The UPSS provide power at sufficient capacity and capability to all safety-related structures, systems and components, to perform their safety function. It is designed, fabricated, erected, to maintain quality standards commensurate with importance safety-related.

It should be able to -- it is designed to withstand the effects of the design basis natural phenomena, without loss of capability to perform the safety function.

It is located to minimize consistent and other safety requirements, the probability and effects of fires and explosions. It has sufficient independence, redundancy and testability to perform the safety functions submitting to a single failure, incorporates provision to minimize the probability of a failure as a result, or consistent with the loss of power and transmission network. And it permits for a probability inspection and testing, to assess the continuity of the system, and condition of components.

Next slide, please. The UPSS is designed using the applicable codes and standards. Applicable portions of the following codes and standards were used for the design or installation and maintenance of the UPSS.

As you can see, some of them authorize seismic qualification, separation and insolation, maintenance and testing, design, battery sizing, environmental qualification, design of DC systems, and circuit breakers.

Specific portions of these standards are used for the design of the UPSS, are described in the FSAR. Use of these codes and standards provide assurance that meeting Criterion 27 and 28 of SHINE's design criteria.

Next slide, please. The Staff evaluation for the SHINE's UPSS. The NRC Staff evaluated the design of the UPSS, as described using SHINE and FSAR section 8a2.21.

The Staff reviewed the SHINE, the Staff reviewed the FSAR to verify that the functional characteristics of the emergency power system, are commensurate with the design basis.

The Staff evaluation was performed based on the following SHINE's plan specific design criteria. Criterion 4, environmental and dynamics effects; Criterion 27, electrical power system; and Criterion 28, inspection and testing of electrical power systems.

Next slide, please.

(Pause.)

CHAIR BALLINGER: Did we lose anybody?

MR. CINTRON-RIVERA: All right, here we are. The Staff evaluation for meeting compliance with SHINE design Criterion 27. The Staff evaluated the safety-related UPSS to verify the design of the UPSS, provide sufficient capacity, and capability to perform its intended safety function.

SHINE classifies the UPSS as safety-related, however, it is not classified as Class 1E electrical for SHINE, for the SHINE facility.

The Staff issue area as to SHINE to verify the design of the UPSS. In specific, the Staff requested the codes and standards used for the design of the UPSS, supporting equipment, and the classification of the UPSS.

While SHINE does not classify the UPSS as Class 1E systems, and apply the full scope of all Class 1E standards of the UPSS, portions of Class 1E standards are applied for the design of the UPSS, in order to satisfy applicable SHINE design criteria.

The Staff finds that the use of --

DR. BLEY: This is Dennis Bley. The reason they don't have to be Class 1E, even though its safety-related, is because some of the parts of Class 1E don't apply to their design criteria. Is that the basis?

MR. CINTRON-RIVERA: That's correct. We issued RAIs to verify that information, and since the SHINE design is not as the same as a normal nuclear power plant, they don't need to provide the full scope of the actual policy standards to qualify their equipment.

They only use the, those that are applicable for meet their design basis.

DR. BLEY: Okay, thank you.

MEMBER BROWN: This is Charlie Brown again. I wanted to amplify to make sure. I had a slightly different thought process, in that SHINE effectively stated that you got a walk away capability relative to power.

If everything goes dark, you can walk out and go home and have a beer, okay? Come back a day later and everything's still okay.

I'm obviously exaggerating slightly, but that's a fairly important design capability, when you really do not have anything that's going to become critical when it's not paid attention to for a significant period of time.

So, it's just a different way of I thought of it, the way I read the chapter. So, I don't know whether that conflicts with what Dennis said, but a Class 1E, portions of it seem to make sense to me.

So, that's all. I just wanted to get that on the record. Go ahead.

CHAIR BALLINGER: No, this is Ron Ballinger. Here we are talking about design Criterion 27 and others. That's in section 3.1, chapter 3, and we haven't gone through that, and that's not going to happen until July.

So, just to put that on the record. I couldn't quite figure out why we didn't do section 3.1 when we talked about chapter 3. But here we are talking about design criteria, that we haven't talked about.

DR. BLEY: Yes, I agree, and we need to double check that when we get to that point. But they are closely interrelated.

MEMBER DIMITRIJEVIC: Just to add to what Charlie said, you know when we say VNA, we don't need, we don't need the power for operation, but we need them for all of those demands created by the loss of power.

When we have to, you know, open breakers, or vacuum pump, or the feed, the extraction feed pump, or to close the, you know, the exhaust fan.

So, there is a lot of things which we have to do in the first middle chapter, loss of the power, and then we are fine, so.

I mean that's a part which is safer to

delay, that he has to make sure there is no, you know, radiation leaks, and has to make sure that, you know, solution has been dumped into the passive cooling, and things like that, so.

MEMBER BROWN: All right, can I ask SHINE a question while you're on?

MR. BARTELME: Sure.

MEMBER BROWN: I forgot to ask this during your presentation. You're orientation and you talked about auctioneering, UPS, 125-volt UPSS buss seat.

So, you had power, auctioneered power coming from A and B, that feeds C, to a bunch of DC loads.

And the way I looked at it that is A and B busses, have certain loads on them but C had loads that you really wanted to make sure had DC power, even if you lost A or B. Is that a correct? I would expect the loads on that buss to be more critical loads than on A or B.

MR. BARTELME: This is --

(Simultaneous speaking.)

MEMBER BROWN: This is where you have the auctioneering, but not the others.

MS. RADEL: This is Tracy Radel from SHINE. Actually, that oxygen power is supporting

Division C instrumentation, and that's a much smaller load that is in the safety-related control system.

There are certain functions where we have three instruments coming in rather than two and that third instrument is on Division C and that's for operability reasons that we want three instruments measuring certain parameters.

So, it's not more important loads, it's just limited number of Division C instruments.

MEMBER BROWN: I understand. Go ahead.

MEMBER DIMITRIJEVIC: I have also a question which I missed in the previous one. Do you have to strip any loads from the 125 basis on the loss of offset power?

MR. THOMAS: I'm sorry, I didn't pick that question up, could you repeat it?

MEMBER DIMITRIJEVIC: If you lost offset power for you not to extend the battery life, do you have to strip any loads from those UPS buses?

MR. THOMAS: Yes, those are where we group those loads in the five-minute, two-hour, and six-hour categories. We need to limit the amount of the five-minute loads because those are the biggest loads. You pull those off to be able to hit the criteria for those long tie-offs.

MEMBER DIMITRIJEVIC: So, basically, I know UGS and things like that doesn't have loads, but so after 5 minutes, after 20 minutes you strip certain things, right? Is that how it goes? In the beginning you don't have to strip anything automatically.

MR. THOMAS: Correct. All the loads are supported after five minutes, when you drop off those five-minute loads, and then two hours is another group that gets dropped off.

MEMBER DIMITRIJEVIC: That's done by operators?

MR. THOMAS: No, those are automatic, they are part of the UPS system itself part of the safety-related system.

MEMBER BROWN: They are stripping loads, three and five-minute load stripping and then they've got two hours for the smaller loads. I think I phrased that correctly, didn't I?

MR. THOMAS: Close enough.

MEMBER BROWN: Thank you, that's all I need. Go ahead, Jorge, I'm sorry to interrupt.

MR. CINTRON-RIVERA: No worries. The Staff finds that the use of specific persons IEEE codes since it provides reasonable assurance that the UPSS provides sufficient capacity and capabilities to inform its intended safety function.

Next slide, please. Compliance with Criteria 28 is Staff evaluated the safety-related UPSS to verify the system is designed to permit appropriate inspections and testing as safety-related equipment.

Trying to follow specific portions of standards, testing, and installation, and maintenance offsite technical equipment. The Staff finds the proposed approach that SHINE used of the use of IEEE standards is acceptable for inspection and testing of the UPSS.

Compliance with SHINE Design Criterion 4, the Staff evaluated the safety-related UPSS to ensure the design to perform its intended safety-related functions with the environmental conditions associated with normal operations, testing, or postulated accidents.

SHINE's design of the UPSS will be in accordance with applicable portions of IEEE 44 for seismic and 32003 for environmental qualification. The Staff finds the use of these IEEE standards will provide reasonable assurance that the UPSS will meet Design Criterion 4.

Next slide, please. Staff evaluation of the SGS, the NRC Staff evaluated that non-safety-related SGS as defense in-depth for SHINE's emergency electrical systems.

The SGS consists of a 480 to 77 volts 60 Hertz natural-gas-driven generator and a 480 switch gear and a switch to all figure out the SGS switch gears to be connected to either or both emergency 480 volts of the normal power system process.

The purpose of the SGS is to provide a temporary source of non-safety-related alternative power to the UPSS and select additional loads for operational convenience and defense in-depth.

The SGS is designed in accordance with of Article 700 of NFPA 70 2017. In response to NRC Staff's RAI, SHINE describes the specific portions that are the goal of NFPA 700 2017 for use for design of the SGS.

Next slide, please. Upon loss of onsite power, the SGS will automatically start both non-light breakers and the Breaker 1 and Breaker 2. They will automatically open and transfer switches operated to provide power to the associated 480 volts normal power system transfer loss.

The SGS provide power upon loss of offsite power, the SGS is not required to support safety-related functions of the SHINE facility.

Next slide, please. Staff evaluations of technical specifications, the Staff evaluated the sufficiency of the Applicant's proposed technical specifications for the SHINE electrical power systems of describing FSAR Chapter 8.

The proposed tech specification 3.3 emergency power limited conditions for operations, 3.6.1., and surveillance requirements, 3.6.1 LCL 3.6.1 requires, in part, that two divisions of the OPSS should be operable. The LCL provides the criteria to determine if the division of the UPSS is considered operable.

SCR 3.6.1. provides surveillance requirements for the UPSS, Table 2.6.1 UPS actions provide the actions to be taken upon completion times to restore operation of the UPSS if one or two divisions of the UPSS are not operable.

Next slide, please. The NRC Staff reviews SHINE's electrical power systems of applicable guidance of Chapter 8 of NUREG 1537 Part 2. The Staff have determined that the phone rate of the PSS and the emergency power system are commensurate with SHINE's plant-specific design criteria 427 and 28.

The normal power supply systems provide reasonable assurance that the event of loss of electrical power, the facility can be safely shut down. In the event of loss of normal power systems, the UPSS provide reasonable assurance that SHINE's facility can be maintained in a safe shutdown condition.

The Staff finds the licensees use specific codes and standards provides reasonable assurance that the normal power system and the emergency electrical system meet the SHINE's plant-specific design criteria in 427 and 28.

Next slide. Based on the information provided, the NRC Staff finds that the description and discussion of SHINE's electrical power system are sufficient to meet the applicable regulatory requirements and guidance and acceptance criteria for the issuance of an operating license.

That concludes my presentation.

CHAIR BALLINGER: Questions from the members?

MEMBER DIMITRIJEVIC: I am confused about the tech specs. If one of the train of the UPS is found unoperable, what are the tech specs require them to do?

MR. CINTRON-RIVERA: Yes, let me rephrase your question. Are you're saying both of the redundant trades are unoperable the text provides through how to handle what to do, the actions to be completed?

MEMBER DIMITRIJEVIC: Yes, if the last train of UPS is found but two divisions and one division of UPS is found unoperable.

MR. CINTRON-RIVERA: If both additions of the UPSS are inoperable, there is actions associated with completion times as well and they will provide what actions to be taken in the facility upon loads of both of them.

MEMBER HALNON: This is Greg, I got it up in front of me.

One division inoperable, you just store 72 hours. If both divisions are inoperable, you have 1 hour to place the units into Mode 3 open vacuum breaker, open vacuum breaker valves and place tritium and all 3 TPS process equipments in storage.

So, those are 1-hour and 12-hour requirements.

MEMBER DIMITRIJEVIC: I understand that one. My question is it's like you need the UPS to place this in safe shutdown. So, I'm curious how would that be done without UPS?

MEMBER HALNON: I think it's assumed normal power is available.

MEMBER BROWN: Are you done, Greg?

MEMBER HALNON: Yes, I'm just reading off the tech spec.

MEMBER BROWN: I had one other question. I hope it's the only other one.

Can you operate this facility or is the SGS going to be sized so that even if you lost the line that you could continue to operate normally on the SGS with all your process controls until, say, the power went out for 24 hours and you could operate on the SGS as long as you had utility gaps?

MR. THOMAS: This is Roger Thomas from SHINE. No, the CMI generator is just more for shutdown.

MEMBER BROWN: I thought that was the case but I wasn't absolutely clear. Thank you.

CHAIR BALLINGER: Other questions from the members? I know we've got a few minutes now. I still want to bring it up again. Here we have been talking about design criteria.

We won't be looking at the design criteria until July and you can be sure that one or more of us will ask a question when we see the design criteria in final form, whether or not any changes in those design criteria have impacted the previous chapters.

So, this has got its tentacles into a lot of chapters I think.

MR. BALAZIK: This is Mike Balazik, NRC SHINE Project Manager. Professor, Section 3.1 does list the design criteria and it spells out what specific system that SHINE has applied that criteria for.

In the individual chapters, for example Chapter 8 has applied certain design criteria and as part of our technical review, we consider those design criteria. I just wanted to point that out.

CHAIR BALLINGER: I'm assuming that's true but we just want to be sure we get a match between, if you will, the design criteria of record and the chapters.

MR. BALAZIK: This is Mike Balazik, yes, I understand.

CHAIR BALLINGER: Other questions from the members? By the schedule which I'm now working on, we will recess until 1:00 p.m.

MR. BALAZIK: And precisely, are we going to Chapter 11 or Chapter 9 upon returning to from lunch?

CHAIR BALLINGER: Chapter 11.

(Whereupon, the above-entitled matter went off the record at 11:29 a.m. and resumed at 1:01 p.m.)

CHAIR BALLINGER: It's 1:00 p.m. -- actually 1:01 p.m., so we're back in session and we're at a point where we're ready for SHINE's presentation on Chapter 11. Are we in good shape?

PARTICIPANT: I think we are.

CHAIR BALLINGER: You sound like your covered? You're in a conference room? That's better.

MEMBER REMPE: Before we get into it, are you hearing us okay? Some folks have complained that it's hard to hear because of an echo when we're talking. How does it sound right now?

PARTICIPANT: We have not had any issue hearing the members today.

MEMBER REMPE: That sounds good. We don't hear that in our room too.

CHAIR BALLINGER: Let's move on.

MR. MCSWEENY: My name is Riley McSweeny, I'm the waste processing lead at SHINE. Today is open session, I'll be presenting on Chapter 11, radiation protection program and waste management.

This presentation will cover the following topics, radioactive liquid waste storage, radioactive liquid waste mobilization, solid radioactive waste packaging and waste resources.

The radioactive liquid waste storage system is a system comprised primarily of storage tanks located in a below-grade shield of tank vaults in the radioisotope production facility.

The system collects and stores liquid waste from various processes in the radioisotope production facility prior to transfer to the radioactive waste mobilization system.

They are sent to radioactive liquid waste storage system that includes washes from strength isotope separation systems, time and state from process vessel event system condensers, liquid waste from non-routine operations such as decontamination flushes.

The good-wave streams are combined out for radioactive decay, sampled and adjusted as needed. Are there any questions on this portion of the radioactive liquid waste system before I move on?

The safety-related functions of the radioactive liquid storage system include the use of favorable geometry tanks in accordance with the nuclear criticality safety evaluation.

Favorable geometry designs are used for a set of two tanks, referred to as the uranium liquid waste tanks.

These two tanks are designed to maintain liquid and annual geometry meets the same general design as the annual tanks use throughout the radioisotope production facility.

Additionally, uranium concentrations of liquid waste within the uranium liquid waste tanks are verified to be within the safe point prior to transfer to non-favorable geometry storage tanks.

Other notable features of the radioactive liquid waste storage system include the use of shielded below-grade areas to provide radiation shielding versus some components and use of the vacuum transfer system to prepare tank-to-tank transfers.

Any questions on this?

This is a flow diagram of our uranium liquid waste tanks. Liquid waste streams are received from the various process systems into the first uranium liquid waste tank. These liquid waste sources are represented by the PBBS ISP not to BTS flow arrows.

Prior to transfer to the second uranium liquid waste tank, the uranium concentration is verified to be within safe limits.

After transfer to the second uranium liquid waste tank, the contents are again sampled and verified to be within a safe uranium concentration limit prior to transfer to downstream favorable geometry tanks.

Transfer from the first to the second uranium liquid waste tank are made into the vacuum tank located in the upgrade hot cell. The lift tank is also where samples are taken from.

MEMBER HALNON: This is Greg, I've got a question, maybe it's a tech-spec question. One is actions of the return solutions to the liquid waste blending tank to the favorable geometry location.

It's a little bit ambiguous where that is. Is that a complicated move to implement this tech spec, where it's a stop transfer of solution, return the solution to the geometry or dilute it? Is that a complicated operational action or is that relatively straightforward?

MR. MCSWEENY: Can you clarify the tech spec?

MEMBER HALNON: I'm looking at the waste tank uranium concentration actions, Table 3.8.4 and I realize that what I don't have a feel for is just how much operator action is required to do this. Because it's a stop transfer immediately and then you have six hours to do something else.

I'm curious, you've got one operator on Staff out in the field, I just was curious how much operator action is required to implement that.

MEMBER MARCH-LEUBA: This is Jose. Didn't you say a moment ago that you mentioned the concentration of uranium before you started transfer? It's not an online measurement, correct?

MS. RADEL: This is Tracy Radel, it's a sample that's taken to the measurement.

MEMBER MARCH-LEUBA: It's not an online measurement but before you do the transfer you verify that?

MEMBER HALNON: We wouldn't even do the transfer.

MS. RADEL: Correct.

MR. MCSWEENY: These are both geometry tanks that never get to the non-favorable for this one.

MEMBER HALNON: We need to have a second one before this would even -- that's fine, I wanted to make sure it wasn't just something that --

(Simultaneous Speaking.)

MEMBER MARCH-LEUBA: Do you have it defined how you're going to measure the concentration, is this one mass spec, overlaying with a sample?

MR. MCSWEENY: We plan to analyze the sample in our labs using ICP-MS mass spectroscopy.

MEMBER MARCH-LEUBA: Changing the subject, or the same subject, when does the ING solution become waste? I thought we were recycling most of it? Are these small spills or things that get contaminated?

Is it going to be a large volume?

MS. RADEL: As far as timing or cadence of recycle and reuse, that would be proprietary so we'd have to cover that in closed session. The normal waste streams going into here are coming from the washes during the extraction and purification processes. And the normal uranium concentration in those washes is below the safe limit concentration limit.

MEMBER MARCH-LEUBA: Is the waste stream from the , for example? This is going to be a small percentage of the total uranium in the plant?

MS. RADEL: Correct.

MEMBER MARCH-LEUBA: Thank you.

MR. MCSWEENY: So, the exhaust left connection to the process vessel event system and nitrogen systems to ensure proper ventilation, overflow lines leading to a direct drain system and hydrogen lines for mixing prior sampling.

If there's no other questions we can move on. This is a flow diagram of the liquid waste blending tanks which are large and non-favorable geometry tanks downstream of the uranium liquid waste tanks.

These tanks have process connection to samplers located in the hot cells and additional lines so that liquid waste could be adjusted and sampled as needed.

These tanks also have process connections to the radioactive liquid waste on mobilization feed tank following waste storage and connections to the process vessel event system.

The third lens ensures proper ventilation. If there are any questions on the blending tanks? Radioactive liquid waste and mobilization system is located downstream in the process from the radioactive liquid waste storage system.

It's physically located above graded level in radioisotope production facility. The functions of the system include separation of classification driving radioisotopes and the solidification of the liquid waste.

Prior to the transfer to the liquid waste,

waste is sampled to verify the chemical properties of the waste are appropriate to processing indoor radioactive liquid waste and mobilization system.

After the solidification process is complete, the solid waste is transferred to a material staging building where it's starred for additional radioactive decay in prior shipment.

Any questions on this portion of the radioactive waste mobilization? This is a flow diagram for the radioactive liquid waste and mobilize mobilization system.

The waste is transferred to the mobilization feed tank from the radioactive liquid waste storage system by vacuum transfer.

The feed to the mobilization feed tank is shown in the lower left corner. If the liquid waste stream requires cleanup prior to liquefication, it's pump-through waste cleanup valves in return to the column effluent tank prior to feed into the waste solidification drums.

Waste can also be pumped directly from the mobilization tank to the waste solidification drums. The waste solidification drums are filled with solidification agents outside of the AWI system.

Once filled with liquid waste, the waste location drums are filled within the system. Any questions on this?

MEMBER PETTI: This is Dave Petti, just one clarification. All of these tanks/drums are not in a critically safe configuration. Is that just because of the uranium concentration is so low it's not --

MR. MCSWEENY: Yes, upstream controls on the uranium concentration that control -- there's no need for criticality-safe tanks in this system.

MEMBER PETTI: Thank you.

MEMBER MARCH-LEUBA: Going back to the criticality safety question, are those wastes going to be stored for a significant amount of time so that liquid or water can evaporate and increase the connection by operation?

The geometry is so safe that it doesn't really matter? And I will suppose that we have area radiation monitors to even indication of an criticality and somebody comes into the room.

MS. RADEL: There are storage for extended periods of time and we do see it holding periodically through storage.

They are also covered by the criticality external lens system, there's coverage through that whole area of this upgrade vault.

MR. MCSWEENY: We're talking about the thanks, not the solidified waste, right?

MS. RADEL: The tanks.

MEMBER MARCH-LEUBA: Okay, thanks.

MR. MCSWEENY: The solid radioactive waste packaging system consists of equipment needed to collect, segregate, and package solid radioactive waste.

This is handled and shipped offsite in accordance with the radioactive waste management program, sideways handled by radioactive waste packaging system that includes dry active waste and ion exchange resin and spent filters.

Any questions on the solid radioactive waste packaging system?

Radioactive waste stream sources and their waste classifications are shown below. The streams include spent accelerated components, process filters, glass used in the liquid purification and trash, which includes contaminated radiation protection equipment.

Target solution casts vessels skid components are replaced as needed. Waste streams also include isotope extraction columns used in our molybdenum and iodine extraction systems.

Waste separation columns, water deionizer units, contaminated oil from accelerated pumps and solidified liquid waste. Any questions on this table?

MEMBER PETTI: This is Dave Petti again. This Class C, is it just because you're not convinced at this point that those waste streams can always read Class B?

MS. RADEL: There is some uncertainty in your extraction definition, the extraction media. So, we have data that we've set on the chart are nominal and based our analysis on but those aren't certain and so are evaluated as those three are produced.

MEMBER PETTI: Once you get real data you can make the most informed decision in operation?

MS. RADEL: Yes.

MEMBER PETTI: Thanks.

MR. MCSWEENY: Are there any questions?

CHAIR BALLINGER: Questions from members? Thanks, we switch over to the Staff.

MEMBER MARCH-LEUBA: While the Staff is coming can I ask a question? Is there any chemical hazards on the waste? I'm thinking mixed waste possibilities.

CHAIR BALLINGER: Good question, we're going to find out.

MEMBER HALNON: We have them on the list, radioactive oil is mixed waste.

MEMBER MARCH-LEUBA: Those are much harder to change.

MR. BARTELME: Could you clarify the question?

MEMBER MARCH-LEUBA: Do you have plans to handle what is known as mixed waste where you have a chemical and radiation together? You have to do special plans for that and it was mentioned, the example of having contaminated oil.

MR. BARTELME: The contaminated oil would be misplaced and would need to be handled separately.

MEMBER MARCH-LEUBA: You don't have any significant chemical hazards, do you?

MR. BARTELME: No, nothing besides the contaminated oil, which is produced in small volumes.

MR. BALAZIK: This is Mike Balazik, NRC Project Manager. Do you have the Chapter 11 slides?

MR. GRAN: Am I good to start? Hello, everyone, my name is Zachary Grand and I am a health physicist at NRR. I am the leader for Chapter 11, radiation protection program and waste management for the SHINE review.

I will be presenting the Staff's review of

Chapter 11. The Staff's review was based on the guidance provided in NUREG 1537. It is broken down into radiation protection, radioactive waste management, and respiratory protection topic areas.

Next slide, please. In radiation sources, the Staff reviewed the information provided by the Applicant for two source term scenarios nominal and safety basis values.

The Staff evaluated the information provided in the SAR for the gaseous liquid and solids source terms.

This review included a review of several calculations made available during an audit with SHINE. The Staff review ensured that an appropriate level of detail is contained in the SAR to confirm their confirmatory calculations.

The results of the Staff review determined that the Applicant provided enough details to allow Staff to verify F1 releases, direct doses into that calculation. Next slide, please.

For the radiation protection program, the Applicant provides information to establish their RP program and provide commitments to training and annual auditing of their RP program. The Applicant provides commitments to Reg Guide 8.2 and ANC ANS 15.11.

Applicant's commitment to this guidance is consistent with NUREG 1537 and is an acceptable method for describing RP program that is consistent with the requirements in 10 CFR 20101 for our radiation protection program.

Next slide, please. The Applicant describes a ALARA program that conforms with the guidance in Reg Guides 8.2, 8.8, 8.10, 8.13, and 8.29. The Applicant also provides information that the radiation protection they enter conforms annual evaluation of their ALARA program.

The Applicant uses design features such as building ventilation hot cells and shielding that is made available for personnel to maintain doses of ALARA and to do minimize the spread of contamination.

Based on the information provided in the SAR, the Staff determined that the Applicant has described an ALARA program that is acceptable and consistent with NUREG 1537 and is again compliant with the requirements of 10 C.F.R. 2011-01 for the ALARA program.

Next slide, please.

Slide 5. In radiation monitoring and surveying, the Applicant provides information on gaseous F1 monitoring, continuous air monitoring, and radiation monitoring.

The Applicant provides stacked monitoring to ensure that gaseous to releases are below the dose limits contained in 10 C.F.R. 20.1301.

The Applicant also provides tech specs to ensure radiation monitoring is operable and below the regulatory release limits.

Based on the information presented in the SAR, Staff determined that the Applicant has appropriately described radiation monitoring that will control and monitor the radiologist conditions of their facility.

Next slide, please. In radiation exposure control dosimetry, the Applicant provides information on the use of signage and postings. The Applicant provided information on the radiation areas as well as the use of interlocks and visual warnings.

In addition, all workers will wear personnel monitoring while working in restricted areas of the facility.

Based on the information provided in the source term section, the Staff use that information to perform several confirmatory calculations to verify the established radiation zones specified in the facility.

The Staff also reviewed several calculations provided during audits to verify the dose rates in the facility. The results of the Staff's review determined that the Applicant has described the satisfactory program for the radiation exposure control dosimetry.

And the Staff has verified through calculations and reviewed all the calculations that the Applicant has correctly determined the radiation zones established in their facility.

Next slide, please.

Contamination control at the facility is summarized by the use of shielded compartments and hot cells that are incorporated as part of the facility design. Like what was described previously with the ALARA design features, ventilation considerations are made to control airflow patterns to reduce the spread of contamination.

In addition, the Applicant describes the use of continuous air monitors located at various locations in the facility to monitor airborne contamination.

The Staff's review determined that the Applicant adequately provides information on design features and accurately provides information on the monitors to the spread of contamination in the facility.

Next slide, please. In environmental monitoring, the Applicant describes the use of Regulatory Guide 4.1 and NUREG 1301 for developing the REMP and ODCM. The Applicant describes and environmental monitoring program that provides offsite monitoring around their facility and has provided that they'll use direct radiation monitoring and air sampling at these offsite locations.

Given that they'll have no radioactive liquid influence, the Applicant does not expect to need surface water and bio-monitoring. The Staff finds this acceptable given the RENP will be evaluated annually to ensure if new pathways will need to be monitored.

Based on this information, the Staff plans the Applicant has described an acceptable environmental monitoring program.

MEMBER PETTI: Just a question here. The tritium release that they'll have goes up their stack but eventually that gets into biota. That doesn't count in terms of this idea of not having to monitor because it might happen outside the site boundary?

MR. GRAN: I think it's more like the F1

monitoring stack that will still have the in-person sampling for tritium, I think determining how much tritium they have offsite maybe annually, they'll figure out if they need to unmonitor anything.

But I think I could be correct in that I think the biota in the area didn't seem like there was anything they needed to but I could be corrected on the current biota around the area.

MEMBER PETTI: I would be interested to know what, for instance, can-dos do. It's probably a lot more tritium than here.

MR. GRAN: Slide 9, environment. In the radioactive waste management program, the Applicant describes the structure for their program. This includes the description that their staff will be trained and have procedures to ensure appropriate waste handling.

In addition, the Applicant will be required to maintain records of their waste disposals. Based on the descriptions provided in the Applicant's program, the Staff finds the Applicant has acceptably described their radioactive waste management program.

Next slide. In radioactive waste controls, the Applicant provides information on the estimated annual waste treatings at their facility in

January.

The Applicant provides information on the practices used to minimize the generation of radioactive waste through the training, goals, segregation of waste amongst other practices as described in their SAR.

The Applicant describes the use of the material staging building for the interim storage of waste for decay prior to transport. The Applicant also provides the sources, types and volumes of waste generated at their facility.

Based on the information provided in the descriptions of their waste sources, the Staff determined that the Applicant had acceptably described their radioactive waste controls. Next slide, please.

Slide 11. In release of radioactive waste, the Applicant describes the gaseous effluent releases and the anticipated solid waste generation rates. No liquid waste releases are anticipated because all liquid sources are solidified prior to disposal.

Gaseous release are from the facility stack and are monitored to ensure compliance with the release limits. Staff confirmatory calculations determines that the gaseous effluent releases are below the 10 C.F.R. 20-1101D 10 millirem limit for airborne effluents.

Based on the information provided in the release of radioactive waste, the Staff determined that the Applicant has acceptably described the release of radioactive waste. Next slide, please.

The final slide, the respiratory protection program from SHINE will follow the guidance contained in Reg Guide 8.15., which is an acceptable method for demonstrating compliance with 10 CFR Part 20 Subpart H.

This commitment is acceptable and ensures protection of personnel from airborne concentrations exceeding the DAC limits in 10 C.F.R. Part 20 Appendix B. This concludes my slide presentation.

MEMBER PETTI: This is Dave again, I have another question but it may be more appropriate for SHINE. What technology are you going to use in measuring the tritium? Does it go in a stack?

MR. GRAN: I don't know what specific monitoring they would be using.

MS. RADEL: We have a bungler system for measuring the tritium in that step.

MEMBER BIER: This is Vicki Bier, I have a few questions, some of which may be more appropriate for different days of presentation so let me know. First, the document mentions that there is capacity to hold waste for up to five years for the radioactivity to decay before shipment.

Is the anticipation that always will be held for five years or that it's going to be shipped out on a regular basis?

MR. GRAN: From the Staff's review, the third descriptions say that waste will be held for no longer than five years and then be shipped. I'm not sure if I recall anything about the shipping prior to that.

MR. MCSWEENY: This is Riley McSweeny from SHINE. We don't anticipate holding ways for the full five years, it's more of an upward limit.

MEMBER BIER: Is there a sense of do you plan to ship once a month, once a year, how frequently, and how much volume of storage would build up by then approximately?

MR. MCSWEENY: We haven't fully planned out how the shipments will be staged.

MEMBER BIER: Have there been conversations with local authorities about what the volume of stored material might be and they're okay with that? Or again, is that at a later stage?

MR. BARTELME: This is Jeff from SHINE. Actually, as part of the agreement of obtaining the land from the city, the city of Janesville reviewed SHINE's waste management plans as a condition of that land transfer. And they're aware of the volumes and storage times.

MEMBER BIER: Second topic with regards to aerosol releases, what is the prevailing wind direction? I assume roughly west to east and what's the nearest significant population, how far would that be?

MS. RADEL: We had covered that in Chapter 2.

(Simultaneous speaking.)

MS. RADEL: -- look back at those notes and get back to you on that one.

MEMBER BIER: I can go look that up. Thanks for the reference.

The last question, which I'm guessing is probably best deferred until the human performance presentations, but it strikes me that everybody dealing with hazardous radioactive material has two somewhat schizophrenic jobs.

One is persuading everybody that you have it all under control and RC, local county, reporters, et cetera, and the second job is making sure the Staff does not get complacent. And those two really work at odds with each other in a sense.

The same day you're telling somebody don't worry, we know what we're doing, you have to be telling the Staff, hey, something could have happened at any moment, don't take this for granted.

So, what thoughts have been developed for dealing with complacency as a possible issue? And it's totally fine if you tell me, hey, we'll just discuss that under human performance.

But I wanted to raise it now.

MR. BARTELME: That's something we can discuss in July in the conduct of ops discussion. We can see if we can put some information in there about dealing with complacency, like you mentioned.

MEMBER BIER: Super, thank you.

CHAIR BALLINGER: Other questions from members or consultants? Steve Schultz?

DR. SCHULTZ: Hi, Ron, this is just a question perhaps for the NRC for Zachary. You described the programs associated with the ALARA program, employee radiation protection programs and so forth.

The documentation has presented the

programs in concert with the regulations associated with the timeframes, one-year reviews of the ALARA programs and so forth.

Is the Staff anticipating and discuss with the Applicant any special programs associated with startup, more frequent reviews of these programs in the first year of operation as an example?

MR. GRAN: I didn't know if that was a question you wanted handle, Mike?

MR. BALAZIK: Yes, this is Mike Balazik, NRC Project Manager. At this point, no, we haven't had those discussions with the Applicant on changing it any frequencies for the startup program.

But we will be presenting the startup program later this summer. I'll look forward to that, thank you.

MEMBER BIER: I realized I have one additional question. Sorry about that.

In the discussion of potential failure modes for FVZ4, I believe there's a discussion that there is not a risk because of pressure differences in the system that you're not going to get flow in the direction you do not want.

And is that pressure maintained actively by electric power or something or is it an inherent feature of the system design?

MS. RADEL: For clarification as far as the pressure difference, are you talking about from inside process piping and tanks and systems to the outside? Or between parts of the process systems?

MEMBER BIER: Yes, releases to outside environment I believe.

And it says pressure gradients, the response to information request says, create flow patterns that direct air towards areas of increase and contamination potential and not to places with easy access to the used.

And I think that is Page 4 of the ML 2109 something or other. I can follow up later if need be.

MS. RADEL: I believe that's referring to our HVAC system, which will be covered as part of today.

CHAIR BALLINGER: Additional questions? Hearing no more questions, thank you very much, we're all set there. Now we need to switch to Chapter 9 and SHINE is up first.

Are we ready to go?

MR. BARTELME: I just need a minute to turn the room over until folks in the room check out.

CHAIR BALLINGER: Should we take a small

break?

MR. BARTELME: It'll be 30 seconds, we're getting everything set up. We should be all set to go here on the SHINE side.

For Chapter 9, auxiliary systems, we've got Tony Palumbo our systems engineer presenting on ventilation systems, Cody Fagan, our tritium engineer presenting on our tritium purification system, and Eric Edwards our chemical process systems manager presenting on during the solution lifecycle, the vacuum transfer system, and our gas management system.

So, with that, I'll turn it over to Tony to get started on the ventilation discussions.

MR. PALUMBO: Hi, everyone, I think everybody got that my name is Tony Palumbo. I'm the ventilation engineer. Starting with the first slide here, let's look at the production facility ventilation system.

As you can see, the system is breaking down to the subsystem screen, ventilation zone 1 is broken down into a recirculation and exhaust subsystem. Ventilation zone 2 is broken down into a supply and exhaust and a recirculation subsystem.

And then we have radiological ventilation Zone 3 there at the bottom and that consists of transfer ducts that we'll get into in a little bit. Underneath that, you'll see the non-radiological area for ventilation system and its subsystems.

We call that one an FVZ4, a facility ventilation zone 4, that consists of a supply exhaust and recirculation substance. The next slide, you'll see this is a breakdown of our zones and areas served from RVZ1, 2, and 3.

Those are our radiological ventilation zones. You can take a look but you'll notice that we've got this set up in a way that we're going from areas from the least amount of potential to the areas on the right, all the way to the left, which is the RBZ1.

So, you can see just the highlight areas here, we've got the IU cells, the tog cells, the left is what we call a super cell. The TPS process equipment, TPS disillusion tanks, prep tanks, glove boxes and primary closing cooling system and expansion tank.

Zone 2 there, areas are general zones, those are normally occupied areas in the RCA. And again, Zone 3 you'll see those transfer areas that should be received the emergency access to the labyrinth.

From a high level, this gives you a pictoral view of how the radiological ventilation zone is served. You'll see I have some boundaries on there and when you start over on the right-hand side of your screen, that's the non-RCA Zone 4, that is FVZ4.

That transfer is cascading air into the RCA through RBZ3 that you see there in blue through one of those transfer paths. I have it laid out as the RBZ transfer path and that's cascading into Zone 2, which is our generally occupied area.

There was a circulation unit inside Zone 2, we have couple of those and then the air once again travels from that zone into the RBZ1, that's only one space. You see that over there in red.

Do we have any questions on that?

MEMBER HALNON: This is Greg, tell me if this is better handled in July when we talked about fire protection.

If you have a fire in the non-RCA zone in Zone 4 or in Zone 3 or even in Zone 2 for that matter, you had fire dampers and the system shuts down on a fire alarm, and the second question would be how would you inject the smoke? Or maybe you don't.

Using ventilation, how would you inject the smoke?

MR. PALUMBO: It's a little hard to get there but, yes, we do have fire dampers at all of our different fire boundaries.

MEMBER HALNON: The second question is, is the system designed with the smoke ejection mode or is that going to be manually done by fire brigade?

MR. PALUMBO: No, sir, there is no active smoke handling.

MEMBER HALNON: I didn't see it so I thought that was the case.

MR. PALUMBO: These are radiological ventilation system functions. We've listed the non-safety-related functions of the RV system and that's just to provide that ventilation and air conditioning to the RC environment to the workers.

We've moved down into the safety-related functions for the ventilation system.

You'll notice that the Zone 1 exhaust, Zone 2 exhaust, Zone 2 recirculating and supply right there, they have safety-related functions that the 1 and 2 exhaust provide locations for that in-duct fan monitoring 2 provide air flow.

That's air flow leaving the RCA portions of that one exhaust, two exhaust, two recirculating and two supplied, they provide redundant isolation in the form of volatile dampers and they make up a portion of the confinement boundary.

And those dampers under the exhaust supply air flows, they will isolate when signaled by the safety activation systems.

Below that you can see radiological ventilation zones recirculating, that's a closed system in the RCA and extends to the confinement boundary of the IU in the toggle cell.

Below that you see the RVZ3 portions of the ventilation zone 3 provide that same redundant isolation. You have volatile dampers and they make up a portion of the RCA boundaries. That system also isolates the signal of the safety actuation system.

If we go to our next slide here, this slide gives you a couple of images. This is a radiological ventilation safety-related flow path so you're looking at those safety flow paths.

On the left, we highlight our point out the IU cells and the TPS exhaust. At the bottom of that image on the left would be our irradiation unit cells. You'll see two valves in there.

In the cooling room those are isolated, those are redundant safety-related valves for that train, then you'll also see that as all connected at a point to the ventilation zone 1 exhaust supplied from there.

In the center you'll see the RSC is supplying the exhaust at the boundary. This is the RCA boundary.

So, here I'll note for you once again there could be tornado dampers and fire dampers at the boundary and what I've highlighted in red here, those are the bubble side dampers and those are the safety-related patchworks that form that isolation at that boundary of the RCA.

On the right, we have super salt supply and exhaust, that's being supplied up on the top of that image by a ventilation Zone 2 recirculating. We're reconditioning some of the air inside of the RCA and we are using that, it's going through the super cell.

You'll note the two dampers on the inlet side and the two dampers on the outlet side of the supercell, those are safety-related. And then you have the radiation detection on that as well and that's ventilated to RBZ1E, or the Zone 1 exhaust.

It comes in from the recirculating and goes out to one exhaust. Then we have the non-radiological area support systems that just highlight some of these for you real quick.

This would have been that green zone outside. We have FBZ4 which is that ventilation system zone 4 that provides ventilation air conditioning exhaust, return amber circulation and that's in the non-RCA portion of the building.

That just conditions that space for the workers.

The FBZ4 and RBZ2S, so the supply units for both the radiological side and the facility ventilation, they're provided their cooling water by the facility's chilled water system and then we also have each of those units that's served by the facility heating water system.

That heating water system does extend to someplace outside of the RCA for other coils because different areas of space may need it. Those are our non-safety-related functions right there.

MEMBER DIMITRIJEVIC: This is Vesna. I have a question which I asked a little or was connected to electrical system. Most of your sensitive answers are just to provide this relation, right?

Do you have in the loss of information, like for example cooling of electrical area, did you ever consider that could initiate some loss of electrical systems for the operation of the break?

Actually, would anything happen in the plant if you lost ventilation?

MR. PALUMBO: The system is designed, FZV4, for loss of power to keep airflow in our battery rooms in our EPS room. Other than that, our facility is safe by design. If we have an issue, we isolate and let the radiological area of elevation secure.

MEMBER DIMITRIJEVIC: Your normal 480 volts switch gas, ABCD, where are they located? In the switch gear rooms? Do those areas of the UPS need cooling?

MS. RADEL: As Roger stated earlier, there is a calculation that was out ventilation, after ventilation, in those battery rooms that the heat-up would not exceed the design temperature of those units.

Does that answer the question?

MEMBER DIMITRIJEVIC: Even during normal operation when you have all the loads and things like that, there is no -- basically, if you lost information, the plant will come to you operating normally, that's my question.

MS. RADEL: As far as the operation of the batteries, that air is normally conditioned. If we lost all flow in our ventilation systems, we would be monitoring temperature and if anything was unsafe, take action.

I don't know if Catherine is on and wants to speak to any procedures that have been drafted to that effect.

MS. KOLB: Yes, this is Katherine Kolb from SHINE. We don't have -- or I would have to go check and see what procedures we have for responding to a loss of facility ventilation.

But we have no tech specs related to required temperatures because of the heat-up calculations that Tracy has mentioned and Roger mentioned earlier, that it's not required for safety.

If we did lose ventilation and didn't also lose offsite power, it was a loss of complete offsite facility ventilation without the loss of offsite power, things would heat up. I'd have to check what our draft procedures say in that event.

There's no requirement or tech spec limits around those.

MEMBER DIMITRIJEVIC: Thanks.

MEMBER BIER: If I can have a quick follow-up on Vesna's question? This is Vicki. One of the main purposes of the ventilation is to keep the batteries cool is the anticipation that heat-up would cause an immediate battery failure. Or is it just going to lose battery life in the long-term?

MS. RADEL: The heat-up path shows that without ventilation it doesn't exceed the design temperature so I guess we didn't evaluate beyond that. I just want to note that we do have redundant --

MR. PALUMBO: Those are redundant air handling units, because E4 are the radiological ventilations. So, each one of our supply units are 100 percent redundant.

DR. BLEY: Okay, Vicki?

MEMBER BIER: I'm good for now, thanks.

DR. BLEY: This is Dennis Bley. I have to admit a knowledge gap on my part. I think I heard you talk about tornado dampers, if that's what you said, I'm guessing they're there to prevent a low-pressure outside the building from damaging or overpowering your ducts or ventilation system.

Is that correct?

MR. PALUMBO: That's 100 percent correction.

DR. BLEY: I don't think I've seen those before but thanks.

MR. PALUMBO: Anymore questions on ventilation before we move on to the tritium purification system? Go ahead, Cody.

MR. FAGAN: Thanks for the opportunity to talk. Like I was introduced before, my name is Cody. I'm one of the trading engineers here at SHINE technologies so I just wanted to start off with what the tritium is and does.

It's a very simplified block diagram here shown on the right, essentially, the purification can be broken into three sub-units, the tritium handling system that is designed to deliver or cover and store purified isotopes that are moved around the facility.

The secondary enclosure cleanup system, which is a support system for the TPS glove box which houses the THS subsystem that maintains that environment inside the glove box to reduce tritium contamination from building up.

And the very subunit would be vacuum and impurity treatment system, also known as ITS, that is an additional support system for both the THS and the newfound vacuum assembly for decontamination and material supply as well.

We'll walk through and break down each of these slides.

MEMBER PETTI: Just a quick question. Remind me, your little box, IU of N, that means it's one system for all eight, right?

MR. FAGAN: No, we have three systems with the first one moving two IU cells and the remaining two systems each serving three. So, that's just representative of NEI cell where the cell is serviced for that particular train.

MEMBER PETTI: Physically, how big is the glove box?

MR. FAGAN: It is I believe eight feet long by standing on top of a spring, about six feet high.

To talk a little bit more in-depth about the tritium handling system, the THS was designed to store, deliver, recover, again purify isotopes. We store tritium and deuterium that it's mixed with in double wall tritium uranium meds as a solid metal tritide.

So, that before was UT3, that is considered a solid form due to the process of hydrating.

The tritium is delivered to the end that's targeted by the group to maintain the desired target concentration to support fission neutron products being mixed tritium with deuterium is the cover from the NDAS.

You can use non-mechanical cryogenic pumps. We started through a few other additional filters such as a permeator for moisture and dryer bed. And then we isotopically purified that gas using a process called TDOT or thermal absorption process and recycled that back to the target loop.

So, essentially, it's a feed volume and then a return volume in purification to maintain the desired target concentration. The TDOT process equipment is housed inside a credited secondary barrier, that's the THS glove box that we just talked about.

That does make up part of the credited treatment.

MEMBER PETTI: Just another question. I know DU has been used for a long time in the tritium community for storage tritium. But did you guys look at all at the Japanese technology? It's been a while since I've done this stuff, Zircobalt, I think?

MR. FAGAN: This is historic media. UT3 does have the highest density of storage. There are other advantages as well. You cannot generate significant pressures if you don't leave for this system.

Other things such as titanium, what the Canadians used, and palladium also exists as storage media, I think they have their advantages and disadvantages but we did pick the tried and true UT3 that gets us high density for storage, relatively moderate solution temperatures in high density.

MEMBER PETTI: Thanks.

MR. FAGAN: The subsystem that helps serve as the tritium glovebox is the secondary enclosure cleanup system.

Its entire job is to maintain the dirt environment inside of that glovebox, which helps to reduce the impacts of product or acute omission by releasing that gas over a series of tritium capture beds.

So, in that series, the first bed removes any reactive permit D.C., water and oxygen for the glovebox of these D.C.s are actually to migrate through the material in the membrane.

That can stimulate the out-gassing of tritium from surfaces that are inside of the pump box. That's a phenomena known as humidity release. By cleaning out those DCs, we keep that well over acceptable limits.

Tritium is removed from the inert gas bad so after we removed out the water and oxygen using iron beds, that's a different type of hydrating material, using a stream opener for the gas to return back to the glovebox.

And we can actually assess the reduction factors by taking the difference between an inlet monitor and an outlet tritium monitor and capable of changing the loop to circulate to gain even greater initiation factors.

As part of that, the SAC is forming part of the tritium confinement boundary along with the glove box itself.

The last fact I'll talk about for the TPS system is the vacuum impurity treatment system. The first side of it, the vacuum side, allows us to treat the vacuum so the process gas rejection from the tritium handling system.

It allows us to pull 10 to the minus 9 TOR so we can maintain very high levels of accuracy inside those THS process lines. We again use the hydrate bed, that's the same as the SCC, to reduce tritium. Having large factors, that was replaced through the loop.

The second part of it is the KTS side if you will. One gets split into two, so effluent, that is mixed, can be sent to either the exhaust waste stack, which Tony alluded to a little bit earlier, or we can send that to the ITS tritium reduction. What that does is it allows us to treat it in the vacuum system.

If it still maintains a high level we can recirculate and if we really want to get it clean, we can send it to the ITS for further reduction. The ITS also submits our cases with the NDAS by receiving mixed air effluent.

So, the vacuum side is meant for inert effluent and vacuum effluent, the mixed air side of things will go to the IGS, which decontaminates by flushing and oxidizing any elemental hydrogen that may come has mixed air and capturing, which is HTO on the left.

The ITS is also designed to support the material in rapid cleanup and vacuum element of the same manner where you have quantities of tritium and you can treat it for that as well.

So, just to talk about some of the safety-related equipment within the TPS scope. We've mentioned the glove boxes of low-beacon boundary for confinement of tritium inventory.

We also have isolation valves. Any of the penetrations that are not in that boundary, so quantity of actuation can isolate these highest risk inventory to that confinement. So, it's time spreading around the facility.

We have glovebox tritium monitors that sit on top and communicate directly with that environment that monitor for release activity from inside of the glovebox. There are target chamber supply and exhaust pressure monitors on the lines that go to the high cell.

They're redundant as well and all of our safety equipment is redundant, except the glove box in this case.

The pressure valves they're looking for a breach of vacuum and the TPS exhaust is still stacked monitors which are kind of shown there on the two-facility stack line monitoring floor excess tritium release from the ITS.

And then that would cause an isolation event as well.

DR. BLEY: This is Dennis again. It's a small thing but since I didn't know about tornado dampers, since you have them, I assume they sense a low outside pressure is when they shut.

Do they have some kind of throttle function so you can maintain your ventilation zones inside or do they just shut you up completely?

MR. FAGAN: The tornado dampers are a passive device obviously.

They're, of course, closed by that differential that you're talking about but it's a high enough differential where we're not looking at those closing during operation, I guess is what I would say.

DR. BLEY: If they closed, you waited too long but you're going to shut down right away.

MR. FAGAN: Yes, you would get an upset condition in the ventilation system if those were to close and then we would follow our standard safety procedures from there.

I think I get it. At some point, when you talk about how you're going to operate this system, is it likely you'll talk about that at all? Maybe the members are familiar with this but I'm not.

MR. BARTELME: This is Jeff, I don't expect that would come up in future topics. I wouldn't expect so, no.

DR. BLEY: Let me just ask one last question about it then.

I think from what you're saying if weather forecasts show you're likely to have a tornado in your area, you would shut down so that these things wouldn't lead you to a shut down while you operate.

Is that a fair guess?

MS. KOLB: This Catherine again. We do have draft procedures for responding to events for offsite issues like that. We would have to check and see what specific provisions we put into them.

But we do intend to have instructions for the operators on what to do in the event of tornado watch, tornado warning.

DR. BLEY: My guess is still that you wouldn't wait for the dampers to slam shut, you'd try to get ahead of it? If at some point, that was more about that, I'd appreciate it but it's not a key issue.

MR. FAGAN: The last slide on the tritium purification system. Any additional questions on the TPS before we move on to trend solution lifecycle and the tritium transfer system?

With that, I'll turn it over to Eric.

MR. EDWARDS: This is Eric Edwards, the chemical process systems manager at SHINE. We start talking about the target solution lifecycle in the back of the transfer system. The target solution, there's a low-enriched uranyl sulfate solution.

SHINE receives uranium and stores it in the uranium receipt and storage system or USS in racks that are designed for criticality safety.

If the uranium is metal and the URSS is to convert the metal to uranium oxide, uranium oxide is then dissolved in the target solution preparation system or TSPS.

After dissolution of uranium is stored in the target solution preparation tank until it's ready to be staged for radiation or used for makeup. When writing for either of these purposes it may be transferred to the whole tank and the target solution stage consists of TSSS.

Once the target solution leaves the preparation tank, there's no means for it to return to the TSPS. All the solution prepared in the preparation system insists on fresh uranium.

After staging the whole tank, the target solution is transferred into a target solution vessel for radiation. Following radiation, the solution is dumped into a target solution vessel dump tank and then transferred into the hot cell for isotope separation.

While separation occurs, the solution is typically returned to a whole tank and the target solution staging system for subsequent radiation may also be set to the target solution storage tank for the first two radioactive liquid waste and the radioactive liquid waste storage system that we discussed just previous to this.

Next slide. At the end of solution life, it is processed through the radioactive liquid waste storage system where it's blended down where its other waste streams, and then solidified in the radioactive liquid waste mobilization system.

Solidified waste is then served in the material access building prior to equipment offsite. We just talked about that a short time ago. Next slide.

Now shifting a little bit back to the vacuum transfer system, the vacuum transfer system or VTS consists of vacuum pumps to create vacuum and a backup pump that also serves as a vacuum reservoir, vacuum lift tanks that move solution around the facility and the associated piping components and instrumentation.

There are two different patterns that connect to the backup pot, which again is a source of vacuum, one with components that contain target solution and one with components that do not contain target solution.

A vacuum transfer system transfers solution multiple ways. The first system transfers solution to oil tanks and gravity feeds its next location. It may perform this in a single lift or staged lift.

The second method is to open a path directly between the source of the destination tank and put the vacuum on the destination tank. In addition to transfers, the vacuum transfer system provides vacuum services to other RPM systems and provides an interface for sample solutions.

A vacuum transfer system is designed with favorable geometry components analyzed for criticality, safety, and liquid detection is also used to prevent inadvertent criticality.

This includes automatic shut-off balance that prevent liquid from reaching the backup pot. Vacuum transfer system equipment that is required to survive a seismic event has been analyzed for that design basis event.

Our engineer safety feature for actuation, the vacuum transfer system opens the atmosphere, preventing further transfers of radioactive liquids.

The vacuum transfer system is designed to prevent liquid from flashing a vapor by monitoring the temperature of the liquid transfer. The location of the equipment is hot cell and below grade.

This is the last slide of the target solution lifecycle and vacuum transfer system. So, are there any questions before we move into the pressure vessel event system and maybe the other gaseous systems?

CHAIR BALLINGER: This is Ron Ballinger.

I have what might be a dumb question but is vacuum transfer of solutions, all of these solutions have a vapor pressure of some kind and is there a chance that this could encourage collection of stuff within the lines themselves, which amounts to a hold up the train?

MR. EDWARDS: We're not anticipating any hold-up from the vacuum lines themselves.

CHAIR BALLINGER: I've tried that in my lab before and it didn't work.

MS. RADEL: We have done some prototype testing of the system. The system has also been a layout design to gravity during back to certain takes depending on the location you're looking at.

MR. EDWARDS: That's another feature of

the knock-up, once you get that part of that, purpose of the backup pump is to down most other things to prevent and train with the droplets in particular to reaching the vacuum pumps themselves.

And then that liquid can be transferred back into the system from that point too.

CHAIR BALLINGER: I don't think I'd be concerned too much about droplets as much as I would be concerned about precipitation or stuff on the pipes. It's always water?

MEMBER MARCH-LEUBA: It's a water solution of uranium nitride.

CHAIR BALLINGER: It's a water solution of uranium.

MEMBER MARCH-LEUBA: It's mostly water.

CHAIR BALLINGER: It's mostly peaceful. Thanks.

MR. FAGAN: Any other questions? Next I'm going to talk about the pressure vessel led system and then nitrogen perch system, process vessel event system.

The process vessel event system collects and treats gases from the processes and this morning productions facility before releasing to the FAC. These processes include venting from the radioisotope production facility tanks.

Gases discharge from the vacuum transfer system, gases discharge from the TSB off gas system, exhaust gases from the BTS vacuum pumps, sleep gas, nitrogen perches, and pressure relief.

While there is upstream of the Staff pull flow through ventilator tanks in order to remove hydrogen and create radiolysis to maintain a slight negative pressure in the tanks.

The process vessel event system was designed to condition these gases in order to improve the reliability of the down-tier equipment which I'll talk about shortly, filter particulates from the effluents, capture radium iodine, and a lot of the radioactives in krypton isotopes to be indicated before release.

Here we have a flow diagram and I'm just going to discuss it and then go into similar information. Here you see the tank at the bottom so we click on condensers and I'm going to walk basically from left to right here.

On the left there is a condenser and the re-heater, then there's the HEPA filter and the garden beds. On the bottom there's also a pump to return that condensate to our process.

The gases collected by the process vessel first enter the filtration system and this works to condition the gases for particular radio iodine. And that's the dark on the right.

The first section of the system consists of condensers to condense the water out of the gases, re-heaters to heat the gases back up because they're condensed by chilling them, a condensate tank to collect liquids, and a pump to change the condensate.

The next section has an acid absorber to remove acidic gases and another filter to remove particulates from the stream.

After exiting the HEPA filters, the gas goes through the garden beds, which move the radioiodine prior to entering the delay beds, which we'll talk about next.

This filtration tank is located in the hot cell with the exception of the garden beds, which are located in a separated vault.

After leaving the filtration skip, the gas travels into delay beds that delay radioactive xenon and krypton from being released until they are sufficiently decayed to acceptable limits for 10 C.F.R. Part 20.

There's a final HEPA filter to remove any particulates early. Because the delay beds are filled with carbon trailers, they are distinctly different from the delay bed in the case where fire is detected.

The delay beds are located on a separate valve and subsequent equipment, including the HEPA filters and blowers are located in the facility mezzanine.

And then we have a safety-related backup system for the venting, that's called the nitrogen purge system, which is there to provide sweep gas to each system to control hydrogen concentration in the case of a failure that would affect the process vessel event system or the TSV off-gas system.

The nitrogen purge system, or NPS, is actuated by the engineered safety features actuation system on loss of normal power or loss of sweep gas flow.

The system stores sufficient nitrogen to provide sweep gas for three days. The nitrogen purge system consists of an above-grade reinforced concrete structure that houses high-pressure supplied to be extended for the nitrogen gas.

These tubes are folded together so they'll activate a simultaneous supply of nitrogen. The system also includes isolation valves, regulators, relief valves, pressure instrumentation, and the piping and tubing for transfer of the nitrogen gas.

The structure is designed to withstand the impact of tornado missiles and the design basis earthquake. It's located in an area where non-safety-related components, for example, a facility could not impact the housing or operation.

Nitrogen purge system uses the pressure vessel system piping and components for portions of the flow. A safety-related exhaust point is opened for N2PS actuation in the case that the N2PS flow is stopped due to an issue with the normal exhaust point.

That's the end of I believe the entire Chapter 9 presentation. Are there any other questions on this section?

MEMBER SUNSERI: Yes, this is Matt Sunseri. I have more of an observation than a question and it follows this nitrogen purge system.

So, there is a proposed tech spec that identifies that if fewer than 11 storage tubes of pressurized greater than 2100 PSIG or if the purge system is not available to deliver 1600 standard cubic feet of the sweep gas, then you have to place all your radiation units in Mode 3 with equal routers and then restore the system to operable in each tube.

To me, it sounds like you're expecting 92 percent or greater availability of this system and what this risk is all of the operation of all the irradiation units.

So, if you can't maintain that, your second bullet that on the previous page really -- oh, no, the second bullet on this page identifies the challenge. There's a lot of components there that have to be potentially flawless to maintain this reliability of the system.

My comment is I think you have a little bit of a vulnerability there because maintaining a nitrogen system to that high reliability might be challenging for you.

So, the so-what would be it's not a safety issue, we just shut the units down. But the nexus to safety could be if it really turns out to be not a very reliable system, then you could be unnecessarily cycling these units, which then could introduce a human performance challenge.

So, that's my observation. My comment would be it might be prudent to look at this tech spec and see if you can gain any additional margin. If there's only 10 tubes available, do you have to shut down all of the units or do you have to shut down a fraction of them?

I don't know, the system works in tandem, maybe you can't do that. I would just offer that might be an area to look at to see if you could get some more margin in your facility.

That's all I have.

MR. EDWARDS: Thank you, we wrote that down.

MEMBER HALNON: This is Greg, I've got a question. Back on the air treatment systems you have with the HEPAs and the charcoal and whatnot, do you know what standard you'll be testing those to, or manufacturing and testing those to?

Do you know what standard you're going to using? It used to be ANSI 510 or N510 but I think that's been superseded over the years.

MR. EDWARDS: I don't know offhand, I don't know if anyone in the room knows offhand but it's something we could get back on.

MEMBER HALNON: I'm just curious. It goes to you have a lot of filtration and whatnot, and a lot of testing needs to be done according to the current standard.

I'm interested in how you're going to manufacture the appropriate testing points and how those systems can be tested while online, offline, those types of questions.

MR. EDWARDS: Is there a question specifically about the HEPA filters or the entire skid?

MEMBER HALNON: It's specifically probably, based on my experience, the charcoal and the HEPA filters.

MR. EDWARDS: AG1.

MEMBER HALNON: Is it AG1? That's the most recent one, is that what you guys are testing to?

MR. EDWARDS: Yes.

MEMBER HALNON: And then I assume there would be appropriate testing points put in there so that you could do that either online or in the outage, depending on where the system is, I guess, is that correct?

MR. EDWARDS: It won't be a regularly scheduled activity but it will be possible.

MEMBER HALNON: Remote instrumentation, did you determine whether or not the DP on the HEPA filters need to be replaced or is there a roughing filter in front of that to help?

MR. EDWARDS: There is differential pressure measurement on it.

MEMBER HALNON: That's in the weeds in the stuff I know but it's interesting to be able to see how you're going to test these things and whether or not it's going to take an outage to replace certain portions of it based on the DP falls out.

So, if you're using AG1 I'm satisfied. Just out of curiosity, this is Walt Kirchner, how frequently will you have to -- I think those are underneath one of your shield plugs.

How frequently will you have to change out the HEPA filters?

MR. EDWARDS: They're in the supercell so they'll be replaceable by manipulator.

MEMBER REMPE: I believe Member Kirchner asked how frequently you're replacing them and you responded back how you're replacing them. Do you understand still need a frequency, Walt?

MEMBER KIRCHNER: It's more curiosity. The expectation is for --

(Simultaneous speaking.)

MEMBER KIRCHNER: I didn't have my mic on. I was saying, what's the expectation for changing out the HEPA filters in terms of a duty cycle?

MR. EDWARDS: This is Steve from SHINE. The current estimate is once a year because we know that will be replacing the assets in medium once a year.

MEMBER KIRCHNER: Thank you.

MEMBER BIER: This is Vicki, I wanted to come back to my earlier question about the HVAC and whether the pressure that is supposed to prevent significant air releases is created actually and requires a lot of power or if it's inherent in the system?

I don't know whether the people who are presenting now if they were here for the earlier question?

MR. EDWARDS: I wasn't here for the earlier question. Can you frame it one more time for me? I wasn't here for the earlier question.

MEMBER BIER: There was a request for additional information that dealt with -- I don't have it pulled up right now but a Z something. If somebody has it?

MR. EDWARDS: FZV4, facility ventilation 4?

MEMBER BIER: Correct. And there was an explanation that we don't need to worry about leases through that path because of pressure differentials that go the other way.

And I'm just trying to check do the pressure differentials require you to actively maintain them with electric power?

MR. EDWARDS: The pressure differential between FVZ4 and RVZ1, I spoke to earlier how we cascade that area into the facility, all of that is maintained by those exhaust fans for ventilation zone 1 and 2.

It is not a safety-related function of the system though.

MEMBER BIER: Does that mean those fans would not be provided emergency power on the uninterrupted power supply?

MR. EDWARDS: That's correct, that's how the system stands, yes.

MEMBER BIER: Thank you.

CHAIR BALLINGER: Other questions from members? We're getting towards the end. It's time for the Staff, is the Staff ready to go?

MR. KAIPINENI: Mike, do you have any opening statement about two reviewers here on this section?

MR. BALAZIK: No, Rao, this is Mike Balazik. No, Rao, just go ahead and Rao will be presenting most of the presentation but Joe

Staudenmeier is going to talk about the TPS.

MR. KAIPINENI: Next slide, please. My name is Rao Karipineni, I'm a reviewer in Safety and Systems Branch in individual safety systems. We're going to be reviewing the HVAC systems and the PBBS and the nitrogen purge system today.

Next slide, please.

These chapters were covered in Section 9A21 of the SAR. The SAR states that the RPF and the radiation facility systems are covered in different sections.

In actuality, when you go to the RPF portion of it, it refers you back to the radiation facility, claiming that these are all common systems and therefore, whatever is provided in Section 9A is in Section 9B also.

Therefore, we only cover the 9A Section. And then outside of the RCA, the non-RCA portion ventilation systems and the chill water systems, heating water systems also will be in this section. Next slide, please.

The facility has four regular articulation zones as we have heard many times today. The zones are determined with the idea that you want to procrastinate from areas of least potential for contamination to areas with the most potential for contamination.

So, in this case the three onsite RVZ1, RVZ2, and RVZ3, RVZ3 in some sense is really a transfer system officer outside into RVZ3 and then into RVZ2.

The RVZ1 systems is probably the pressure varies the least is what I mean, therefore, these areas that are RVZ 1E, meaning exhaust there, they're not directly supplied with any air into the same areas.

You would supply the area in a different portion of the building and in this case it is RVZ2 and by turning the RVZE system on, you would be natural pulling the air from RVZ2 into RVZ1 and that is the basis of how to move the air from one zone to the other.

There was a question about how these zones are maintained at these pressures from one of the ACRS members.

What I remember reading, and I didn't have time when the session was going on to go check back on it, what the SAR says is there are some pressure indicators inside the ducts.

That will be sending the signals based on the pressure differentials between the different AS of the buildings, whether to increase the flow from one fan or whether to decrease the flow from another fan.

This is all set up into the control systems, from what I understand and I was pretty satisfied with what was described there. RVZ4, that is the non-regular containing systems.

It has its own supply systems, exhaust systems, and recirculation systems, just like all the other systems have the recirculation and exhaust systems in RVZ2 and RVZ1.

The purpose of RVZ2 is to supply air into the main facility into the open areas basically, and sometimes, directly to RVZ2 and then the left hole air inquiry had that door but the other air quantity would move into the RVZ1A.

So, the way this whole system is set up, it is a once-through system. The RCA is a once-through system. You don't reuse any of the air. The entire supply to the RCA comes RBZ through supply.

All the MRA would be through the RVZ1E exhaust or RVZ2E exhaust or PBBS system. So, this way, maintaining the whole facility at an added pressure and making sure all the air going out of the facility is always going through all these filters is one of the good safety features of the full AC.

Next slide, please.

The external to the RCA, you have these two other systems, facility chilled water system, and facility heating water systems. The facility chilled water system serves the equipment located external to the RCA back.

It not only serves the FVZ4 supply system, it also serves the RVZ2 supply system and they can do it that way because the RVZ2 system is outside of the RCA and the equipment is located in a non-RCA zone.

So, both the heating and the air conditioning for RVZ2, meaning the RCA supply, is performed by this unit, the facility chill water and facility heating water systems.

Next slide, please.

We'll cover some of the isolations, et cetera, as we go and I have a few schematics from the FSAR to show in this session to get a better understanding. As you know, all the isolations are only in the RBZ, 1, 2, and 3 systems.

There are no isolations needed for the outside facility systems. Next slide.

In addition to the HVAC heating systems, we will be covering a little bit of the covered gas control and primary cooling system and covered gas control in the RPF, meaning the PBBS and the nitrogen purge systems today.

Next slide.

We are into tritium here, I'll skip this next slide.

MR. STAUDENMEIER: This is Joe Staudenmeier, I'm from the Office of Research. I'm going to be covering the tritium purification system review.

The tritium purification system, the main function is to supply pure deuterium and tritium streams to the neutron driver assembly system, and also separate the deuterium tritium gas mixture coming back from the NDAS and into pure deuterium and tritium streams and also remove any impurities in the streams.

The TPS equipment is all located inside the TPS room. The TPS room is exhaust to the RVZ2 exhaust system. That was that system, processes are performed inside gloveboxes to minimize exposure to workers.

The glovebox has its own ventilation system that's part of the RVZ1 ventilation system. Next slide. Another function is to limit the amount of tritium and waste streams exhausted to the facility ventilation system.

And finally, it's designed to minimize the release of tritium to the facility and environment during normal operations and design basis accidents and for normal operations it keeps the releases within 10 CFR Part 20 limits.

And a bit of information that's not related to this, I was asked before, I think the amount of a tritium that a can-do generates in a year is a bit over 100 grams per year. So, not part of this but some additional information.

That covers the tritium system. Next slide.

MR. KAIPINENI: These are the regulatory basis on the criteria that we looked at in reviewing these HVAC systems. The guys mentioned the 10 CFRs. We reviewed them for completeness and consistency between each other.

We follow any other guidelines we have in 1537.

The 10 CFR occupational dose limits individual members to the public, those were reviewed to ensure all of the requirements described in the CR are consistent with the assumptions made in the chapter zone controls of the system and Chapter 13, the accident review.

The actual results of those reviews will be provided in the Chapter 13 SC. But our intention is to make sure the systems are properly described and functions are clearly described and actuations are clearly described.

That's how we did it. Next slide, please. In addition, we also looked at the design criteria, we also looked at the isolation features and as I said before, we looked at the Chapter 7 review of these different accidents or events that are described.

And essentially, we made sure all the design features and the equipment that is required to be in the tech specs are actually included in the tech specs. These are some of the processes we followed with the end goal of concluding that they're all right, they're all consistent.

We don't have any other versions. Next slide, please. The summary of the application on these isolations and other issues, et cetera, we'll write that in the later slides looking at the schematics I mentioned before.

This is the RVZ2 supply system. You can see that the system is located in the non-radiological area of this.

We have an outside area coming in, going through the filters, the cooling and heating coils and then a ray of fans and then a humidification in case humidity is added.

And then it goes to a damper, which is the tornado damper that we discussed a little bit in yesterday's session, followed by the two buffer-type isolation dampers. The two S system is very small letters to see here but the cooling coil is applied by the facility 2R, like I said.

The heating system is applied by the facility heating system. The array of fans is something a little bit different than we have traditionally seen in the nuclear industry.

They include a bunch of fans, for lack of exactly knowing how many numbers they have I'll just say that. They operate in a little bit differently, fans dropping out, fans coming back on, needed, it helps that maintaining the pressures on everything makes it a little bit easier so you're not fighting with one big fan on that issue.

It could potentially have for six fans inside, I have no idea, but how many numbers they have there. They all have very low frequency drive on their walls that makes it a little bit easier to increase the speed and decrease the speed.

So, these features would help manipulate those pressures inside the facility a little bit easier. The tornado damper we discussed about the fact that it will close if the tornado were to occur.

A good question was brought up about the facility, what happens afterwards? The most safe thing to do is that you close that tornado damper, the tornado damper closes when there is a tornado.

After that design, that separated feature and it is there. As far as in the hybrid effects, the plant operations in the sense immediately what you would do, the longer of what you do, that I did not necessarily go into that because I felt that was a safe design.

It has been normal for the operating plants nuclear big plants to go into this anticipation of tornado, take some actions and all those things. But in a system like this, if you want to continue operating and make the radioisotopes that you want to do, and if you are on there operating it's pretty hard to stop that.

And so you're in a situation where we have to be ready for what would you do after that?

If a tornado in fact hits and it did not damage any equipment, if you want to restart the facility because the location of the tornado damper is such, it has to go through in some sense, a lot of pressure has to go through the units there and that potentially could damage that unit.

Maybe the filters get pulled off or maybe some of other thing gets pulled off in the equipment. Design-wise, it is needed tornado to have it. Operationally-wise, what you do is the other issue and that's open I guess, it can be out with the arrow here.

The regular isolation dampers, they're the RCA isolation dampers, all these systems have those two dampers when you go from RCA to non-RCA, and the signal that comes to it from the FPAS system closes all those dampers in the facility.

The most important signal is the track radiation model signal. If those send a signal, that eventually pulls a lot of equipment, not only the RCA, there are so many other pieces of equipment -- I'll list them later here -- they would close too.

So, that also in some sense, just like the tornado, what would you do right away? That's a different issue that needs to be probably addressed from the regulations side. If the isolation is there, that is a safe thing to do in the section.

These are some of the isolations described before. The top ones are the PCLS isolation from RVC1E system.

What that system is doing is there is a way they could -- any radiolysis gases in the PCLS gets pulled through the expansion tank, which is located in the PCRS cooling room, the IC cell cooling room, and it gets pulled to those two dampers, isolation dampers on a cover.

And if there is a radiation signal there, this doesn't clearly show where the area is, the dampers would close and you isolate the IEO. The good thing about it is if you can isolate it quickly enough, you have only one by you that you're isolating.

But if that is delayed and a signal goes to the stack eventually because you're talking about I already see 1E here, that may require RCA isolation. So, the local isolations in some sense help this plan to not isolate the earlier RCA if these react quick enough so the other radiation monitors in the stack did not react.

The bottom portion isolations are all the supercell isolations. They're coming from the RVZ2 S system, basically, but what the system has is after the air enters from RVZ2S into the generator area, there is another subsystem, cooling system, provided in the dock work, it's called RVZ2R, recirculation.

They have it close to I don't remember exact numbers but for five things like that at different points.

The reason for that is there may be some additional pulling required after the way it comes from RBZ2S so these would be the porters that could turn on and keep the facility at even a cooler temperature.

I don't know the exact technical reason of why a supercell would help by doing but if it is in the process it helps.

So, those colors pull the air, supply them into this supercell, and at the outside of this supercell you have a connection to the RBZ1E again and it all goes to the RBZ1A.

So, other than this two or three, most of the other exhaust points from the RBZ2 system comes from RVZ2E. I'll show that exhaust system in a second. Next slide, please.

It is the RVZ1E and RVZ2E exhaust systems so these are located, I'm trying to see here, the total crane is located within the RCA but the trends that are pulling the RA off this RVZ283 and RVZ1A, they're located in the cleaner side, in the non-RCA area.

So, it can be easier without any maintenance to be done and things like that, you don't have to worry too much about this. The filter frames have a little bypass there. This bypass can help them not shut down.

You have at least some cleaning of the filters or some small problem they have in those filters, et cetera.

This was a slight design change that was performed and I'm okay with it because the stacks and everything have one more variation monitors so for a short time they open the door or something and bypass those filters.

We thought it's not a big issue unless there's a response, then they'll obviously take some action about it. So, the two fans provide you the redundancy to the only two active components there.

So, if one fan goes you have another fan so that should not cause any problem. The filtration system itself is all past-use so it's unlikely that you will really get a problem or anything like that.

So, the design chain would help be comfortable and we don't have other issues than that. Next slide, please.

Let me just go back to one more slide, go back. Again, you see those two filter trains right at the separation between the two zones, RCA and non-RCA. You have a tornado damper and you have two isolation dampers in the RCA.

Again, if a tornado comes right by the side of the area where they have all this exists and the entries are, the tornado dampers, depending on how light the tornado is.

Next slide, please.

This is the FVZ, the outside RCA portion of the air conditioning system.

As you can see, the heating and cooling components of getting the water from the facility chill water and facility heating water systems, they have the facility chill water and the facility heating water systems.

The chill water system has two chillers and two pumps, almost 50 percent each, not almost, actually, they're 50 percent each. There are two pumps, basically on pump into this unit and another pump pumping it into RVZ2 supply unit, I just described it before.

The facility system is dealing with all the cooling parts of the HVAC systems to both the RCA and non-RCA with the exception of these small recirculation coolers I mentioned that are in the RVZ2ES system.

And those recirculation coolers, because they are in the RCA, the design used the RPCS2 water system, which is slightly different. This is a part of facility chillers, and the second part of the escorting chiller system that they have.

This system, the RPG system, unlike the main facility, this has a return damper and a return fan, you can see it in the very top.

Because this is non-RCA, it is pretty common to use the safety systems that way so you don't have to spend a lot on air conditioning and heating on all those things.

So, just a portion that is being imposed by different exhaust fans will be replaced from outside to the bottom line at the left, that's where the A is coming in. Next slide, please.

That's basically how the HVAC systems work here. The design is pretty consistent and they provide the features that will maintain the main facility that enable it to get different negative pressures.

And the FVZ part of it, there is a small requirement FVZ that they would maintain the pressure also there because the common portions, they will not want A to be any chance speaking out of the main boundary.

So, by maintaining a slight pressure there, you would actually have it going in only.

The RBZ 3 part, which I haven't really touched on until now, is sort of that system. You have a small dock port that passes through from RVZ3 to RVZ2 and there's air coming in from RVZ4 to RVZ3.

Also, they're just more dark. There are dampers in those transfer docks. If something happens that requires isolation of the entire RCA, those dampers also close by any unexpected way that somebody tries to go out.

The transfer docks, they have a backtracked damper there, almost like a check round, that would close and would not cause any immediate issue for the facility.

The expansion tank is designed to prevent radiolysis gases. I mentioned that a few minutes ago and also we have addressed that same system in Chapter

5 and 4 analysis in the last discussions with the ACRS.

The boxes are there freely but are not in my portion, I forgot to take that off. The PBBS process vessel event system and N2PS and the IBZ isolation also, I'll go into that. There's more on the next slide.

You see in this sketch for a few minutes ago, the PBBS in the top portion on the left side in the lines come in, the main PBBS line, you have the treatment of the gases due to normal operation to condense them and heat them a little bit more to get to better humidity levels and then go to the carbon, HEPA, carbon again, to have that system and come back into a single line.

At which point it enters into the below-grade delay beds, we have altogether eight delay beds, three plus three plus two. The system, the PBBS system, when PBBS is operating, it is operating based on those two little fans, the ambulatory fans.

They create the negative pressure for flow to travel through the PBBS lanes towards the fan. The PBBS lines come in from different tanks, et cetera, all those things. There is a small supply connection to all of them coming from RBZ2S system inside the facility.

A lot of times it is a small line going into the tank. There is a valve there, an operator valve, when the normal operation is going on.

If something happens to the PBBS flow, whether it is a stack issue or a fan issue, a loss of power, you would turn the system back to the automatic sign based on loss of flow and based on loss of power.

And the N2PS and the PBBS connections, those valves will close then and the PBBS valves close, and the other system valves open.

And the nitrogen gets going into all the PBBS lines with the past-due pressure and the push pressure coming into the PS system, just because the fans are not operating at the end here.

We are going on assumptions there.

So, that pressure pushes the flow to the filter trains. The whole treatment part of the system in those conditions can be bypassed, which is one of the lines that's created on the entire filters and the hitters, et cetera.

That can be turned on but you're going to get the loss of power and everything to happen, that's one way they can just bypass that and go straight to the delay beds.

MEMBER HALNON: This is Greg. That sequence you just described, is the timing of all those valves closing and pressurizing in NPN2, is all that really important or is it just simultaneously happening?

MR. KAIPINENI: The signal goes to those two valves at the same time, one is closing and the other one is opening. So, time-wise, I don't think that appears to be a big issue.

MEMBER HALNON: Thanks. I think it just all happened simultaneously and what happens happens based on signals, yes.

MR. KAIPINENI: The delay beds underneath, at the bottom of the skid, you see there are some bypass valves there so it looks like a TBB valve but the operation, they were added mostly because of the fire protection issues that were discussed in Chapter 13 I believe, fire personnel accident, that took credit for the ability to isolate any section of those delay beds and operate the remaining ones, which seems to be variable.

But there is the reason why they did it that way. The HEPA filter is there at the end, it is always there under both conditions whether you're operating under PBBS or 2PS.

Next slide, please.

This is a sketch I just want to show of the same thing we saw before. And on the very bottom on the left, the lines, there are two liens of those two. The top line, they show you the N2PS and the PBBS, the PBBS and the nitrogen purge.

And also, same way with the other ones here. These are happening and the inlet locations of the N2PS are the RBC2S. Those are the fractions that are one closes and the other one opens.

This has this continuous sweep flow going onto the thanks pretty much. Next slide, please. This is the nitrogen system basically that is in the basement structure right adjacent to the facility.

And there are two lines going up there, the RPF and et cetera going and making the connections to the PBBS lines basically, the larger manifold and all that stuff, and it fills in the connection at the bottom.

MEMBER HALNON: Before you go on, Member Sunseri put a caution out there that 12 tanks, only 1 in reserve, the 16 SCFM and the 2100 PSI, did you all have any concern with the system causing maybe excessive shutdowns based on the tech specs or did you feel the margin was adequate?

MR. KAIPINENI: The tech specs were very descriptive and a lot of numbers were there. I thought it was a very safety -- the safety caution done.

My thinking was if this system of getting these gases out is probably thought to be very important and that's why the client in this case, SHINE, has put himself in a very tight tech spec there.

And I thought it was good. The other part, like you said, the operations part, how we could possibly delay or shut down some of the equipment inside if it's up to the licensee to look at?

The quantity we are talking about is so small really, there's so many tanks and all these combined.

I guess the gas that was created 15 CFR both the mags and the tech specs have in fact places where individuals will in some places will measure and require, in fact, to be 1.5 or 2 CFM.

It's very small flows here.

MEMBER HALNON: That's the one piece that clearly has margin.

I think the concern was potentially what you said, it's a tight tech spec and every time you shut down the plant, you introduce additional operator actions that introduce additional risk relative to potential errors.

So, I think we've talked about and I think they'll look at it and maybe make whatever adjustments operationally they need to.

MEMBER KIRCHNER: This is Walt Kirchner.

One thing that struck me in a lot of these line diagrams, and maybe they're simplified, I see single point failure for this system. You have lots of redundancy in the storage tubes but you've got at least showing just one line to deliver the function.

MR. KAIPINENI: There is one line where all these --

MEMBER KIRCHNER: Come together?

MR. KAIPINENI: Yes, come together and go. This is a safety-related system.

(Simultaneous speaking.)

MEMBER KIRCHNER: -- for both reliability, functionality, separate the trains, just a thought. This works but it's vulnerable to single failure. There's no diversity or redundancy. You break that line somewhere and you shut down.

MR. KAIPINENI: Yes, if you break this line --

MEMBER KIRCHNER: Several of the other line diagrams, it may be they're just poorly simplified, I don't know.

CHAIR BALLINGER: This is Ron Ballinger. Another thought I have when I look at something like this, and it has nothing to do with sinking, is that you've got calibrate all these things all the time and you can't take any of these things off of service without shutting the plant down.

So, it wonders from a standpoint of having to have these things calibrated periodically whether that's an impact.

MR. KAIPINENI: Calibration-wise, it's because it has so many loops and everything there. They can work on one calibration at one time and isolation valves, et cetera.

CHAIR BALLINGER: Lot of pressure gauges and sensors.

MR. KAIPINENI: Right, more than the calibration, a more valid question might be is a safety failure created as something that needs to be assumed here? If we do break it, I don't recall now what the tech spec says on outage times for all these systems.

But we can look at that.

MEMBER KIRCHNER: If the architecture of these systems is like this, it may not be a safety issue per se because it may force you into a finite period of time to shut down but it sure could be a productivity issue.

My observation, maybe I should made this to the SHINE people, I was overall for all these support systems, I was a little bit surprised to see schematics with a similarity to this one where you had single point failure potential.

That's an observation.

MR. KAIPINENI: If you look at the design criteria to the point where how that applies to the facility here, in 29 it talked about many boundaries and RCA boundaries was one of them.

There was called a foot class boundary and the design satisfies it because you're closing these valves, the isolation is maintained and the boundary is maintained.

Provisions for testing and inspections, based on what we have seen in the drawings and the schematics and everything, we are satisfied and rolls up areas of radioactive materials as we describe with the isolations, et cetera, and the PBBC and the N2PS.

One of the radioactive releases that the points were there in the common stack where any other leaders were supposed to go through. We're okay with that. And the 39 hydrogen part, there were systems provided for the PBBS and into PS to do that, to do the functions needed.

Next slide, please. We already talked about the LCOs a little bit. These are the LCOs we all looked at, the supercell confinement dampers in CL3.4.4., 3.4.5, the IU boundary, the RF boundary I should have said.

The shield products and the RBZ 1R unit, the RBZ1R is a recirculation unit that keeps pulling the air from the radiation part, radiation cells, et cetera, and puts it back in.

And it was described as an extension of the IU boundary and the licensee actually included that into the consideration into the tech specs, et cetera, in that.

3.8.9 RCA isolation dampers, they were all used up and they're all there. And we also looked at the PBBS, N2PS 3.5.1 and 3.8.1. The reception of the systems and the actions taken and what they are testing, et cetera, we will find you that.

TPS portions have somebody, I guess, providing more on that. That's the end of my conclusion unless you have any questions.

MEMBER HALNON: This is Greg. There's a lot of ventilation that ultimately ends up in an F float released to the stack and I see that in the annual operating report there will be an accounting of that.

Is there an equivalent? I'm used to seeing an offsite dose calculation manual or program required. Is there going to be an equivalent program required to where that is anticipated and calculated before as a programmatic aspect?

MR. KAIPINENI: I did not notice any but that doesn't mean something is not there because there was such a large tech specs events in the systems in somewhat administrative procedures, et cetera, but we'll take a look at that and we have to get back to you on that.

MEMBER HALNON: The reason being the local health departments typically use that to see where and when they want to do samples to verify the effluent releases.

MR. STAUDENMEIER: They have committed that in offsite calculations.

CHAIR BALLINGER: I see two more slides, at least I think.

MR. KAIPINENI: These are my final conclusions. Like I initially said, the comparisons of these design features and how they're described in other chapters' control systems and accident analysis banks chapters, we have found them to be all consistent.

We did not find any anomalies or anything like that. Chapter 9 information tables brings that back which I have shown you. We have concluded they were all in accordance with what was described and what we conclude that to be acceptable.

Next slide, please. Based on what we have done, we found that they were described, the systems were described, in detail including the design criteria and the tech specifications based on what we find with the assurance.

The deactivating side and operating license can be conducted without endangering the health and safety of the public.

CHAIR BALLINGER: Can you go back to the delay bed picture? Let me see. That one.

MEMBER KIRCHNER: Just a question of clarification, once again I look at this line diagram and I puzzle. I'm having trouble making sense of it, is this just the schematic?

Where's the flow through the delay beds? How does it flow through the delay beds?

MR. KAIPINENI: The main line coming from the left side, let's say it was two lines. Valves would open, come inside to these two beds, and go past again into the main line.

MEMBER KIRCHNER: How does it go through the beds when the pipe is connected to the same line?

MS. RADEL: This is Tracy with SHINE. The beds are connected in series, this single point diagram does not show all of the valves within the system.

So, there's valves arranged such that it will flow through sequentially, bed 1, bed 2, bed 3, bed 4, bed 5, bed 6, bed 7, and bed 8 and go through all beds before exiting the facility.

The grouping that you see here is for isolation in case of a fire event as fast in the safety feature actuation systems that would isolate groups in that group bed and actuate the appropriate valves to bypass a group in the case of a fire event.

But normal flow is through all eight beds in series.

MR. KAIPINENI: Which gives you more delay time also that way in the design time.

MEMBER KIRCHNER: That's what I expected but this diagram makes to me no sense whatsoever. And it again points to one, if indeed that's what's intended, a break in the upper line that takes you out of business. If you shutdown, you lose production.

It's just not what I'm used to seeing for a system like this. That's an observation, not a request to change the design.

CHAIR BALLINGER: Questions from members? We are at the end of the open session and so we need to now ask for public comments before we go into a closed session if necessary.

So, if there are members of the public that would like to make a comment, please either unmute yourself or hit star 6 and make your comment please. Please identify yourself as well. That's for civilians. 10 seconds.

Hearing no comments, now this is the end of the open session. By my reading, we have slides for closed session for Chapter 11 from SHINE and Chapter 9 from the Staff but this is just what I have in front of me.

So, I guess my question to the members and to the Staff in China are do we need a closed session?

MEMBER MARCH-LEUBA: Chapter 9 is just a

picture of --

CHAIR BALLINGER: Yes, Chapter 9 is just one slide and Chapter 11 is quite a few, a lot of numbers.

MR. BALAZIK: This is Mike Balazik, NRC Project Manager for SHINE. No, we just had that backup slide just in case there was further discussions and we thought that we could use that to help promote the discussion. So, we don't specifically need a closed session.

CHAIR BALLINGER: Can we ask the same question to our SHINE folks? Five-second rule for SHINE. It doesn't sound to me as if we're going to need a closed session --

MR. BARTELME: We do have closed session slides to present on Chapter 11 on the radiation sources.

CHAIR BALLINGER: Right, do you wish to present them regardless of whether there are questions from the members or are there questions from the members that would require that?

MR. BARTELME: If there's no question from the members and no need to present the slides, we wouldn't need to, no.

CHAIR BALLINGER: I'm just trying to be

complete. Hearing all negatives, thank you folks, both the Staff and the SHINE folks very much for these presentations. It's been a long day and we're looking forward to another long day for the Subcommittee meeting.

I would remind members who have been assigned tasks to write little memorandums for us to start the process of constructing these memos to do the best you can to get them to Chris and I as quickly as you can.

But, other than that, are there any comments the members would like to make?

MEMBER MARCH-LEUBA: It's a question to you, Jim, do you have an updated template for the memos?

CHAIR BALLINGER: Yes. On the SharePoint site.

MEMBER BIER: Chris, can email you a template?

MEMBER MARCH-LEUBA: I can't find it.

CHAIR BALLINGER: It's there. Chris is not here, but I'm absolutely 1,000 percent, 100 million years penalty positive that it's there.

MEMBER MARCH-LEUBA: And it's called template?

CHAIR BALLINGER: Okay, so if there aren't any other comments or issues that need to be addressed, we are adjourned.

(Whereupon, the above-entitled matter went off the record at 3:27 p.m.)

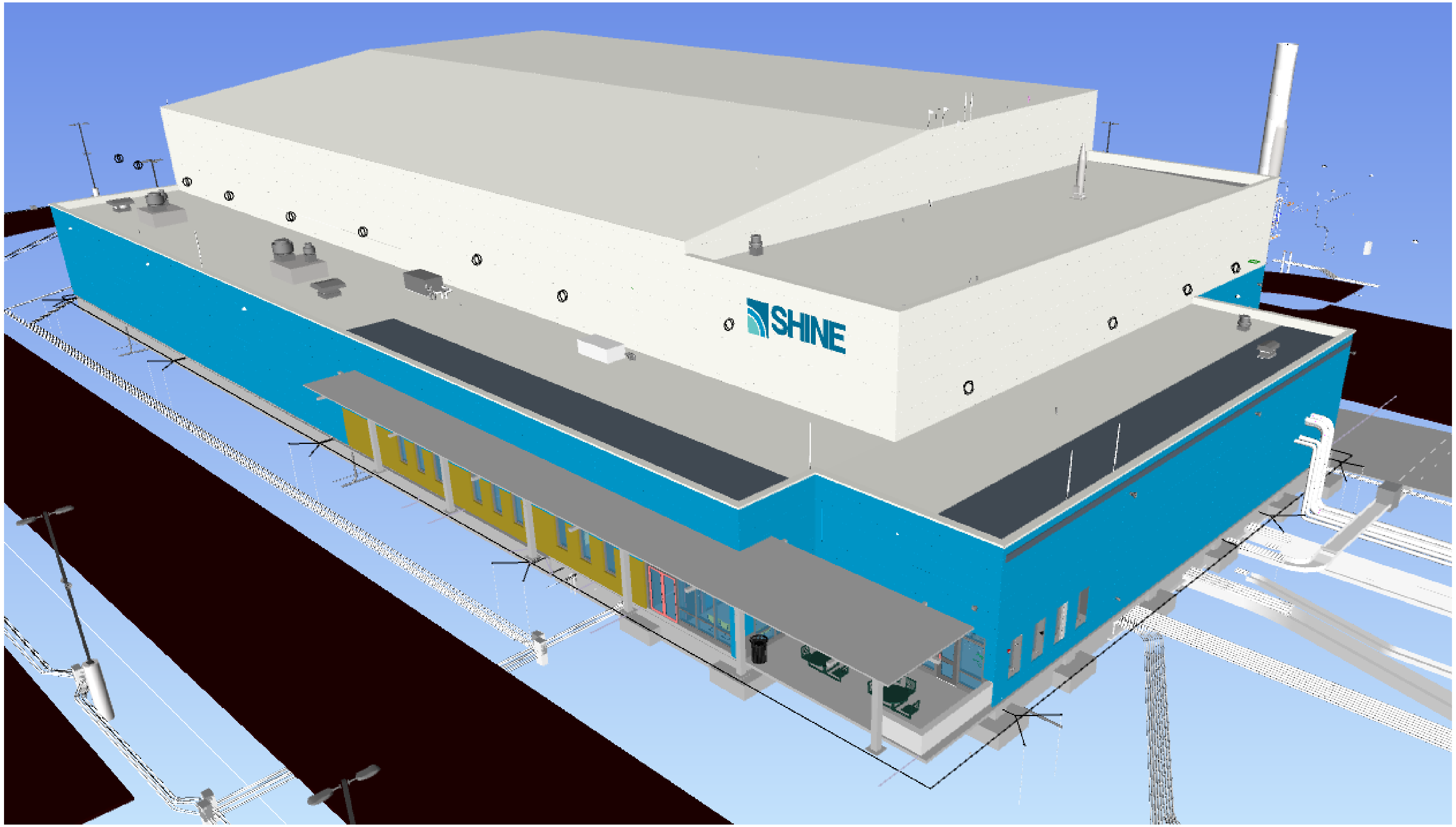
Chapter 3 – Design of Structures, Systems, and Components

MARC ANDERSON, STRUCTURAL ENGINEERING MANAGER, SARGENT & LUNDY

Outline

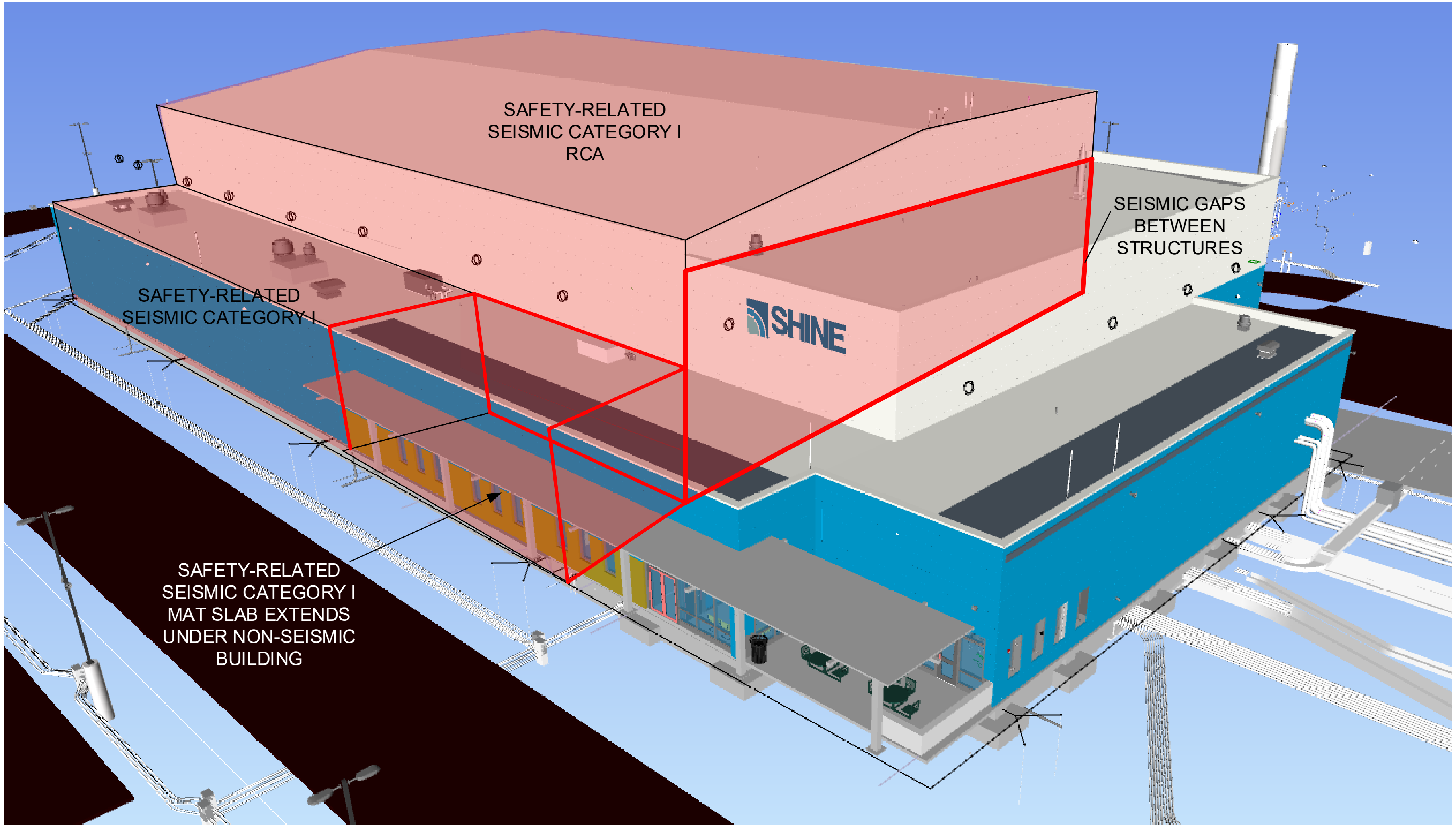
- Main Production Facility Structure
  - Meteorological Damage
  - Water Damage
  - Seismic Damage
- Nitrogen Purge System Structure

Main Production Facility Structure



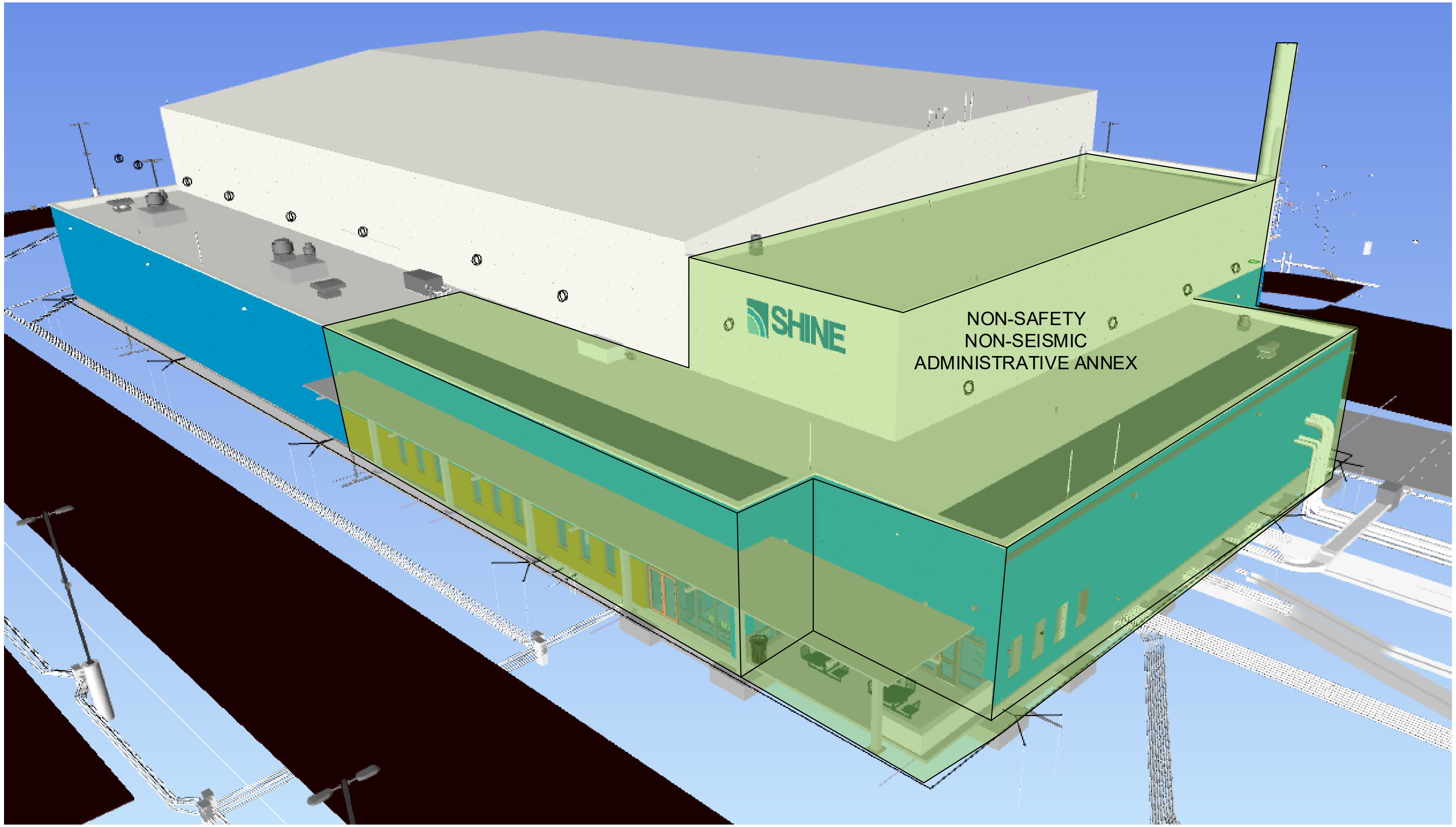
Main Production Facility Structure

SAFETY-RELATED AND SEISMIC CATEGORY I



Main Production Facility Structure

NONSAFETY-RELATED AND NON-SEISMIC



Main Production Facility Structure

METEOROLOGICAL DAMAGE

- Wind Loading
  - Pressure calculated per American Society of Civil Engineers/Structural Engineering Institute (ASCE) Standard 7-05
    - Basic wind speed of 90 mph adjusted for 100-year mean recurrence interval (1.07 factor)
    - Importance Factor of 1.15
- Tornado Loading
  - Tornado characteristics per Regulatory Guide 1.76 for Region I
  - Pressure calculated per ASCE 7-05
    - Basic wind speed of 230 mph (per Regulatory Guide 1.76)
    - Importance Factor of 1.15
  - Differential pressure of 1.2 psi
  - Tornado missile spectrum and speeds per Regulatory Guide 1.76
  - Tornado missile impacts transformed to equivalent static loads per NUREG-0800, Section 3.5.3, Subsection II

Main Production Facility Structure

METEOROLOGICAL DAMAGE

- Snow, Ice, and Rain Loading
  - Snow loads calculated per ASCE 7-05
    - Adjusted for 100-year mean recurrence interval (1.22 factor)
  - Unbalanced snow loads considered
  - Drift surcharge loads considered

Main Production Facility Structure

WATER DAMAGE

- Design Basis Water Level
  - Design basis flood level: 50 feet below grade
  - Design basis precipitation level: at grade
  - Maximum ground water level: 50 feet below grade
- Flood Protection
  - Lowest portion of the structure is above the design basis flood level
  - Mat slab is 4 inches above grade
  - Water stops and waterproofing of exterior surfaces up to 4 inches above grade
  - Berms and ramps are used to contain and capture internal flood water
  - Water-sensitive safety-related equipment is raised off the floor above internal flood levels
- Structural Design for Flooding
  - No dynamic force due to precipitation or rain because of relative elevation of building and water levels

Main Production Facility Structure

SEISMIC DAMAGE

- Seismic Input
  - Maximum ground acceleration of 0.2 g and design response spectra per Regulatory Guide 1.60
  - Synthetic acceleration time histories generated to envelop the design response spectra per Approach 2, Option 1 of NUREG-0800, Section 3.7.1
  - Critical damping values per Section 1.1 of Regulatory Guide 1.61
- Seismic Analysis
  - Soil Structure Interaction (SSI) analysis performed using SASSI2010
    - SSI analyses performed separately on equivalent linear-elastic basis for best estimate, upper bound, lower bound soil properties
    - Strain dependent soil properties form geotechnical investigations and free field site response analysis
  - Structural seismic qualification analysis performed using SAP2000
  - Earthquake components are combined according to Section 2.1 of Regulatory Guide 1.92
  - Stability evaluated per ASCE 43-05 and NUREG-0800, Section 3.8.5

Main Production Facility Structure

SEISMIC DAMAGE

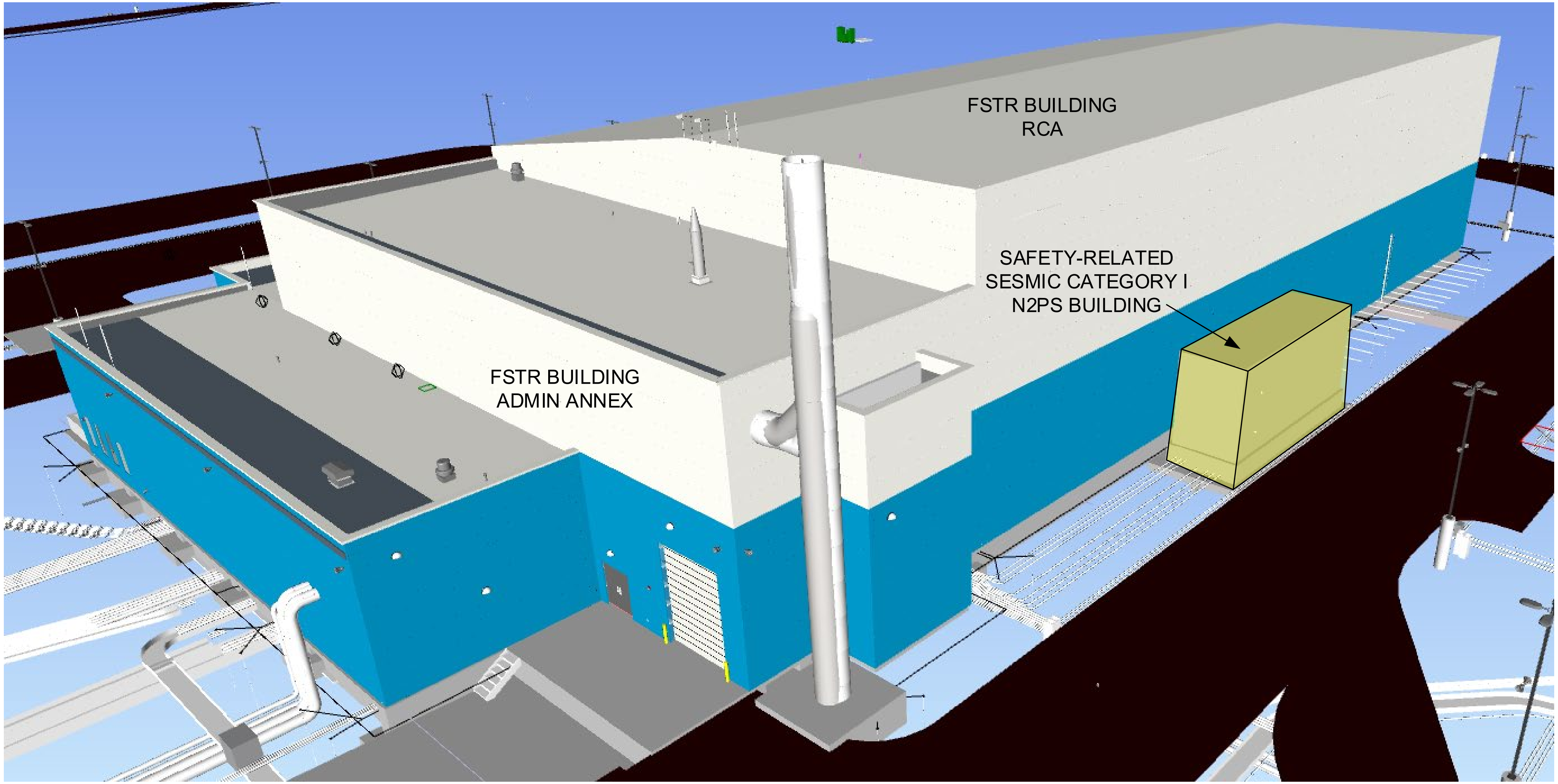
- Seismic Analysis (cont.)
  - Robust reinforced concrete seismic force resisting structure designed to American Concrete Institute (ACI) 349-13
  - Structural steel roof trusses and mezzanine support designed to American Institute of Steel Construction (AISC) N690-12
- Seismic Classification and Qualification
  - Seismic Category I and II components designed for safe shutdown earthquake (SSE)
  - Category I: Facility structures, systems, and components (SSCs), including their foundations and supports, that must perform safety function(s) after an SSE
  - Category II: SSCs that are co-located with a Seismic Category I SSC and must maintain structural integrity in the event of an SSE to prevent unacceptable interactions with a Seismic Category I SSC, but are not required to remain functional
  - Seismic qualification of SSCs may be performed via analysis, testing, comparison to databases or a combination of these methods

Main Production Facility Structure

DAMAGE FROM EXTERNAL HAZARDS

- Aircraft Impact Analysis
  - Critical aircraft selected from Southern Wisconsin Regional Airport (SWRA) records
  - Horizontal and vertical velocity at impact per Attachment E of UCRL-ID-123577
  - Global impact response per DOE-STD-3014-2006
    - Ductility limits per ACI 349-13 and AISC N690-12
    - Perpendicular impacts considered at center of wall and roof panels and at critical locations near edges
  - Local impact response per DOE-STD-3014-2006
    - Resist scabbing and perforation
    - Punching shear not postulated because sections 20% thicker than required to prevent perforation (ACI 349-13)

Nitrogen Purge System Structure



Nitrogen Purge System Structure

- Meteorological Damage
  - Design methodology matches the main production facility structure (FSTR) with one exception:
    - Uniform snow load of 60 pounds per square foot (psf) is conservative considering 30 psf ground snow load with 1.2 importance factor for the 100-year mean recurrence interval
- Water Damage
  - Design methodology matches the FSTR
- Seismic Damage
  - Seismic Category I structure
- Aircraft impact addressed qualitatively based on location relative to main facility and off-site power structures

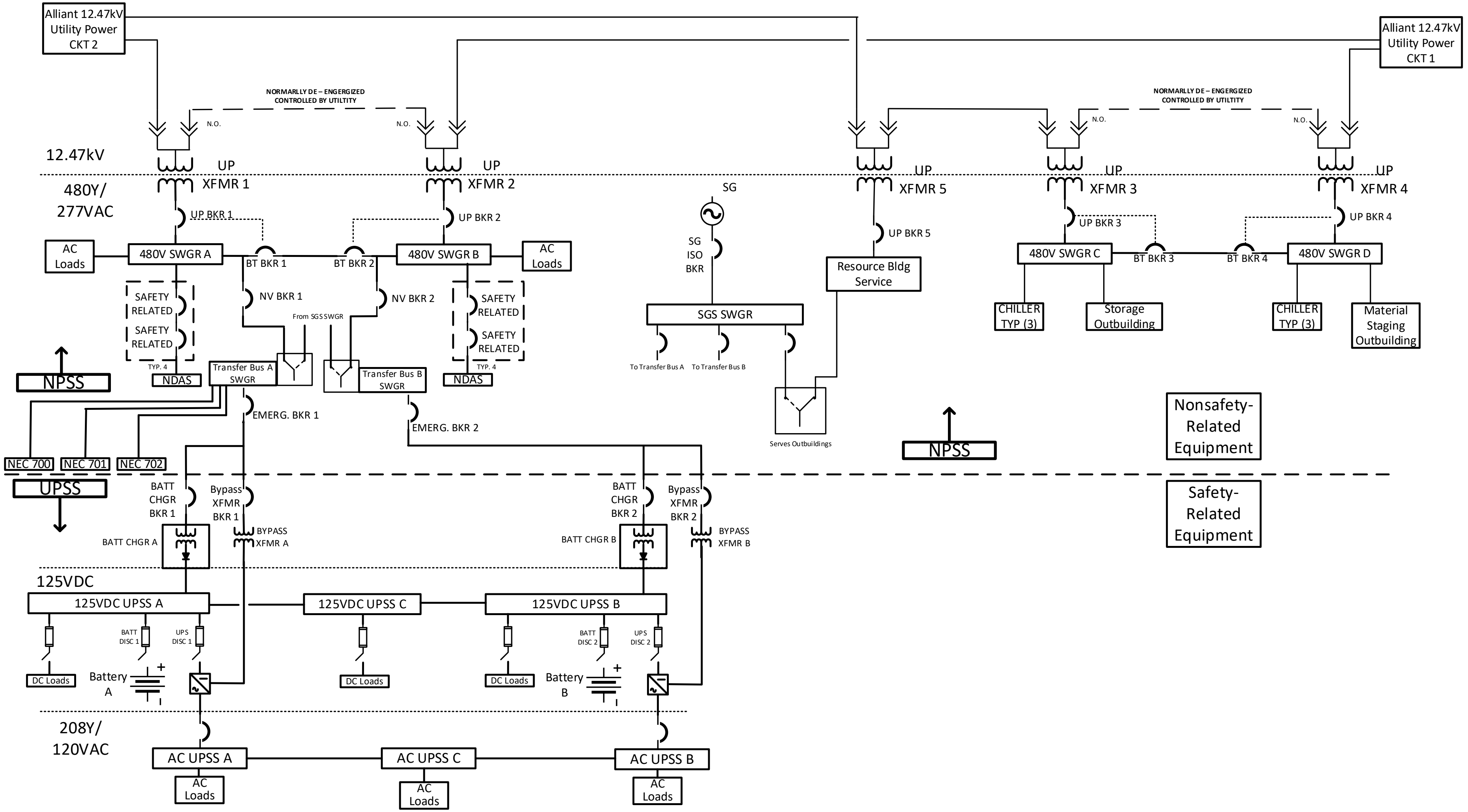
Chapter 8 – Electrical Power Systems

JEFF BARTELME, DIRECTOR OF LICENSING
ROGER THOMAS, LEAD ELECTRICAL ENGINEER

Outline

- Electrical Power Systems Overview
- Normal Electrical Power Supply System
- Emergency Electrical Power Systems
  - Uninterruptible Electrical Power Supply System
  - Standby Generator System

Electrical Power Systems Overview



Normal Electrical Power Supply System (NPSS)

- The normal electrical power supply system (NPSS) for the SHINE facility consists of the normal power service entrances from the electric utility and a distribution system providing three utilization voltages, 480Y/277, 400Y/230, and 208Y/120 volts alternating current (VAC), 3-phase, 60 hertz.
- Physical separation between nonsafety-related circuits and safety-related circuits is achieved through compliance with applicable sections of Institute of Electrical and Electronics Engineers (IEEE) 384-2008.
- Surge protection is provided at each electrical service entrance.
  - Electrical services are monitored for voltage, frequency, and loss of phase.
  - When prescribed limits are exceeded, the facility is disconnected from the utility.
- The NPSS contains redundant safety-related breakers that provide power to certain plant equipment that does not perform an active safety function.
  - The safety function of these breakers is to disconnect power to prevent actions that could initiate or increase the consequences of an accident.

SHINE

Uninterruptible Electrical Power Supply System (UPSS)

- The UPSS consists of a 125-volt direct current (VDC) battery subsystem, inverters, battery chargers, bypass transformers, distribution panels, and other distribution equipment necessary to feed safety-related alternating current (AC) and direct current (DC) loads and select nonsafety-related AC and DC loads.
- Redundant, independent UPSS divisions provide a reliable source of power to AC and DC components upon a loss of offsite power.
- Redundant divisions of UPSS batteries are sized per the guidance of applicable sections of IEEE 485-2010 to ensure battery capacity and capability are sufficient to support UPSS loads.
- Each division of UPSS batteries is located in a separate fire areas in the safety-related, seismic portion of the main production facility.
- Nonsafety-related loads are isolated from safety loads by breakers or isolating fuses meeting the requirements of applicable sections of IEEE 384-2008, ensuring that a failure of nonsafety-related loads does not impact safety-related loads.

Uninterruptible Electrical Power Supply System (UPSS)

- Distribution wiring from each division of the UPSS is isolated and separated from the other division per applicable sections of IEEE 384-2008.
- The UPSS is designed and sized to support run time requirements of required loads.
- The run time requirements are established as follows:
  - Equipment required to prevent hydrogen deflagration is powered for five minutes.
  - Equipment used to minimize transient effects on the facility due to short duration power loss is powered for five minutes.
  - Equipment used to provide alerts for facility personnel and monitor the status of the facility during immediate recovery efforts is powered for two hours.
  - Defense-in-depth power for nonsafety-related equipment used to monitor and reduce the tritium source term in the tritium confinement is powered for six hours.

SHINE

Uninterruptible Electrical Power Supply System (UPSS)

- Facility loads on the UPSS consist of:
  - Target solution vessel (TSV) off-gas system blowers, recombiner heaters, and instruments
  - Nitrogen purge system (N2PS) valves
  - TSV dump valves
  - Neutron flux detection system (NFDS)
  - TSV reactivity protection system (TRPS)
  - TRPS radiation monitors
  - Engineered safety features actuation system (ESFAS)
  - ESFAS radiation monitors
  - Tritium purification system (TPS) tritium monitors
  - Neutron driver assembly system (NDAS), vacuum transfer system (VTS), molybdenum extraction and purification system (MEPS) pump, and radiological ventilation exhaust and supply fan hold circuits
  - Subcritical assembly system (SCAS), VTS, target solution preparation system (TSPS), and radioactive drain system (RDS) level switches
  - Criticality accident alarm system (CAAS)*
  - Stack release monitoring system (SRMS)*
  - TPS secondary enclosure cleanup (SEC) blowers*

* Nonsafety-related loads important for providing alerts to facility personnel, monitoring the status of the facility, and reducing the tritium source term

SHINE

Standby Generator System (SGS)

- The SGS consists of a natural gas-driven generator that automatically starts and provides power to a NPSS transfer bus.
- Provides a temporary source of nonsafety-related alternate power to the UPSS and selected loads for operational convenience and defense-in-depth.
- Operation of the SGS is not required for any safety function at the SHINE facility.

SHINE

Chapter 9 – Auxiliary Systems

TONY PALUMBO, AUXILIARY SYSTEMS ENGINEER
CODY FAGAN, TRITIUM ENGINEER
ERIC EDWARDS, CHEMICAL PROCESS SYSTEMS MANAGER

Outline

- Heating, Ventilation, and Air Conditioning Systems
- Tritium Purification System
  - Tritium Handling System
  - Secondary Enclosure Cleanup System
  - Vacuum and Impurity Treatment System
- Target Solution Lifecycle and Vacuum Transfer System
- Process Vessel Vent System and Nitrogen Purge System

Heating, Ventilation, and Air Conditioning Systems

Production Facility Ventilation Systems

- Radiological Ventilation (RV) Systems/Subsystems
  - Radiological Ventilation Zone 1 (RVZ1)
    - RVZ1 Recirculating Subsystem (RVZ1r)
    - RVZ1 Exhaust Subsystem (RVZ1e)
  - Radiological Ventilation Zone 2 (RVZ2)
    - RVZ2 Supply Subsystem (RVZ2s)
    - RVZ2 Exhaust Subsystem (RVZ2e)
    - RVZ2 Recirculating Subsystem (RVZ2r)
  - Radiological Ventilation Zone 3 (RVZ3)
- Non-Radiological Area Ventilation System/Subsystems
  - Facility Ventilation Zone 4 (FVZ4)
    - FVZ4 Supply and Transfer Air Subsystem (FVZ4s)
    - FVZ4 Exhaust Subsystem (FVZ4e)
    - FVZ4 Room Cooling Recirculation Subsystem (FVZ4r)

Radiological Ventilation Zones and Areas Served

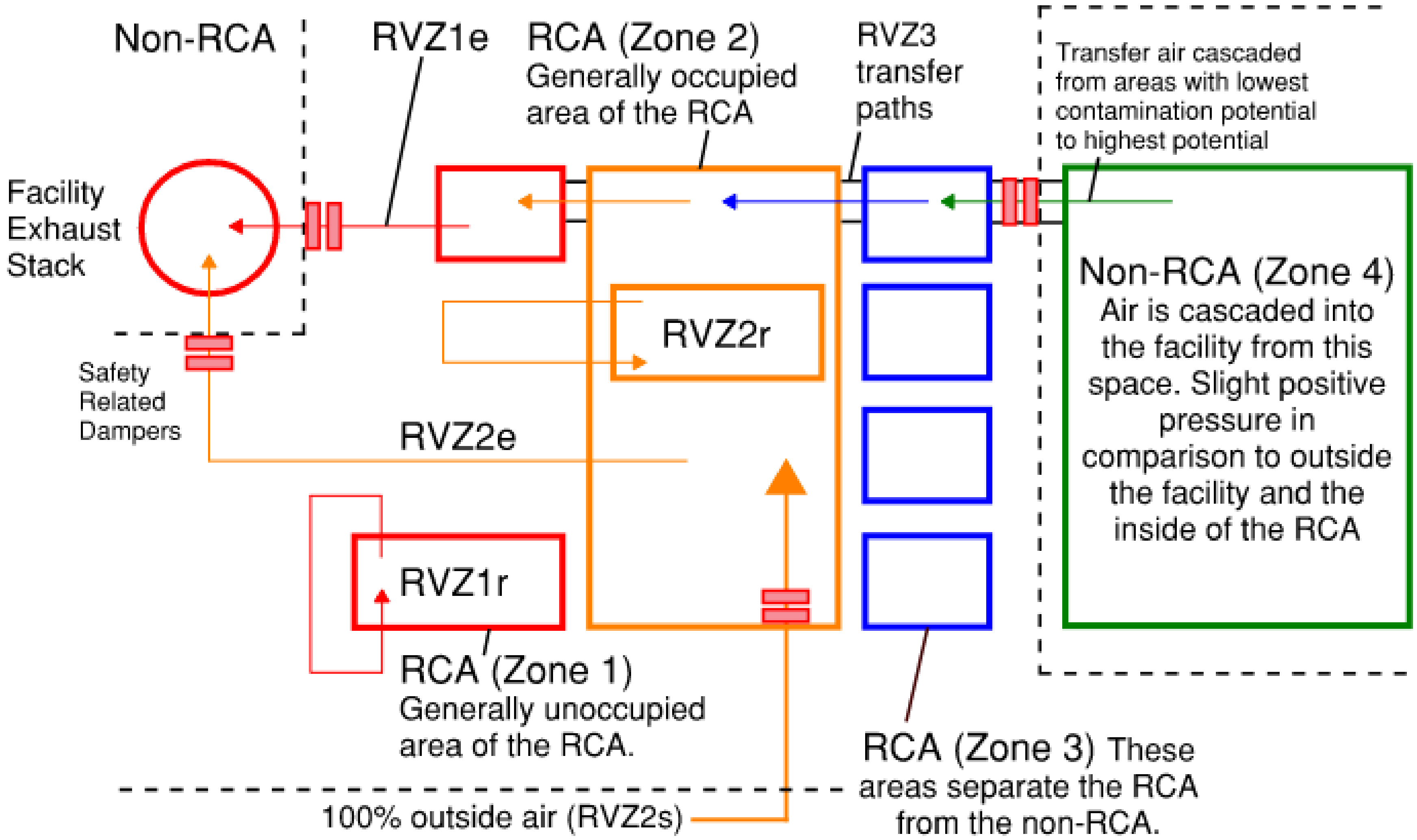
- RVZ1 areas served:
  - Irradiation Unit (IU) cells
  - Target solution vessel (TSV) off-gas system (TOGS) cells
  - Supercell
  - Radioactive liquid waste immobilization (RLWI) shielded enclosure
  - Tritium purification system (TPS) process equipment
  - Target solution preparation system (TSPS) glovebox
  - TSPS dissolution tanks
  - TSPS preparation tanks
  - Uranium receipt and storage system (URSS) glovebox
  - Primary closed loop cooling system (PCLS) expansion tank

- RVZ2 areas served:
  - Irradiation facility (IF) general area
  - TPS room, fume hoods, and nitrogen exhaust
  - Neutron driver assembly system (NDAS) service cell
  - Primary cooling rooms
  - TSPS and URSS rooms
  - Radioisotope process facility cooling system (RPCS) room
  - Supercell
  - Analytical and quality control (QC) labs and fume hoods
  - RCA exhaust filter room
  - Access control area
  - Tool crib, transfer aisle, storage rooms, and workspace
  - Labyrinths and vestibule

- RVZ3 Areas Served:
  - Shipping/receiving alcove
  - Main RCA entry and exit
  - Emergency exits
  - Labyrinths

SHINE

Radiological Ventilation Zones and Areas Served



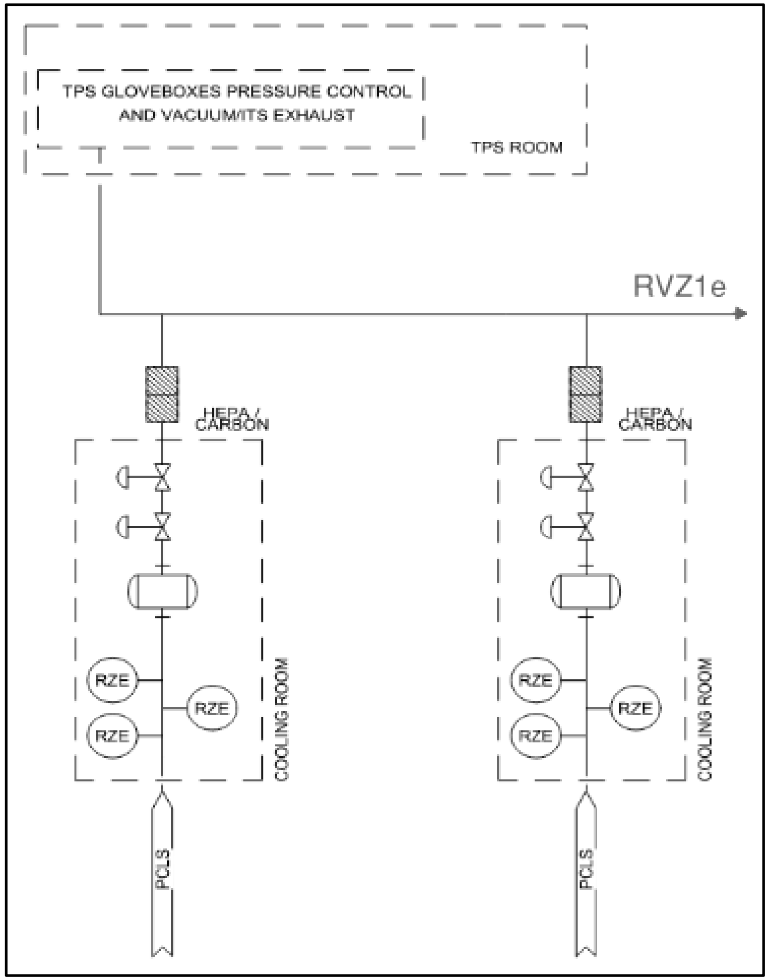
Radiological Ventilation System Functions

- Nonsafety-related functions of the RV subsystems
  - Provides ventilation air and conditioning to the RCA environment for workers.
- Safety-related functions of the RV subsystems
  - RVZ1e, RVZ2e, RVZ2r, and RVZ2s
    - The RVZ1e and RVZ2e provide locations for in-duct radiation monitors prior to airflow leaving the RCA.
    - Portions of RVZ1e, RVZ2e, RVZ2r, and RVZ2s provide redundant isolation and make up a portion of confinement boundaries.
    - These subsystems isolate redundant dampers in the exhaust and supply air flows when signaled by the safety actuation system.
  - RVZ1r
    - The RVZ1r is a closed system within the RCA and extends the confinement boundary extension for each IU and TOGS cell.
  - RVZ3
    - Portions of the RVZ3 provide redundant isolation and make up a portion of the RCA boundaries.
    - This subsystem isolates redundant dampers in the transfer airflow when signaled by the safety actuation system.

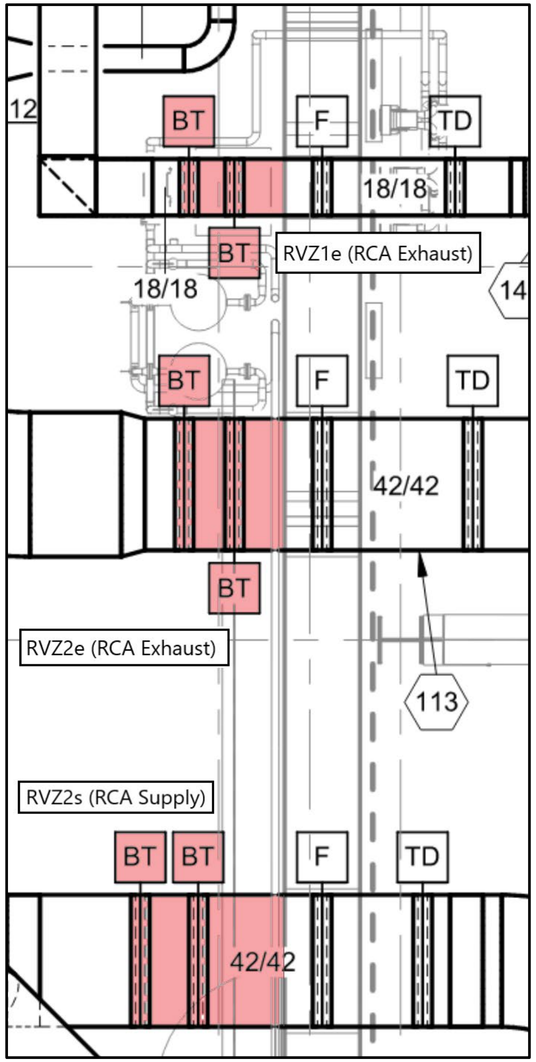
SHINE

Radiological Ventilation Safety-Related Flow Paths

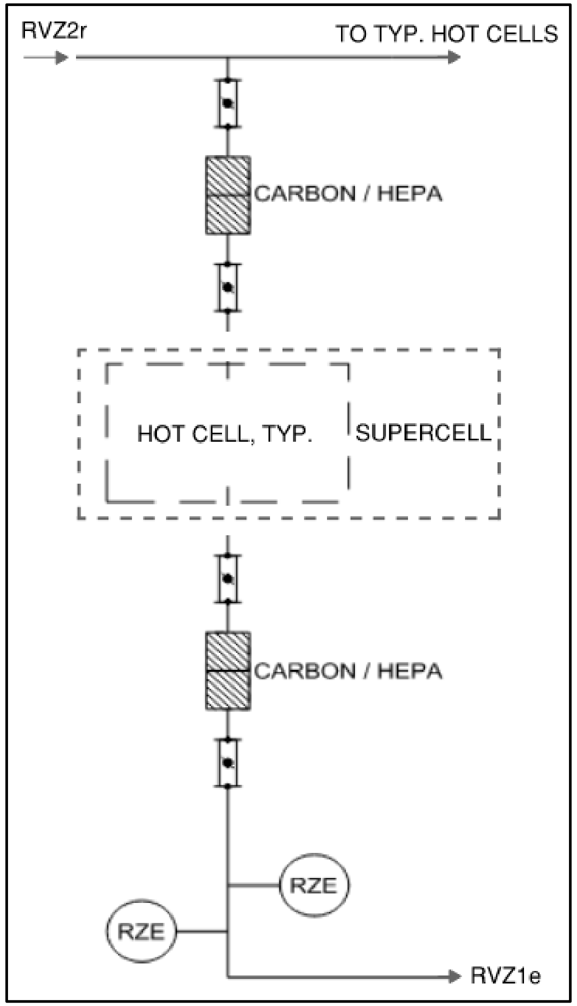
IU Cell and TPS Exhaust



RCA Supply and Exhaust



Supercell Supply and Exhaust



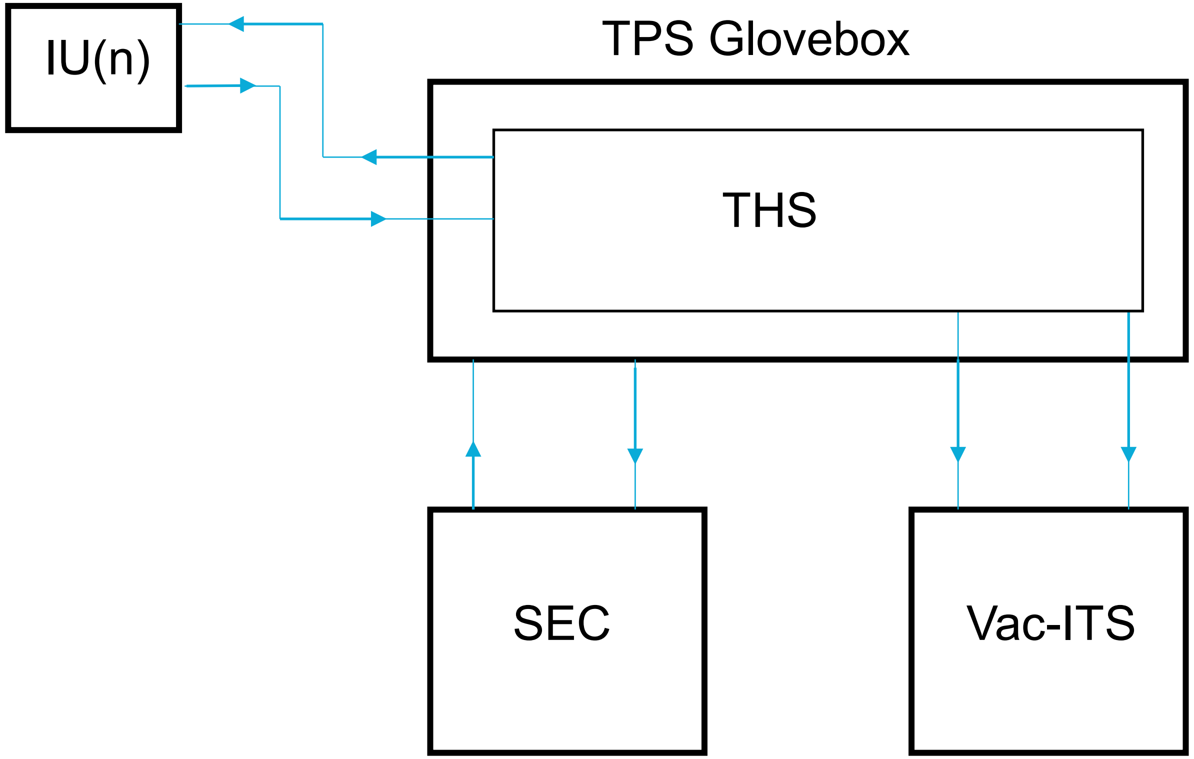
Non-Radiological Area Support Systems

- Nonsafety-related functions of the FVZ4 subsystems:
  - The FVZ4 provides ventilation air, conditioning, exhaust, return, and recirculation to the non-RCA environment for workers.
- Nonsafety-related functions of the Facility Chilled Water System (FCHS)
  - The FCHS is a closed-loop cooling system that removes heat from the RVZ2s and FVZ4s subsystem air handling units (AHUs).
- Nonsafety-related functions of the Facility Heating Water System (FHWS)
  - The FHWS is a hydronic hot water heating system that supplies hot water to the RVZ2s and FVZ4s subsystems along with other heating coils outside the RCA.

Tritium Purification System

Tritium Purification System Overview

- Tritium Handling System (THS)
  - Gas system that delivers, recovers, stores and purifies hydrogen isotopes
- Secondary Enclosure Cleanup System (SEC)
  - Maintains inert environment inside the tritium purification system (TPS) glovebox
- Vacuum and Impurity Treatment System (Vac-ITS)
  - Support system for THS and neutron driver assembly system (NDAS) decontamination



Simplified Block Diagram

Tritium Handling System

- The THS is designed to store, deliver, recover and purify hydrogen isotopes
- Double walled depleted uranium beds store inventory as a solid hydride (UT_3)
- Tritium is delivered to the NDAS target loop to maintain desired target concentration to support fusion neutron production
- Mixed tritium-deuterium is recovered from the NDAS target loop using non-mechanical pumps (cryopumps) and isotopically purified (Thermal Cycling Adsorption Process [TCAP]) for recycling to the target loop
- The THS process equipment is housed inside a credited secondary boundary that makes up part of the tritium confinement boundary

Secondary Enclosure Cleanup System

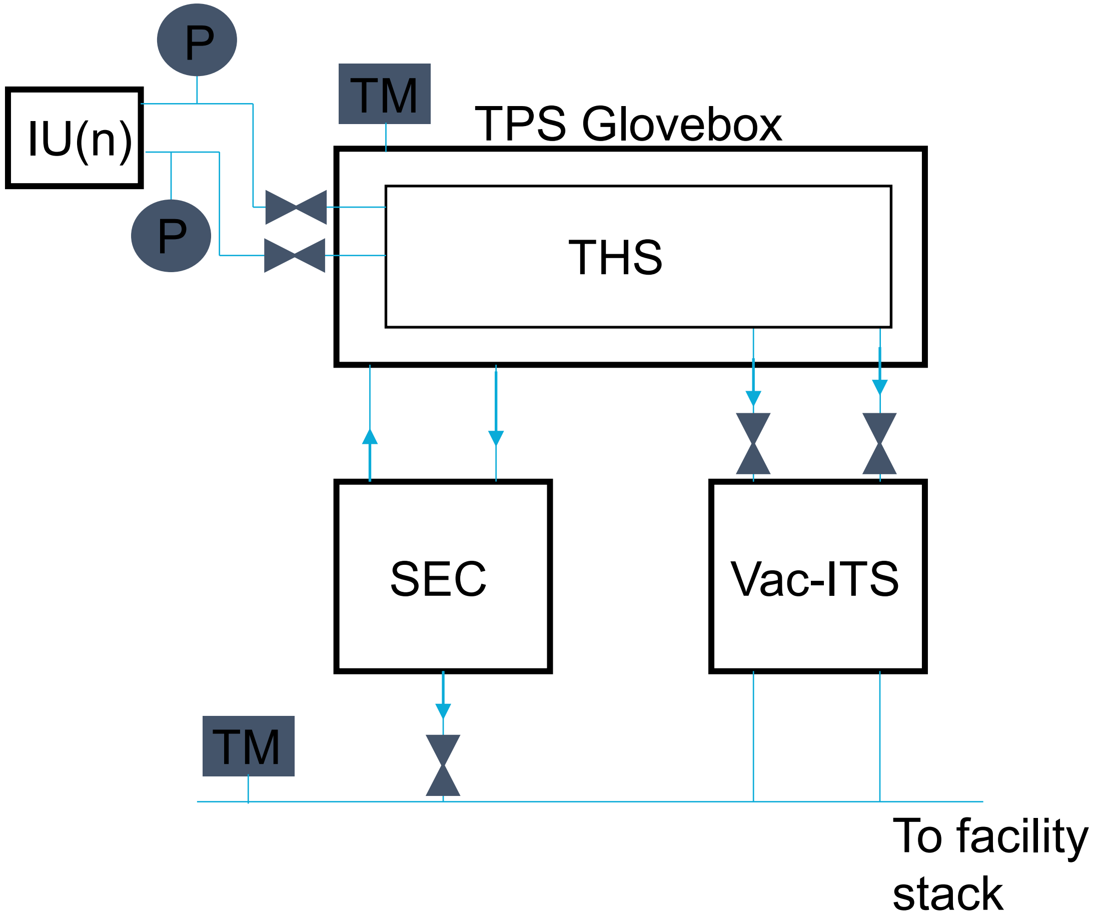
- Maintains inert helium environment in the TPS glovebox to reduce impacts of chronic and acute emissions by circulating glovebox gas through a series of getter beds
- First beds remove reactive permeant species (water and oxygen) that can stimulate outgassing of tritium from surfaces internal to the glovebox
- Tritium is removed from the inert gas stream using a hydride bed, leaving a stream of inerted gas to return to the glovebox
  - The reduction factors are assessed as the difference between a tritium monitor on the inlet and the outlet of the glovebox
  - Recirculation in the cleanup loop is possible to achieve greater de-tritiation factors.
- The SEC forms part of the credited tritium confinement boundary

Vacuum and Impurity Treatment System

- The vacuum system treats inert vacuum effluent and process gas rejection from the THS
- A hydride bed is used, and the gas can be recirculated within the loop, to obtain greater de-tritriation factors
- Effluent can be sent to the TPS exhaust facility stack or to the impurity treatment system (ITS) for further tritium reduction
- The ITS treats tritium in mixed air-effluent from the NDAS decontamination flushes by oxidizing any elemental hydrogen and capturing tritium as HTO on molecular sieve beds
- The ITS also supports deuterium raffinate cleanup and vacuum effluent in the same manner

Safety-Related Equipment within TPS

- Glovebox: low leakage boundary for confinement of tritium inventory
- Isolation valves: provide isolation on process lines to penetrate the credited tritium confinement boundary
- Glovebox tritium monitor: monitors inert He atmosphere for a release of activity inside the glovebox
- Target supply/exhaust pressure monitors: monitor tritium supply/return lines for a line breach
- TPS exhaust facility stack tritium monitor: monitors for tritium emissions



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Target Solution Lifecycle and Vacuum Transfer System

Target Solution Lifecycle

RECEIPT AND STORAGE OF UNIRRADIATED SPECIAL NUCLEAR MATERIAL

- Target solution is a low-enriched uranyl sulfate solution
- Low enriched uranium (LEU) is received by the uranium receipt and storage system (URSS)
- The URSS system provides for storage of special nuclear material (SNM) and converts the uranium metal to uranium oxide
- Unirradiated uranyl sulfate solution is created by dissolving uranium oxide using the target solution preparation system (TSPS)
- Once prepared, the solution is stored in the target solution preparation tank until it is needed for a new batch or as make-up volume
- Uranyl sulfate solution may be pumped from the TSPS to any target solution hold tank
- Once uranyl sulfate solution is pumped out of the TSPS, it cannot return

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Target Solution Lifecycle

IRRADIATION AND ISOTOPE SEPARATION

- The target solution batch is transferred into the target solution vessel (TSV) for an irradiation cycle from the target solution hold tank
- Following irradiation, solution is transferred from the TSV dump tank to the supercell, where medical isotopes are separated from the target solution
- After separation processes in hot cells, the solution can be transferred to:
    - A target solution hold tank for the next irradiation cycle
    - A target solution storage tank
    - The first uranium liquid waste tank in the radioactive liquid waste storage (RLWS) system to start the disposal process

Target Solution Lifecycle

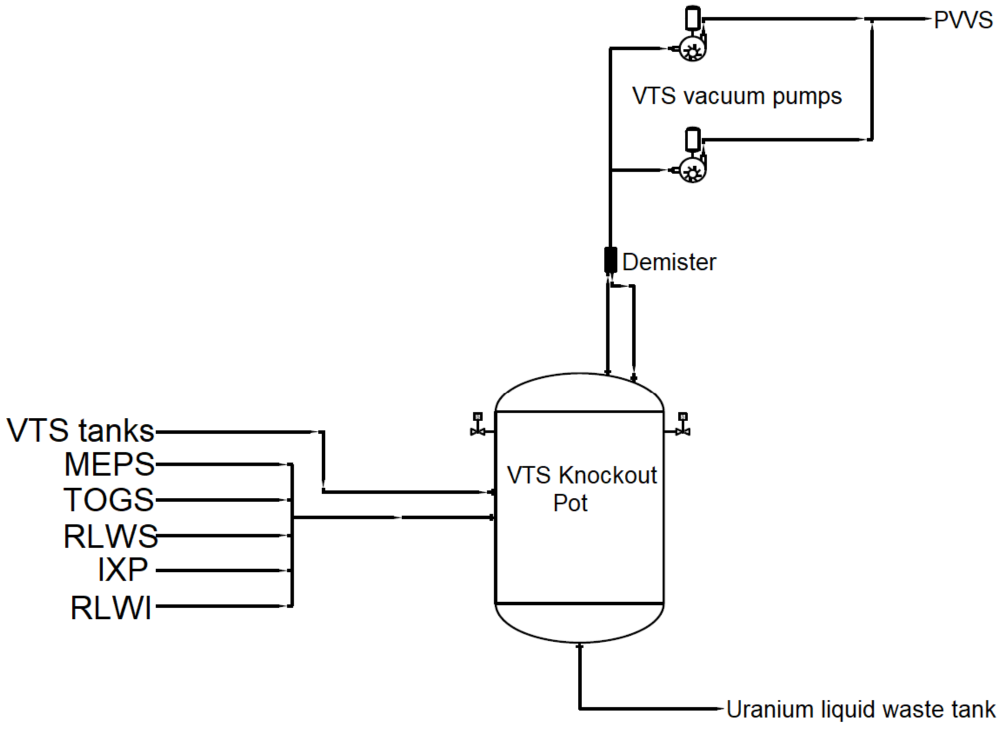
END OF SOLUTION LIFE

- Solutions are eventually processed through the RLWS at the final stage of the target solution lifecycle
- Target solution is blended with other waste streams and stored in below grade tank vaults
- Blended solutions are transferred to the radioactive liquid waste immobilization (RLWI) system to be solidified in drums
- Drums from RLWI are transported to the material staging building for staging prior to shipment

Vacuum Transfer System

SYSTEM OPERATION

- The vacuum transfer system (VTS) consists of vacuum pumps, a knockout pot, vacuum lift tanks, and associated piping components and instrumentation
- Two separate vacuum headers are provided:
  - Processes that contain target solution
  - Process that do not contain fissile material
- The VTS transports radioactive liquids throughout the radioisotope production facility (RPF) by either:
  - Applying vacuum to an intermediary small volume lift tank, moving liquid in small batches, in one or more stages; or
  - Applying vacuum directly to a destination tank
- Provides vacuum services to RPF systems
- Provides an interface for sampling of solutions



Vacuum Transfer System

SYSTEM DESCRIPTION

- Designed with favorable geometry and liquid detection to prevent inadvertent criticality
- Designed to withstand design basis seismic events
- VTS relieves to atmospheric pressure upon actuation of the engineered safety features actuation system (ESFAS) to terminate radioactive liquid transfers
- Temperature of solution in the source tank is monitored prior to a transfer to ensure that the transfer does not induce the solution to flash
- Automatic flow shut-off valves and liquid detection prevent solution from entering the knockout pot
- VTS equipment is located in hot cells, the below-grade tank vaults, and the below-grade valve pits

Process Vessel Vent System and Nitrogen Purge System

Process Vessel Vent System

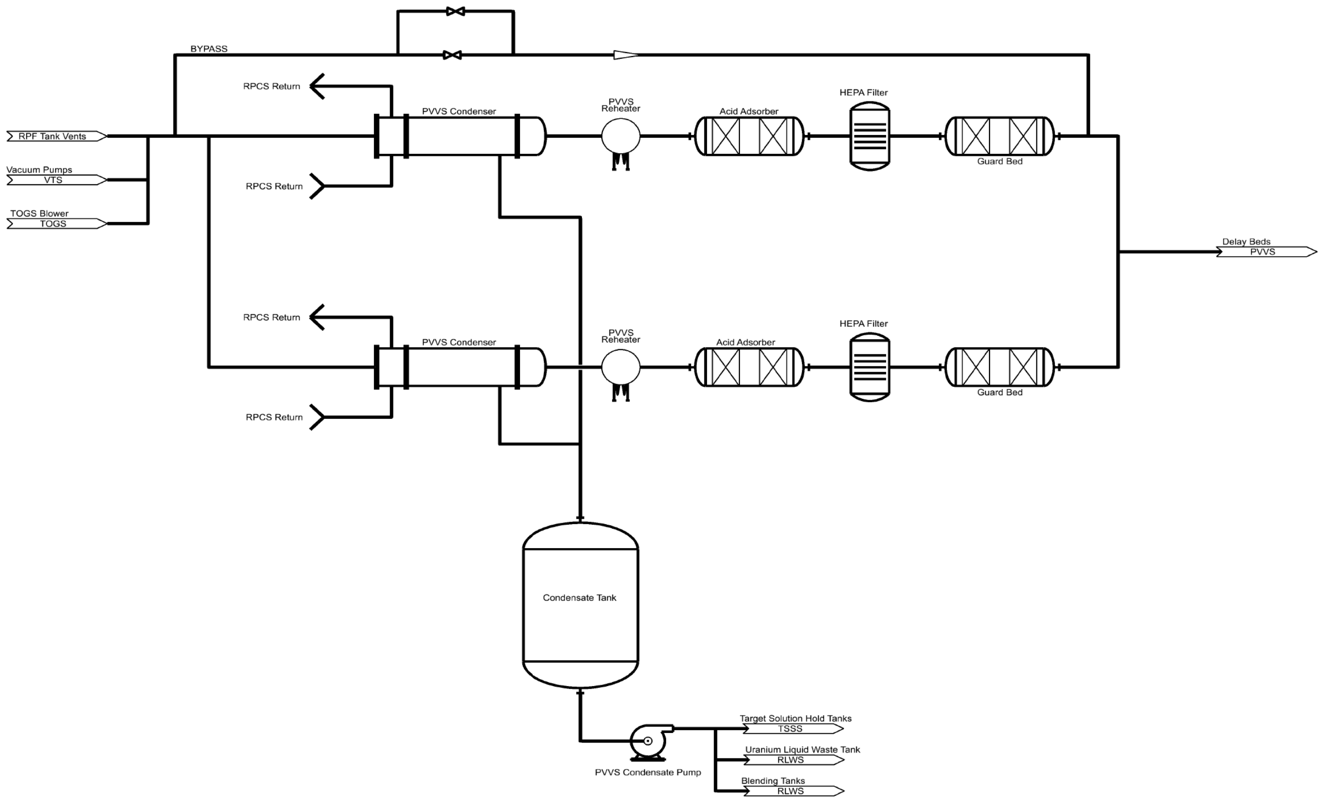
SYSTEM DESCRIPTION

- The process vessel vent system (PVVS) collects and treats off-gases from radioactive processes in the main production facility before releasing to the facility stack
  - Radioisotope production facility tank vents
  - Gases discharged from the VTS and the TSV off-gas system (TOGS); includes vacuum pump discharge, sweep gas from analyzer instruments, nitrogen purges, and pressure relief
- PVVS blowers upstream of the stack induce flow through the ventilated tanks
  - Mitigates radiolytic hydrogen generation in RPF process tanks
  - Maintains RPF tanks and vessels at a slightly negative pressure
- PVVS components are designed to:
  - Condition off-gas to improve reliability and performance of equipment
  - Filter radioactive particulates from the gaseous effluents
  - Capture radioiodine from the off-gas stream
  - Delay the release of xenon and krypton isotopes from the process to allow for decay

Process Vessel Vent System

FILTRATION SKID

- Ventilation for the process tanks exhaust to the PVVS header and flow to the filtration skid in the PVVS hot cell
- The filtration skid consists of:
  - Condensers, reheaters, condensate tank, and condensate pump to reduce humidity and handle condensate
  - Acid adsorbers to remove any acidic off-gases
  - HEPA filters to filter particulates
- Guard beds packed with carbon are located in a subgrade vault to remove iodine from the off-gas



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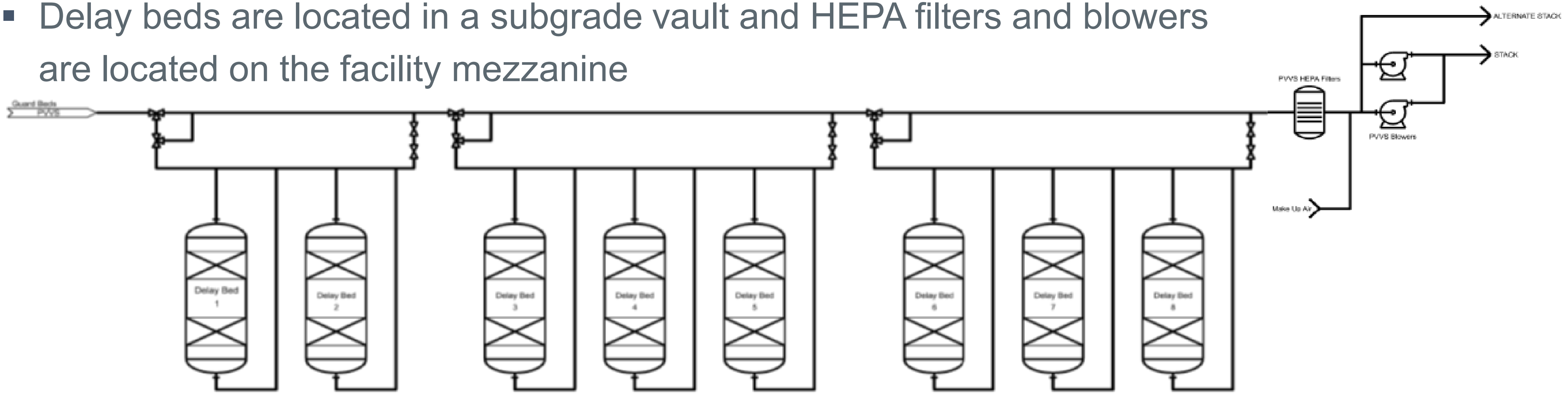
Process Vessel Vent System

DELAY BEDS

- After the filtration skid, process gases flow through the delay beds, high efficiency particulate air (HEPA) filters, and blowers and out the facility stack
- Delay beds adsorb xenon and krypton isotopes to delay their release to the facility stack and ensure 10 CFR Part 20 limits are met
- Safety-related isolation occurs on detection of fire within the carbon delay beds
- Delay beds are located in a subgrade vault and HEPA filters and blowers are located on the facility mezzanine



Nitrogen Purge System

SYSTEM DESCRIPTION

- The nitrogen purge system (N2PS):
  - Provides safety-related backup supply of sweep gas to each irradiation unit (IU) and to tanks normally ventilated by the PVVS
  - Ensures the hydrogen concentration is below the lower flammability limit (LFL) to prevent deflagrations and detonations from potential hydrogen accumulation for safe shutdown
- N2PS is actuated by ESFAS on:
  - Loss of normal power
  - Loss of sweep gas flow
- Sized to provide three days of sweep gas flow

Nitrogen Purge System

SYSTEM LOCATIONS

- N2PS Structure
  - An above-grade reinforced concrete structure adjacent to the main production facility
  - Stores high-pressure nitrogen gas tubes, manual isolation valves, high point vents, low point drains, self-regulating pressure reducing valves, relief valves, check valves, pressure instrumentation, and associated tubing and piping.
  - Supply tubes are manifolded so they will act in unison
  - Designed to withstand the impact of tornado missiles and the effects of a seismic event
  - Located such that the failure of nonsafety-related components (e.g., facility stack) do not affect operation of the N2PS
- N2PS uses existing PVVS piping and components, and the alternate safety-related exhaust point, to ventilate the RPF tanks

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Chapter 11 – Radiation Protection Program and Waste Management (Open Session)

RILEY MCSWEENY, WASTE PROCESSING LEAD

Outline

- Radioactive Liquid Waste Storage
- Radioactive Liquid Waste Immobilization
- Solid Radioactive Waste Packaging
- Waste Stream Sources

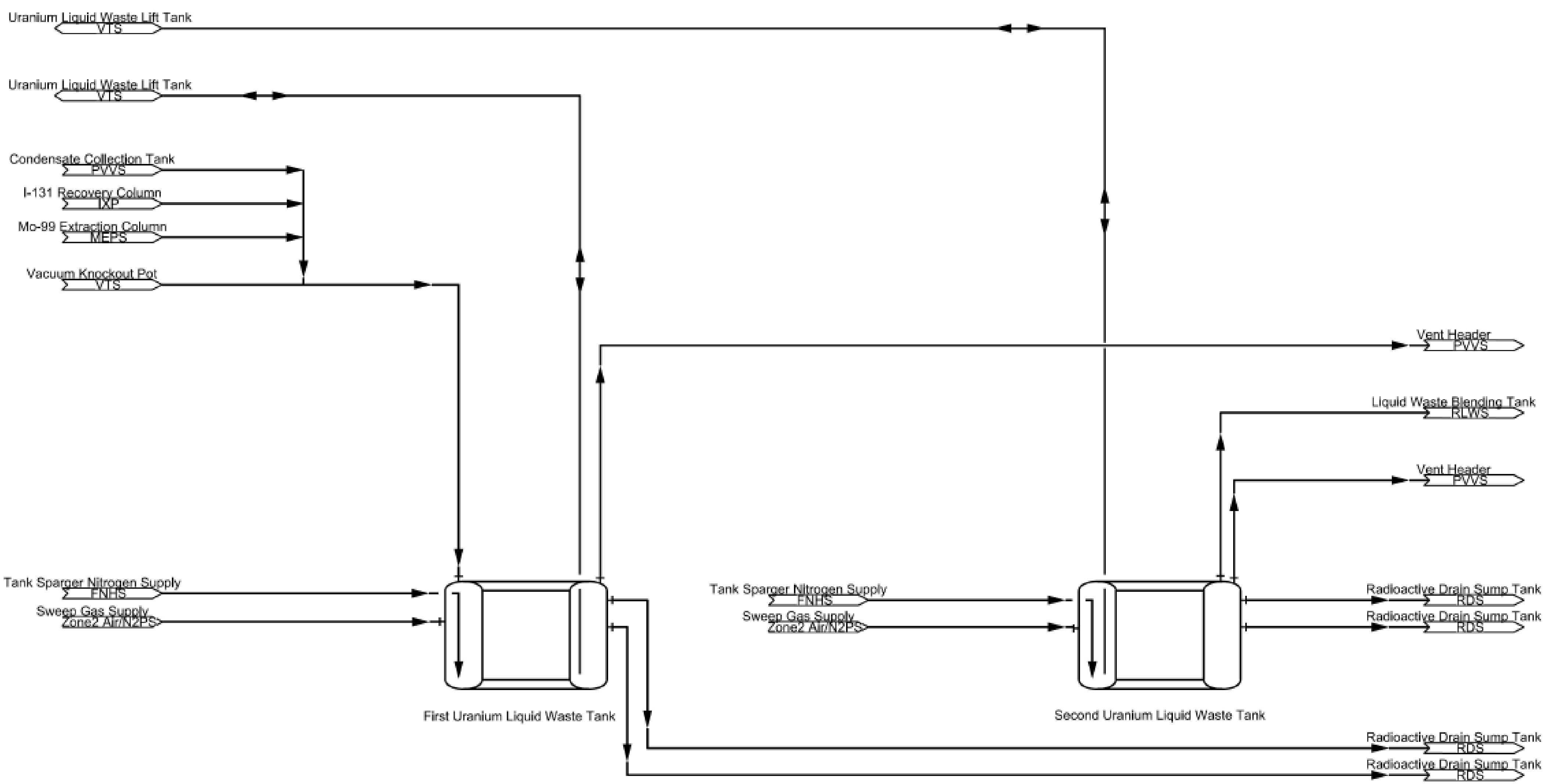
Radioactive Liquid Waste Storage

- The radioactive liquid waste storage (RLWS) system collects, stores, blends, conditions, and meters liquid wastes for processing by the radioactive liquid waste immobilization (RLWI) system for solidification
- Nonsafety-related functions of the radioactive liquid waste storage (RLWS) system:
  - Collect liquid radioactive wastes from the molybdenum extraction and purification system (MEPS), iodine and xenon purification system (IXP), vacuum transfer system (VTS), process vessel vent system (PVVS), and non-routine operations such as decontamination flushes
  - Blend collected liquid radioactive wastes for feed to the RLWI system
  - Provide holdup time for radioactive decay of isotopes in the liquid waste
  - Allow remote sampling of the stored liquid waste
  - Control radioactive liquid waste solution pH

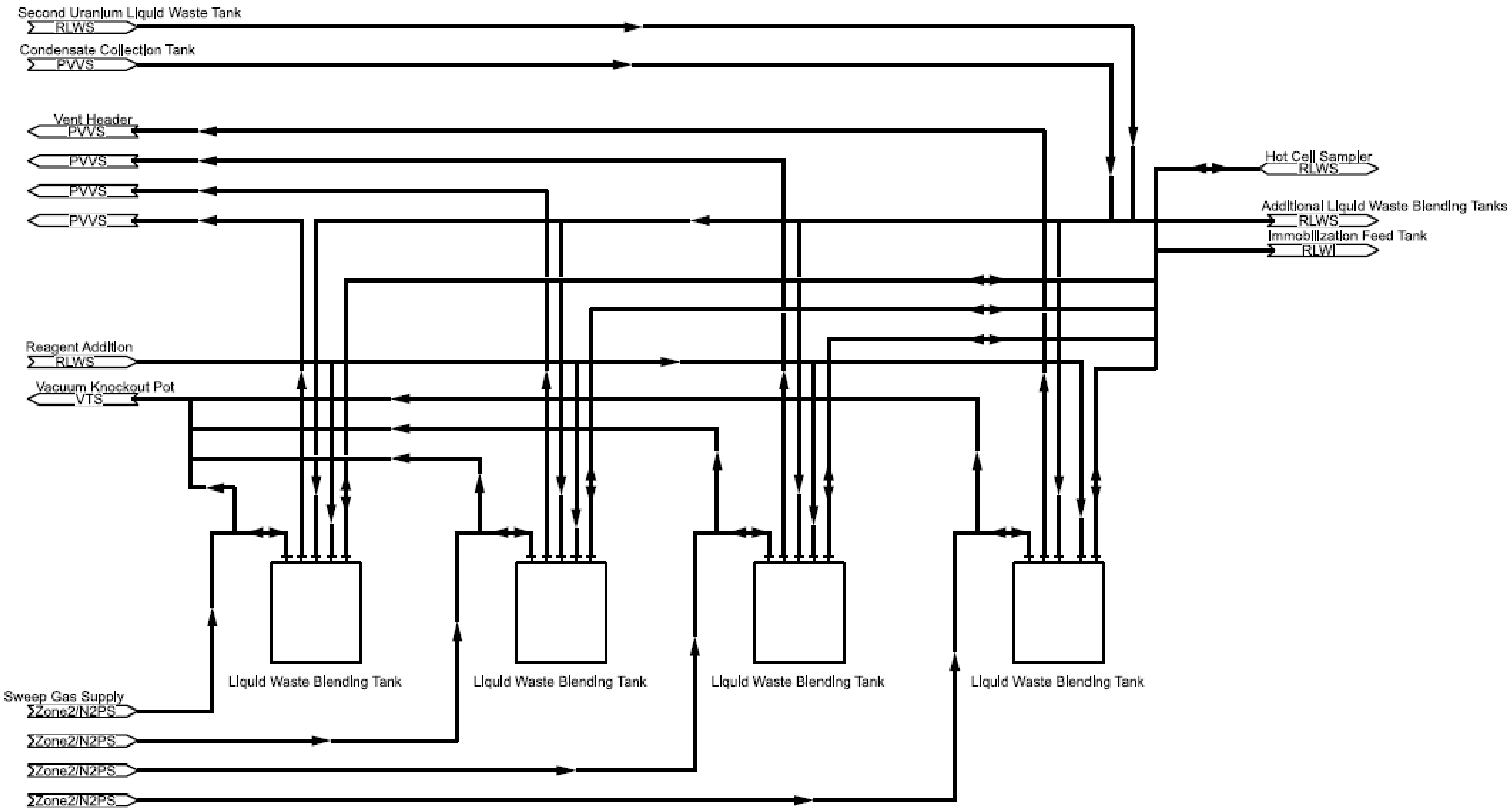
Radioactive Liquid Waste Storage

- Safety-related functions of the RLWS:
  - Prevent inadvertent criticality through design of equipment in accordance with the criticality safety evaluation
    - Favorable geometry annular tanks are used to collect uranium-bearing process wastes prior to blending
    - Uranium concentrations verified to be less than administrative limit prior to transfer to liquid waste blending tanks
- The RLWS system tanks, valves, and piping are located in shielded tank vaults, valve pits, and pipe trenches within the radioisotope production facility (RPF)
- Tank-to-tank transfers in the RLWS are performed using the VTS

Radioactive Liquid Waste Storage



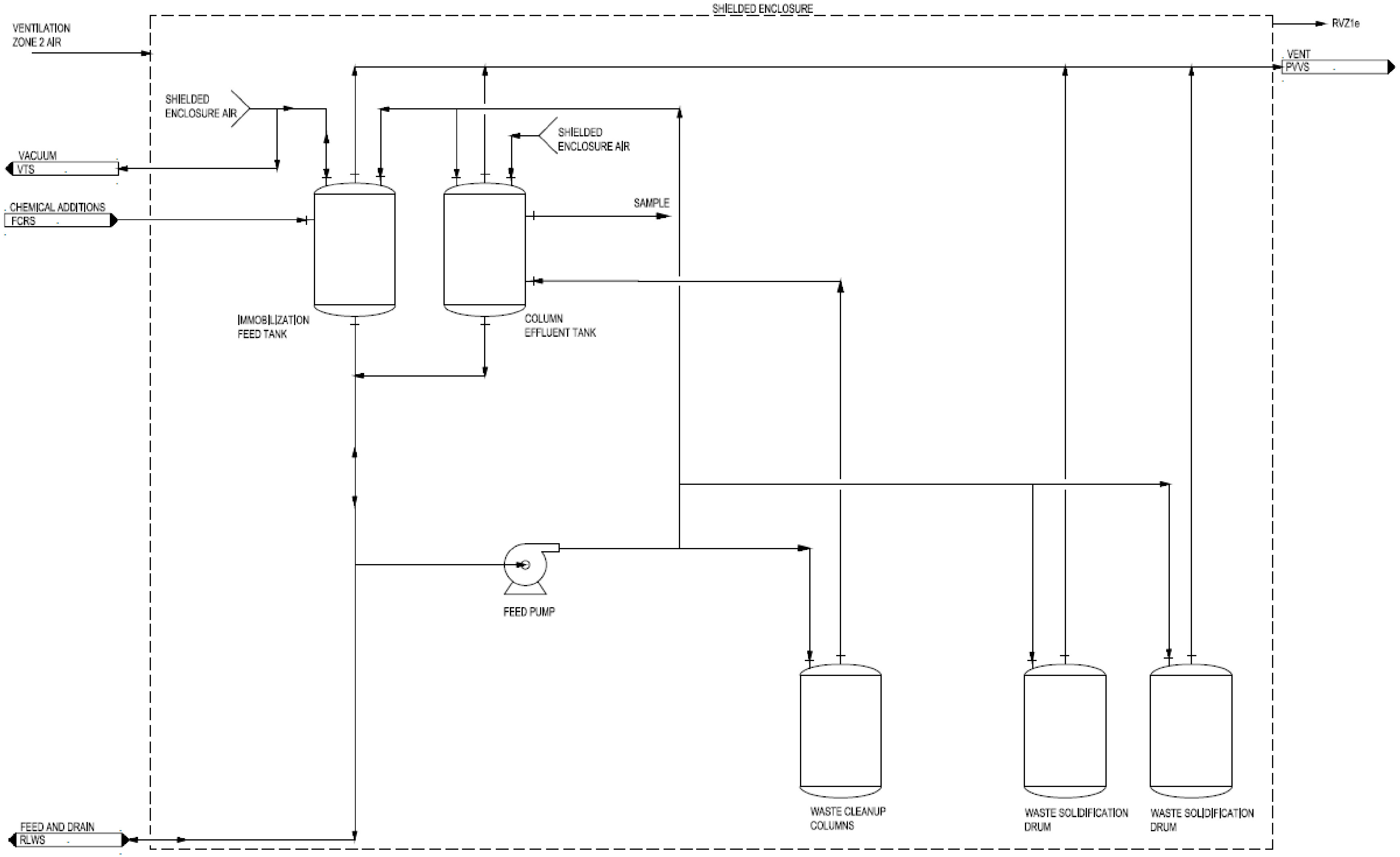
Radioactive Liquid Waste Storage



Radioactive Liquid Waste Immobilization

- The RLWI system solidifies blended liquid waste from the RLWS to a form suitable for shipping and disposal and selectively removes dose and classification-driving radioisotopes
- The RLWI system is designed to limit radiation exposure to workers
  - The RLWI processing equipment is located in a concrete shielded enclosure
  - Localized lead shielding is used around system tanks to provide additional shielding
- Remote sampling for waste characterization is performed in the RLWS prior to solidification activities
- Radiation measurements are performed on the solidified waste drum in the material staging building prior to shipment to verify it meets shipping dose rate requirements

Radioactive Liquid Waste Immobilization



Solid Radioactive Waste Packaging (SRWP)

- The solid radioactive waste packaging (SRWP) system consists of equipment designed and specified to collect, segregate, and package solid radioactive waste from systems throughout the irradiation facility (IF) and RPF
- Solid waste handled by the SRWP may include:
  - Dry active waste (DAW)
  - Spent ion exchange resin
  - Filters and filtration media
- Waste is handled and shipped off site in accordance with the radioactive waste management program

Waste Stream Sources

Waste Stream	Waste Classification
Accelerator Components	A
Filters	A
Glassware	A
Trash	A
Target Solution Vessel (TSV) Off-Gas System (TOGS) Skids	A or B
TOGS Zeolite Beds	B or C
Isotope Extraction Columns	B or C
RLWI Columns	B or C
Water Deionizer Units	A
Contaminated Oil	B
Liquid Waste Streams	A

Advisory Committee on Reactor Safeguards

SHINE Medical Technologies Operating License Application

Chapter 3 – Design of Structures, Systems and Components

May 6, 2022

Andrew Prinaris (Civil Engineer, Structural)
Office of Nuclear Reactor Regulation

Presentation Outline

- Sufficiency of the Design
- Scope of the Review
  - Meteorological Damage Review
  - Water Damage Review
  - Seismic Damage Review
  - Other Structural Damage Reviews
  - External Hazards (EH) Damage Review
- Findings

Sufficiency of the Design 1

- Staff verified that SHINE facility structural design followed:
  - Regulations, regulatory guidance (NUREGs, ISGs, RGs,)
  - ANSI Design/Analysis STDs (e.g., ANS, ASCE, ACI, AISC, ASME)
  - Local Codes
  - Industry Recognized Practices
- Staff in its review used its judgment to determine applicable acceptance criteria, including regulatory guidance

Sufficiency of the Design 2

- Staff’s verified facility SSC design sufficiency
  – Description
  – Performance characteristics
  – Evaluations
  – Technical bases/justification(s) for safety considerations
- Staff verified sufficiency of the facility design considered
  – Environmental and abnormal loadings
  – Effects in facility potential damage

Scope of the Review

- FSTR, Primary Structure (Stage One)
  - A two-story reinforced concrete with basement box
  - Seismically Qualified
  - Passive safety
  - No SSCs (e.g., Stack, Walls, Tanks, Vaults, Plugs, Supercells) shared with other buildings
- FSTR Controlled Area, includes
  - Irradiation Facility or IF and its SSCs
    - Eight accelerator driven Subcritical Assembly Irradiation Units
  - Radioisotope Production Facility or RPF and its SSCs
    - Target Solution Preparation
    - Target Solution Irradiation
    - Isotope (Moly) Extraction
    - Waste Handling
- N2PS, Secondary Structure (Stage Two)
- Structures configuration control consistent with 10 CFR 50.59

Meteorological Damage Review

- Staff verified FSTR and N2PS meteorological load(s) (wind, tornado, snow, ice):
  - Meet recommendations of NUREG-1537, Part 2, Section 3.2, RGs, national standards, and local building codes
  - Are derived based on historical DATA and predictions specified in FSAR Chapter 2, "Site Characteristics"
  - Relevant Design Parameters (e.g., wind velocity, frequency) are determined in accordance with ASCE 7-05 and NRC RG 1.76
- Staff verified facility structural design considered
  - Tornado generated missile impact design consistent with NUREG-0800, Section 3.5.3
  - All safety related SSCs subject to meteorological damage

Water Damage Review

- Staff verified that the FSTR and N2PS structural designs against flooding:
  - Meet recommendations of NUREG-1537, Part 2, Section 3.3, RGs, national standards, and local building codes
  - Satisfy site hydrological conditions (e.g., historical DATA and predictions) specified in FSAR Chapter 2, “Site Characteristics”
- Staff verified that all FSTR, N2PS safety related SSCs are protected from internal and external flooding
- Staff verified water-sensitive SSCs/equipment are:
  - Placed above internal flood heights, discharge of the fire protection system (FPS), or other source for internal flood water
  - Protected from accidental FPS discharge by system redundancy

Seismic Damage Review 1

- Staff verified that the FSTR and N2PS structural designs for seismic events
  - Meet recommendations of NUREG-1537, Part 2, Section 3.4, RGs, national standards, and local building codes
  - Have Design Response Spectra with a maximum acceleration of 0.2g, consistent with NUREG-0800, 3.7.1
  - Have synthetic time history accelerations (STHA) based on El Centro earthquake of 1940; consistent with NUREG-0800, Section 3.7.2,
  - Have STHAs of sufficiently long duration, are mutually independent in 3 orthogonal directions; consistent with NUREG-0800, Section 3.7.1

Seismic Damage Review 2

- Staff verified acceptability of the methodology used for seismic analysis and derivation of in structure response spectra (ISRS), including
  - SASSI2010 Code, to develop ISRS synthetic accelerations
  - SAP2000 Code, to determine in-plane shear forces, wall overturning moment, and facility stability
  - SHAKE2000 Code, to generate best estimate (BE) free field strain-dependent soil properties supplementing those from geotechnical investigations

Seismic Damage Review 3

- Staff verified:
  - Free field site response analysis included BE derived upper bound and lower bound (UB, LB) strain-dependent soil properties; consistent with NUREG-0800 Section 3.7.2 and ASCE 4-16
  - BE soil profile included an analysis with assumed cracked concrete structural components (reduced modulus of elasticity to 50%); consistent with ASCE 4-16 and with RG 1.61
  - At each component node LB, BE, UB, and cracked case responses were combined to develop ISRS bounding response
- Staff verified methodologies used for seismic qualification of equipment/components achieved with analytical methods, testing or a combination thereof acceptable
- Staff verified seismic acceleration measurements at the facility using non-safety-related instrumentation acceptable, as NRC's regulations do not require seismic instrumentation for this facility

Other Structural Damage Reviews

- Staff verified that under normal and overloads (e.g., due to seismic events, external hazards) radiation effects would not affect intended function(s) of FSTR structural SCs associated with:
  - Neutron Driver Assembly System (NDAS)
  - Subcritical Assembly Support Structure (SASS)
  - Irradiation Facility (IF) and Radioisotope Production Facility (RPF) Cranes
  - Irradiation Unit (IU) structure and its light water pool submerged or semi-submerged safety-related equipment

EH – Aircraft Impact Damage Review

- Staff verified; FSTR aircraft impact analysis used:
  - An impactor with heavy engines (Challenger 605) for facility global and local damage assessments, based on airport operational DATA
  - The DOE-STD-3014-2006 for functional assessments, screening, and evaluating global, local, and vibration damage
  - The energy balance method of DOE-STD-3014-2006 for facility global damage assessment while taking into consideration the ACI 349-13, Appendix F and ANSI/AISC N690-12 Codes ductility limits for reinforced concrete and steel truss elements, respectively
- Staff verified that analysis considered several impact scenarios including impact to facility critical areas and aircraft skidding on FSTR rooftop
- Staff verified that no safety related equipment is attached to the facility envelope that can be damaged by aircraft impact
- Staff verified that facility passive fire protection systems, programs, and nearby firefighting capabilities are adequate to control aircraft impact resulting fires

EH – Blast Effects Damage Review

- Staff examined the validity of software and uncertainties in the methodologies used for the design of the FSTR with respect to blast effects
- Staff verified the effects for potential explosions were assessed based on RG 1.91, Revision 2
- Staff verified potential explosions are at safe distance from the facility
- Staff verified those that could take place nearby have a low probability of occurrence
- Staff verified that the nitrogen tank in proximity to the FSTR and N2PS was designed against accidental explosion and fragmentation to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1

Findings

- Staff verified the FSTR and N2PS designs
  - Adequately protect SSCs against potential meteorological, water, and seismic or external hazards damages and the release of radioactive materials
  - Provide reasonable assurance that SSCs would continue to perform their required safety functions, and that incurred damages if any would not cause unsafe facility operation and would not prevent safe shutdown of the facility
  - Provide adequate levels for defense-in-depth against uncontrolled release of radioactive material to the environment

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Advisory Committee on Reactor Safeguards

SHINE Medical Technologies Operating License Application

Chapter 8 – Electrical Power Systems

May 6, 2022

Jorge A Cintron-Rivera – Technical Reviewer
Office of Nuclear Reactor Regulation

Introductions

- **Michael Balazik** - Project Manager, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation
- **Stephen Wyman**- Acting Chief, Long Term Operations and Modernization Branch, Division of Engineering and External Hazards, Office of Nuclear Reactor Regulation
- **Jorge A Cintron-Rivera** - Technical Reviewer, Long Term Operations and Modernization Branch, Division of Engineering and External Hazards, Office of Nuclear Reactor Regulation
- **Sheila Ray** - Technical Reviewer, Electrical Engineering Branch, Division of Engineering and External Hazards, Office of Nuclear Reactor Regulation

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements:
  - 10 CFR 50.34, “Contents of applications; technical information,” paragraph (b), “Final safety analysis report.” requires in part, the applicant shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components (SSCs) of the facility as a whole.
- Acceptance Criteria
  - Chapter 8, “Electrical Power Systems,” of NUREG-1537, Part 1, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,” (ADAMS Accession No. ML042430055)
  - Chapter 8, “Electrical Power Systems,” of NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria.” (ADAMS Accession No. ML042430048)

Regulatory Basis and Acceptance Criteria (Cont)

NUREG-1537, Part 2, Chapter 8, “Electrical Power Systems.”

- Section 8.1, “Normal Electrical Power Systems,” (NPSS) provides the acceptance criteria for the design, safe operation and shutdown for non-power reactors, and to provide for reactor use.
  - Specific areas for review are; design and functional characteristics should be commensurate with the design bases, have a dedicated substation, provide safe reactor shutdown, provide isolation of electrical circuits, and to provide Technical Specifications.
- Section 8.2, “Emergency Electrical Power Systems,” provides the acceptance criteria for the emergency electrical power systems.
  - Emergency electrical power is required to maintain safe reactor shutdown, to support operation of a required engineered safety feature, and to protect the public from release of radioactive effluents.

SHINE’s Normal Electrical Power System

- Section 8a2.1, “Normal Electrical Power Supply System,” of SHINE’s FSAR provides the description of the normal electrical power system of both, the Irradiation Facility and the Radioisotope Production Facility (RPF).

- NPSS operates as five separate branches, each receiving utility power at 480Y/277 VAC. The branches automatically physically disconnect from the utility by opening the associated utility power (UP) supply breaker on a loss of phase, phase reversal, or sustained overvoltage or undervoltage as detected by protection relays for each utility transformer.

- The design of the NPSS is based on Criterion 27, Electrical power systems, and Criterion 28, Inspection and testing of electric power systems, of the SHINE design criteria. The SHINE design criteria are described in FSAR Section 3.1.

SHINE's Normal Electrical Power System (Cont)

- SHINE's follows the National Fire Protection Association (NFPA) 70-2017, National Electrical Code (NFPA, 2017) as well as portions of IEEE standards applicable to the facility for the design of the NPSS.

- The NPSS provides power to the following safety-related equipment;
  - Two redundant safety-related breakers for the NDAS to provide the ability to disconnect power.
  - Two redundant safety-related breakers for per vacuum pump in the vacuum transfer system (VTS).
  - Two redundant safety-related breakers per extraction feed pump in the molybdenum extraction and purification system (MEPS).
  - Two redundant safety-related breakers for the radiological ventilation zone 1 (RVZ1) exhaust fans and RVZ2.

Staff Review of NPSS

- The staff evaluated the technical information presented in Chapter 8 of the SHINE FSAR, as supplemented by responses to RAIs, to assess the sufficiency of the preliminary design and performance of SHINE Normal Electrical Power Systems in support of the issuance of an operating license.
- Staff considered design criteria, design bases, the NPSS descriptions, and design and operating characteristics to provide reasonable assurance that the final design will conform to the design basis.
- Areas of review for this section included the functional characteristics of the NPSS should be commensurate with the design bases, evaluation of NPSS substation, the capacity and capability of providing safe shutdown, the isolation of the electrical system, and the Technical Specifications.

SHINE’s Emergency Electrical Power System

- Section 8a2.2, “Emergency Electrical Power System,” of SHINE’s FSAR provides the description of the Emergency electrical power system for both, the Irradiation Facility and the Radioisotope Production Facility (RPF).

- The emergency electrical power systems for the SHINE facility consist of
  - Safety-related uninterruptible electrical power supply system (UPSS)
  - Nonsafety-related standby generator system (SGS),
  - Nonsafety-related local power supplies and unit batteries.

- The UPSS is the only power source of the Emergency Electrical Power System that is classified as safety related.

SHINE's facility UPSS

- The purpose of the UPSS is to provide a safety-related source of power to equipment required to ensure and maintain safe facility shutdown and prevent or mitigate the consequences of design basis events.

- The UPSS is designed based on Criterion 27 and Criterion 28 of the SHINE design criteria.

- The UPSS consists of a 125-volt direct current (VDC) battery subsystem, inverters, bypass transformers, distribution panels, and other distribution equipment necessary to feed safety-related alternating current (AC) and direct current (DC) loads and select nonsafety-related AC and DC loads.

SHINE’s facility UPSS

- The UPSS;
  - Provides power at a sufficient capacity and capability to allow safety-related SSCs to perform their safety functions;
  - Is designed, fabricated, erected, tested, operated, and maintained to quality standards commensurate with the importance of the safety functions to be performed;
  - Is designed to withstand the effects of design basis natural phenomena without loss of capability to perform its safety functions;
  - Is located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions;
  - Has sufficient independence, redundancy, and testability to perform its safety functions assuming a single failure;
  - Incorporates provisions to minimize the probability of failure as a result of or coincident with the loss of power from the transmission network; and
  - Permits appropriate periodic inspection and testing to assess the continuity of the system and the condition of components.

UPSS's Applicable Codes and Standards

- Applicable portions of following codes and standards are used for the design, installation and maintenance of the UPSS;
  - NFPA 70-2017, National Electric Code
  - IEEE Standard 344 – 2013 (Seismic Qualification)
  - IEEE Standard 384 – 2008 (Separation and Isolation)
  - IEEE Standard 450-2010 (Maintenance and Testing of Batteries)
  - IEEE Standard 484-2002 (Installation and Design of Batteries)
  - IEEE Standard 485 – 2010 (Battery Sizing)
  - IEEE Standard 323-2003 (Environmental Qualification)
  - IEEE Standard 946-2004 (Design of DC Auxiliary Systems)
  - IEEE Standard C.37.20-2015 (Circuit Breakers)
- Specific portions of each of the Standards used for the design of the UPSS are described in the FSAR.
- The use of this Codes and Standards provides assurance of meeting Criterion 27 and Criterion 28 of the SHINE design criteria.

Staff Evaluation of SHINE’s UPSS

- The NRC staff evaluated the design of the UPSS as described in SHINE FSAR Section 8a2.2.1.

- The staff reviewed the FSAR to verify that the functional characteristics of the emergency power system are commensurate with the design bases. The staff evaluation was performed based on the following SHINE’s plant specific Design Criteria:

  – Compliance with SHINE’s Design Criterion 4 - “Environmental and dynamic effects.”
  – Compliance with SHINE’s Design Criterion 27 - “Electric power systems.”
  – Compliance with SHINE’s Design Criterion 28 - “Inspection and testing of electric power systems.”

Staff Evaluation of SHINE's UPSS (Cont.)

- Compliance with SHINE's Design Criterion 27
  - The staff evaluated the safety-related UPSS to verify if the design of the UPSS provides sufficient capacity and capability to perform its intended safety function.
  - SHINE classifies the UPSS as safety related, However, it is not classified as Class 1E electrical for the SHINE facility.
  - The staff issued RAIs to SHINE to verify the design of UPSS. In specific, the staff requested the Codes and Standards use for the design of the UPSS supporting equipment, and the Classification of the UPSS.
  - While SHINE does not classify the UPSS as a Class 1E system and apply the full-scope of Class 1E standards to the UPSS, portions of Class 1E standards are applied to the design of the UPSS in order to satisfy applicable SHINE design criteria.
  - The staff finds the use of specific portions of the IEEE codes and Standard provide assurance the UPSS provides sufficient capacity and capability to perform its intended safety function.

Staff Evaluation of SHINE’s UPSS (Cont.)

- Compliance with SHINE’s Design Criterion 28
  - The staff evaluated the safety-related UPSS to verify the system designed to permit appropriate periodic inspection and testing of safety related electrical equipment.
  - SHINE follows specific portions of the standards testing, installation, and maintenance of safety related electrical equipment.
  - The staff finds the proposed approach by SHINE of the use of IEEE Standards acceptable for the inspection and testing of the UPSS is acceptable.

Staff Evaluation of SHINE's UPSS (Cont.)

- Compliance with SHINE's Design Criterion 4
  - The staff evaluated the safety-related UPSS to ensure that is designed to perform its safety related function with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.
  - SHINE design of the UPSS will be in accordance with applicable portions of IEEE Standard 344 – 2013 (Seismic) and IEEE Standard 323-2003 (Environmental Qualification)
  - The staff finds that the used of these IEEE standards will provide reasonable assurance that the UPSS will meet the design Criterion 4.

Staff Evaluation of SHINE's SGS

- The NRC staff evaluated the nonsafety-related SGS as a defense-in-depth for the SHINE emergency electrical system.
- The SGS consists of a 480Y/277 VAC, 60 Hertz (Hz) natural gas-driven generator, a 480 VAC switchgear, and transfer switches to allow the SGS switchgear to be connected to either or both emergency 480 VAC NPSS buses.
- The purpose of the SGS is to provide a temporary source of nonsafety-related alternate power to the UPSS and selected additional loads for operational convenience and defense-in-depth.
- The SGS is designed in accordance with the requirements of article 700 of NFPA 70-2017. In response to NRC staff RAI 8-10, SHINE described the specific portions within article 700 of NFPA 70-2017 used for the design of the SGS.

Staff Evaluation of SHINE’s SGS (Cont.)

- Upon a loss of off-site power (LOOP) the SGS automatically starts, both non-vital breakers (NV BKR 1 and NV BKR 2) automatically open, and the transfer switches operate to provide power to the associated 480 VAC NPSS transfer bus.

- The SGS provides power upon LOOP.

- The SGS is not required to support safe shutdown of the SHINE facility.

Staff Evaluation of SHINE's Technical Specifications

- The staff evaluated the sufficiency of the applicant's proposed technical specifications (TSs) for the SHINE electrical power systems as described in SHINE FSAR Chapter 8.
- The proposed TS 3.6, "Emergency Power," Limiting Condition for Operation (LCO) 3.6.1 and Surveillance Requirement (SR) 3.6.1.
- LCO 3.6.1 states in part that, "Two Divisions of the UPSS shall be Operable." The LCO provides the criteria to determined if the Division of UPSS is considered Operable.
- SR 3.6.1 provides the surveillance requirements for the UPSS. Table 3.6.1, "UPSS Actions," provides the actions to be taken and completion times to restore operation of the UPSS if one of two divisions of the UPSS are not operable.

Staff Evaluation of Findings

- The NRC staff reviewed SHINE's electrical power systems against the applicable guidance of Chapter 8 of NUREG-1537, Part 2.
- The staff determined that the functional characteristics of the NPSS and the emergency power system are commensurate with SHINE's plant specific Design Criteria 4, 27, and 28.
- The NPSS provides reasonable assurance that in the event of a loss or interruption of electrical power, the facility can be safely shutdown.
- In the event of a loss of the NPSS, the UPSS provides reasonable assurance the SHINE facility can be maintained in a safe shutdown condition.
- The staff finds that the licensee's use of specific codes and standards provides reasonable assurance that the NPSS and the emergency electrical system meet SHINE's plant specific Design Criteria 4, 27 and 28

Staff Evaluation of Findings (Cont.)

- Based on the above determinations, the NRC staff finds that the descriptions and discussions of SHINE's electrical power systems are sufficient and meet the applicable regulatory requirements and guidance and acceptance criteria for the issuance of an operating license.

Questions

Background Information

- SHINE's Design Criterion 4 - "Environmental and dynamic effects."

  Safety-related SSCs are designed to perform their functions with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. These SSCs are appropriately protected against dynamic effects and from external events and conditions outside the facility.

- Applicable portions IEEE Standards SHINE's Design Criterion 4
  - Sections 4.1, 5.1, 6.1, and 7 of IEEE Standard 323-2003 (Environmental Qualification)
  - Sections 8 and 9.3 of IEEE Standard 344 – 2013 (Seismic Qualification)

Background Information

- SHINE's Design Criterion 27 - "Electric Power Systems."

An on-site electric power system and an off-site electric power system are provided to permit functioning of safety-related SSCs. The safety functions are to provide sufficient capacity and capability to assure that:

1) target solution design limits and primary system boundary design limits are not exceeded as a result of anticipated transients, and

2) confinement integrity and other vital functions are maintained in the event of postulated accidents.

The on-site uninterruptible electric power supply and distribution system has sufficient independence, redundancy, and testability to perform its safety functions assuming a single failure. Provisions are included to minimize the probability of losing electric power from the uninterruptible power supply as a result of or coincident with, the loss of power from the off-site electric power system.

Background Information

- Applicable portions IEEE Standards SHINE’s Design Criterion 27
  - NFPA 70-2017, National Electric Code
  - Sections 6.1.2.1, 6.1.2.2, and 6.1.2.3 of IEEE Standard 384 – 2008 (Isolation)
  - Section 5.1.1.2, Table 1 of Section 5.1.3.3, and Table 2 of Section 5.1.4 of IEEE Standard 384 – 2008 (Separation)
  - Section 5 of IEEE Standard 450-2010 (Maintenance and Testing of Batteries)
  - Sections 5 and 6 of IEEE Standard 484-2002 (Installation and Design of Batteries)
  - Sections 6.1.1, 6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.3.2 and 6.3.3 of IEEE Standard 485 – 2010 (Battery Sizing)
  - Sections 5.2, 6.2, 6.5, 7.1, 7.3, Table 2 of 7.4, 7.6, and 7.9 of IEEE Standard 946-2004 (Design of DC Auxiliary Systems)
  - IEEE Standard C.37.20-2015 (Circuit Breakers)

Background Information

- SHINE's Design Criterion 28 - "Inspection and Testing of Electric Power Systems."

  The safety-related electric power systems are designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems are designed with a capability to test periodically:

  1) the operability and functional performance of the components of the systems, such as on-site power sources, relays, switches, and buses; and

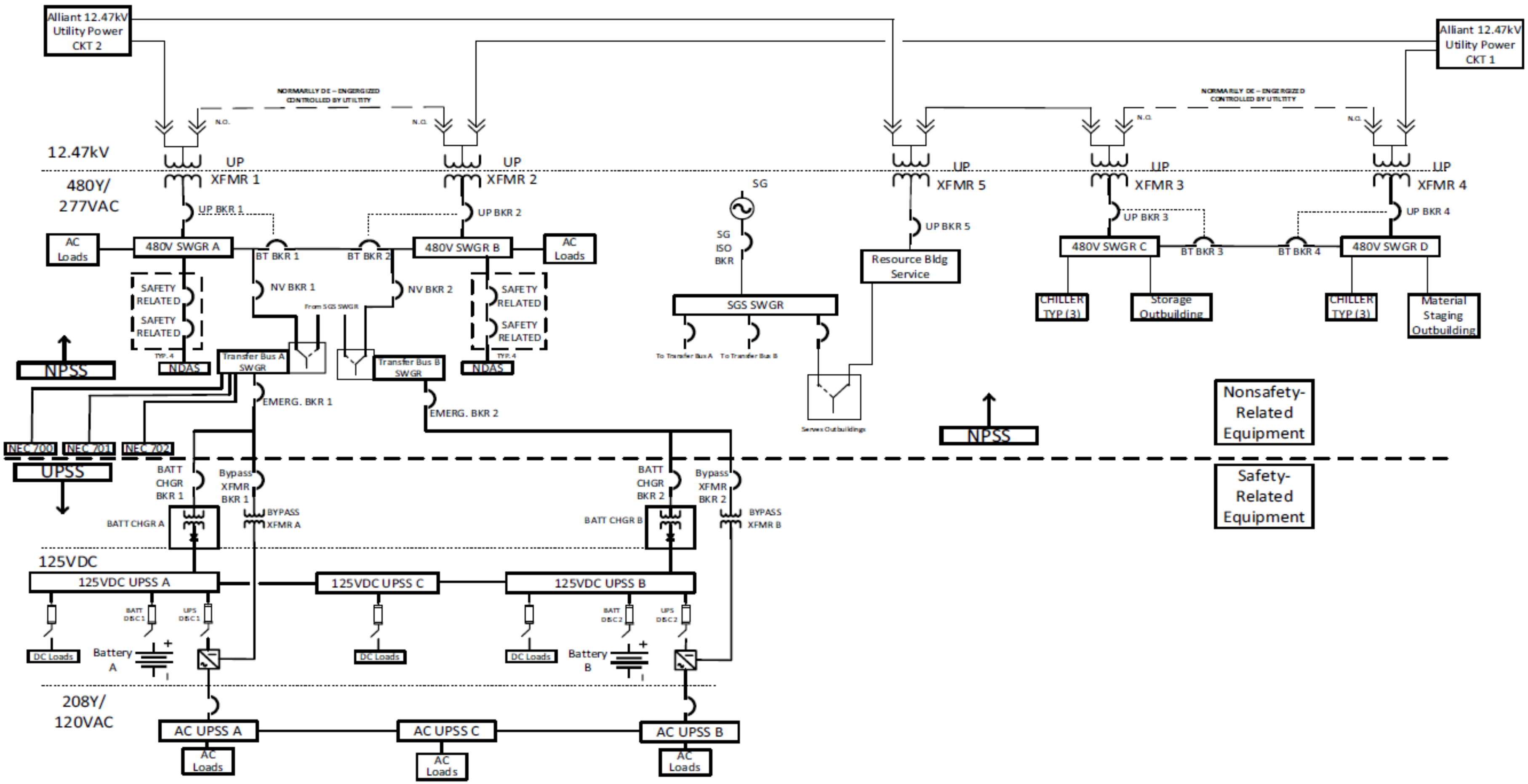
  2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the on-site and off-site power supplies.

Background Information

- Applicable portions IEEE Standards SHINE's Design Criterion 28
  - NFPA 70-2017, National Electric Code
  - Section 5 of IEEE Standard 450-2010 (Maintenance and Testing of Batteries)
  - Sections 5 and 6 of IEEE Standard 484-2002 (Installation and Design of Batteries)
  - Sections 6.1.1, 6.2.1, 6.2.2, 6.2.3, 6.2.4, 6.3.2 and 6.3.3 of IEEE Standard 485 – 2010 (Battery Sizing)
  - Sections 5.2, 6.2, 6.5, 7.1, 7.3, Table 2 of 7.4, 7.6, and 7.9 of IEEE Standard 946-2004 (Design of DC Auxiliary Systems)
  - IEEE Standard C.37.20-2015 (Circuit Breakers)

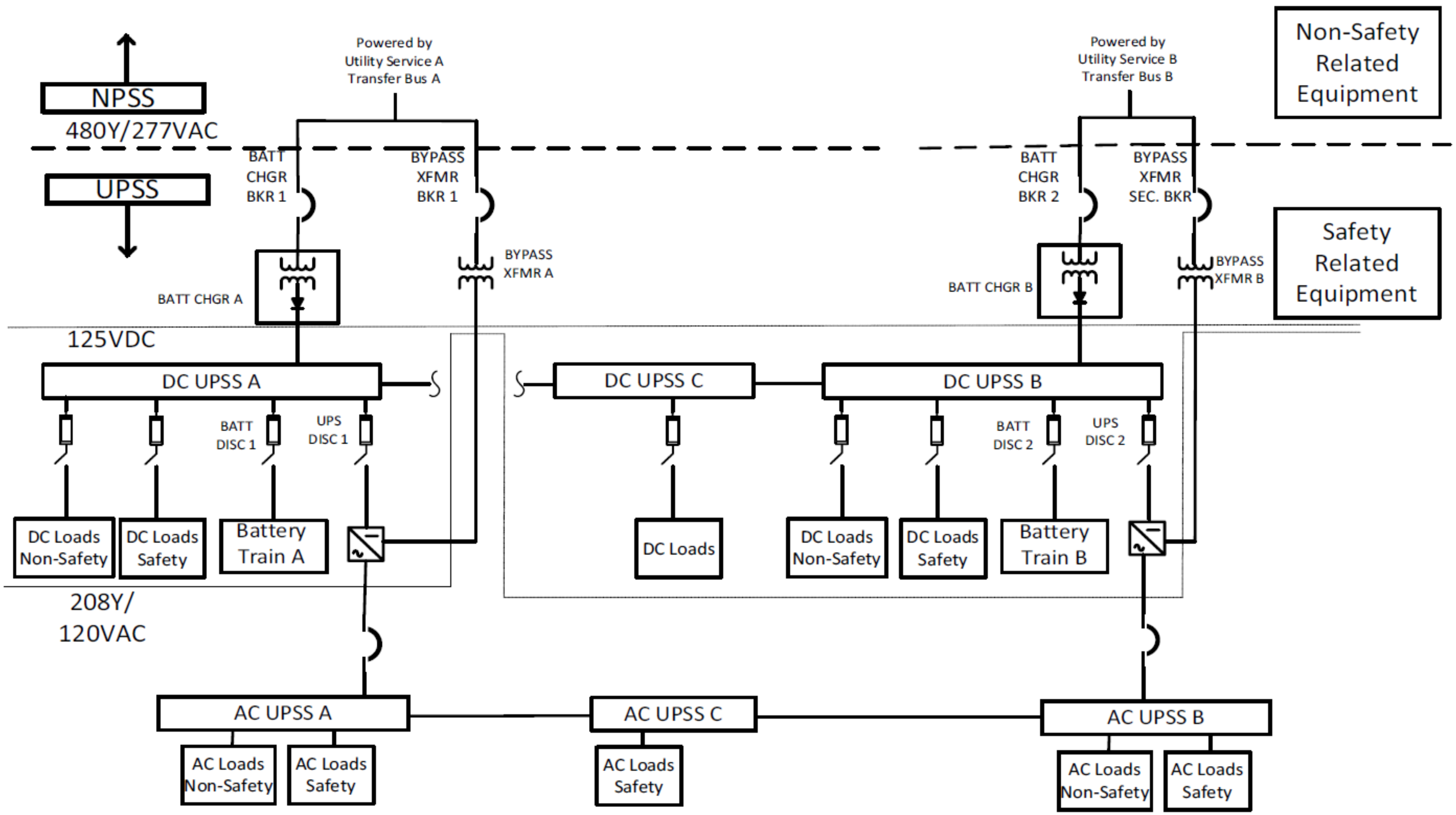
Background Information

Figure 8a2.1-1 – Electrical Distribution System (Simplified)



Background Information

Figure 8a2.2-1 – Uninterruptible Power Supply System



Advisory Committee on Reactor Safeguards

SHINE Medical Technologies
Operating License Application

Chapter 9 – Auxiliary Systems

May 6, 2022

Nageswara (Rao) Karipineni – Technical Reviewer
Office of Nuclear Reactor Regulation

Introductions

Michael Balazik - Project Manager, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation

Nageswara (Rao) Karipineni – Safety and Plant Systems Engineer, Containment and Plant Systems Branch, Division of Safety Systems, Office of Nuclear Reactor Regulation

Facility Descriptions

HVAC Systems

- Section 9a2.1 of the FSAR addresses the design features of the HVAC systems for the IF, RPF, and the supporting external office complex, including the features designed to mitigate the consequences of accidents and events to keep radiological exposures within acceptable limits. Facility chilled water (FCHS) and facility heating water (FHWS) systems are also described in Section 9a2.1 of the FSAR.

Facility Descriptions

HVAC Systems

- Radiologically controlled area (RCA) and non-radiological area HVAC systems
- RCA is divided into three radiological ventilation zones (RVZ1, RVZ2 and RVZ3). Non-RCA is Facility Ventilation Zone (FVZ4).
- Systems consist of supply units (RVZ2s), recirculation units (RVZ1r and RVZ2r), and exhaust units (RVZ1e, RVZ2e). FVZ4 has its own supply, recirculation and exhaust units.

Facility Descriptions

HVAC Systems (Chilled water and Heating water)

- Facility Chilled Water System (FCHS). Serves equipment located external to RCA.

- Facility Heating Water System (FHWS). Serves equipment located external to RCA.

Facility Descriptions

Areas of Review - HVAC System Isolations

- Supercell Isolations (RVZ1e Isolations)
- IU Isolation (RVZ1e)
- RCA Isolations

No isolations are needed for FVZ-4, FCHS, FHWS

Facility Descriptions

Cover Gas Control in primary cooling system

Captures radiolytic gases from primary closed loop cooling system (PCLS) cooling water leaving the subcritical assembly (SCAS) and provide a path to exhaust gases to outside, via RVZ1e exhaust filter train.

Cover Gas Control in RPF

- Process Vessel Vent System (PVVS): Provides radiolytic hydrogen mitigation capability by ventilating process tanks and vessels, accepts discharge from VTS and TOGS, treats the affluents and discharges to outside.
- Nitrogen purge System (N2PS): Provides backup to PVVS during loss of power.

Facility Descriptions
Tritium Purification System (TPS)

- Supplies pure deuterium and tritium streams to the Neutron Driver Assembly System (NDAS)
  - Separates the deuterium-tritium gas mixture from the NDAS into pure deuterium and tritium streams

- TPS equipment is contained inside the TPS room.
  - The TPS room ventilation exhausts to RVZ2e

- Processes are performed inside gloveboxes to minimize exposure to workers
  - The TPS glovebox exhausts to RVZ1e

Facility Descriptions

Tritium Purification System (TPS) – continued

- Limits tritium in waste streams exhausted to the facility ventilation system.

- The TPS is designed to minimize the release of tritium to the facility and the environment during normal operations and design basis accidents and keep the releases within 10 CFR 20 limits.

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements
  - 10 CFR 50.34, "Contents of applications; technical information," paragraph (b), "Final safety analysis report."
  - 10 CFR 50.36, "Technical Specifications."
  - 10 CFR 50.40, "Common Standards."
  - 10 CFR 50.57, "Issuance of operating license."
  - 10 CFR 20.1201, "Occupational dose limits for adults."
  - 10 CFR 20.1301, "Dose limits for individual members of the public."

- Acceptance Criteria
  - NUREG-1537 and ISG, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria."

Areas of Review

- System description, system components and system performance are adequately described.
- Applicable SHINE design criteria considered in the design
- Isolation features included in the design, as described in the applicable figures and tables included in the FSAR
- Actuation of the isolation features and consistency with I&C portions of isolation descriptions in Chapter 7
- Inclusion of appropriate design features and equipment in the technical specifications

Summary of Application

IR and RPF HVAC Systems

RCA

- RVZ1e and RVZ1r
- RVZ2s and RVZ2e
- RVZ3
- Isolation Features (Supercells, RCA boundaries)

Non-RCA

- FVZ4
- FCHS
- FHWS

Figure 9a2.1-5 – Radiological Ventilation Zone 2 Supply Subsystem (RVZ2s) Air Handling Units (AHUs)

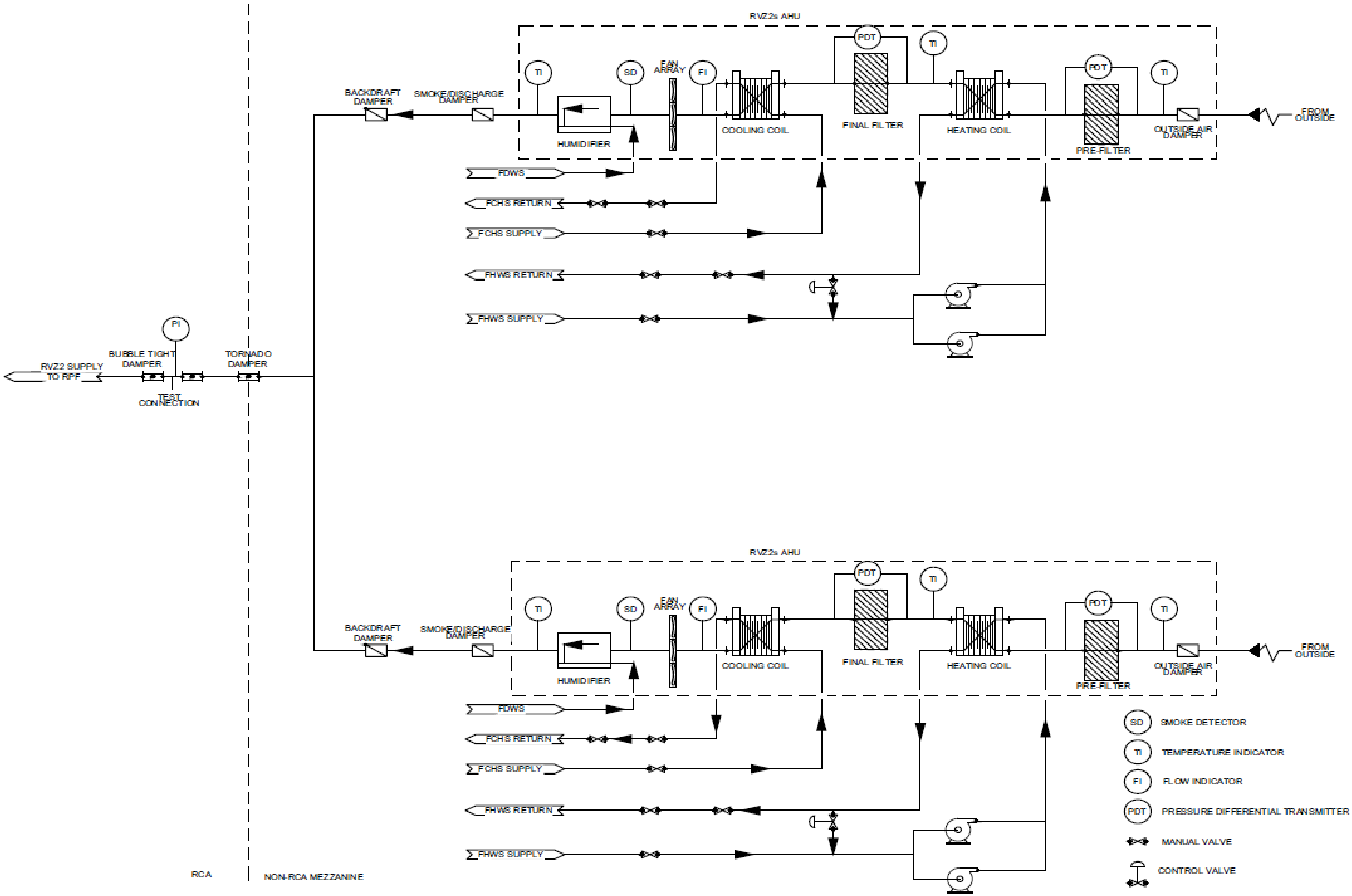


Figure 9a2.1-3 – Radiological Ventilation Zone 1 Exhaust Subsystem (RVZ1e) Flow Diagram

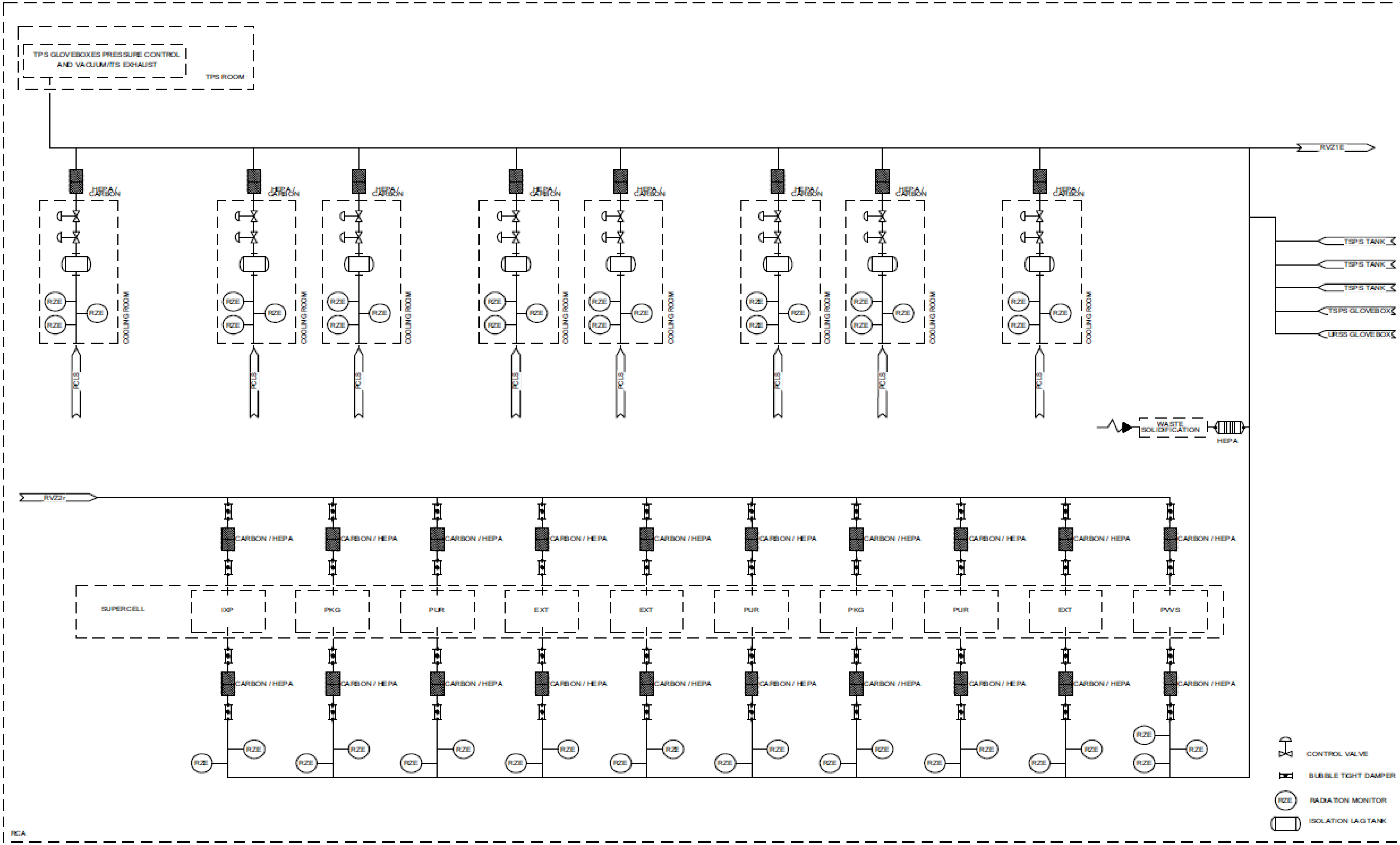


Figure 9a2.1-8 – Radiological Ventilation Zone 1 Exhaust Subsystem (RVZ1e) and Radiological Ventilation Zone 2 Exhaust Subsystem (RVZ2e) Mezzanine

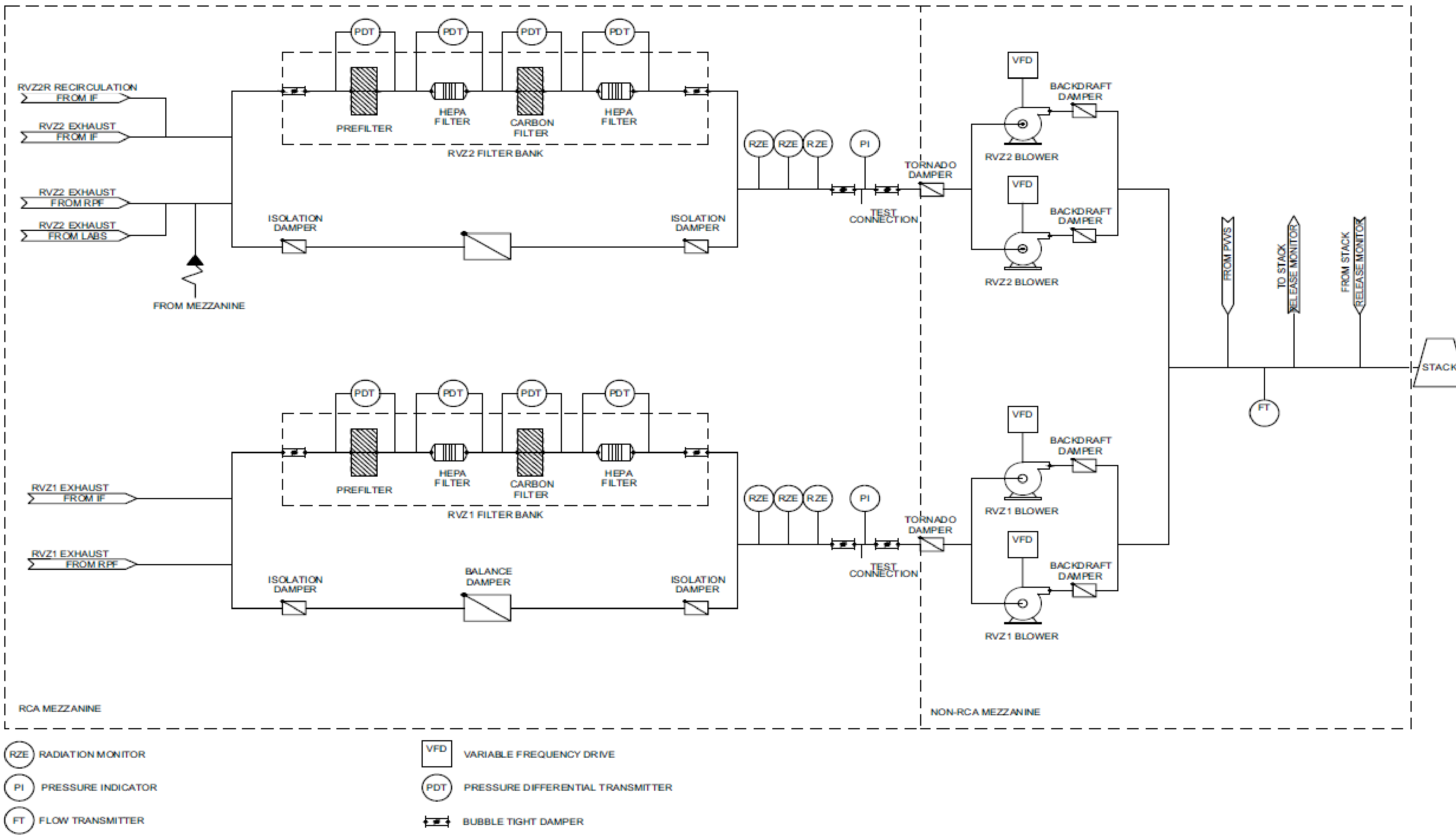
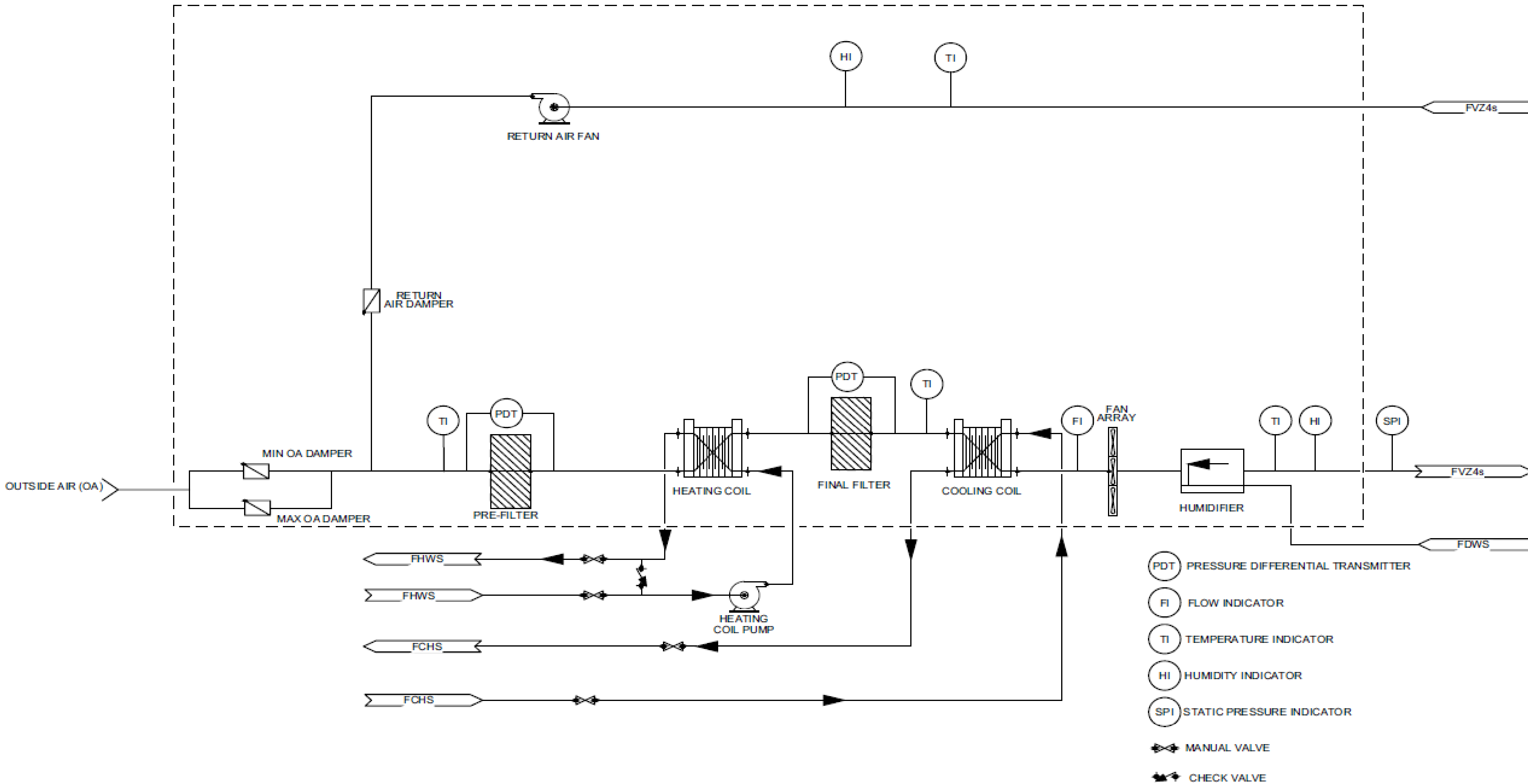


Figure 9a2.1-11 – Facility Ventilation Zone 4 (FVZ4) Air Handling Units (AHUs) (Typical)



Summary of Application

IF and RPF Cover Gas Control

- PCLS and expansion tank design to vent radiolysis gases to RVZ1 system.
- TPS gloveboxes

- PVVS
- N2PS
- RVZ2s isolation valves

Figure 9b.6-1 – PVVS Process Flow Diagram

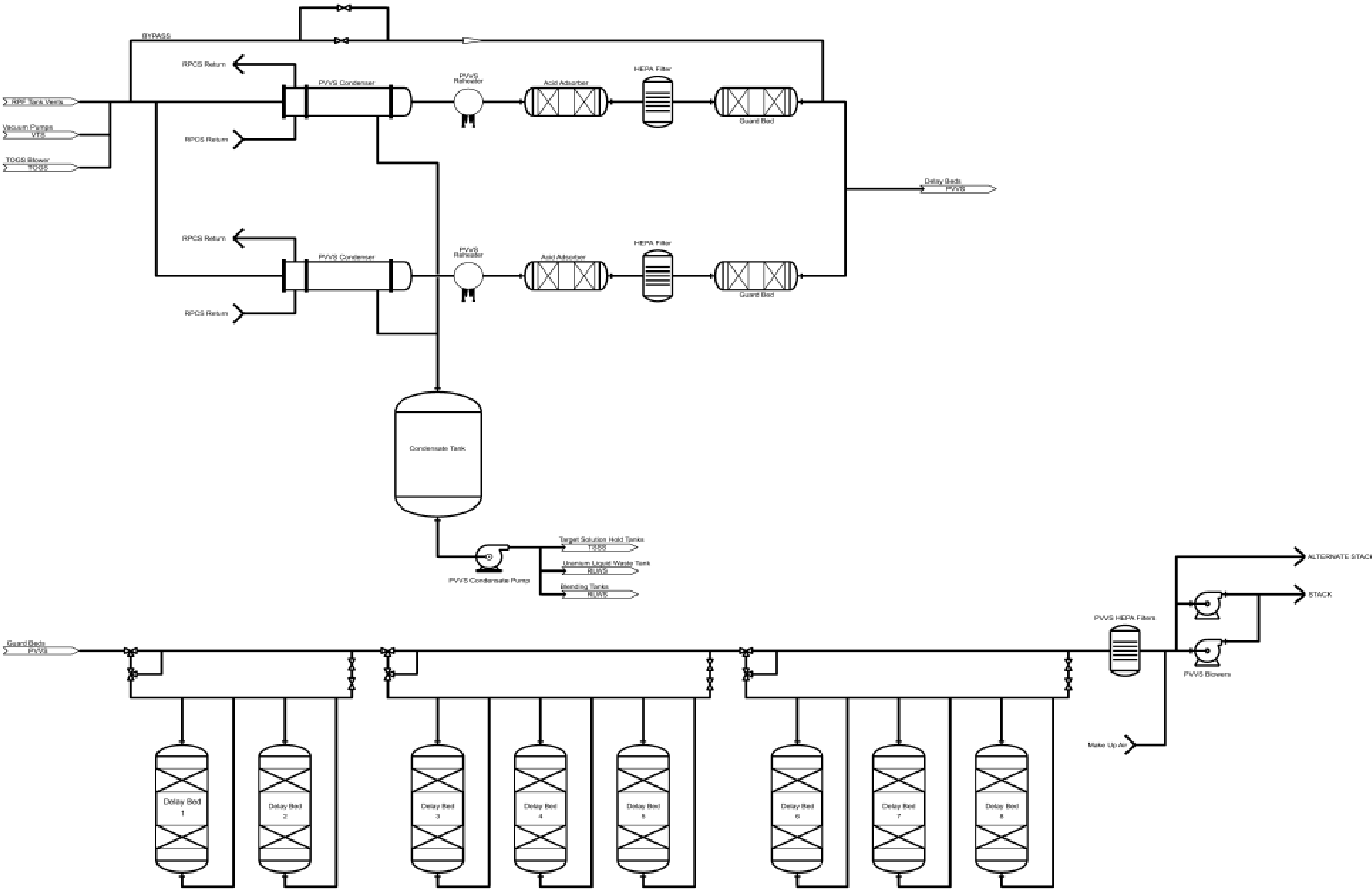


Figure 9b.7-2 – RLWS Uranium Liquid Waste Tanks Process Flow Diagram

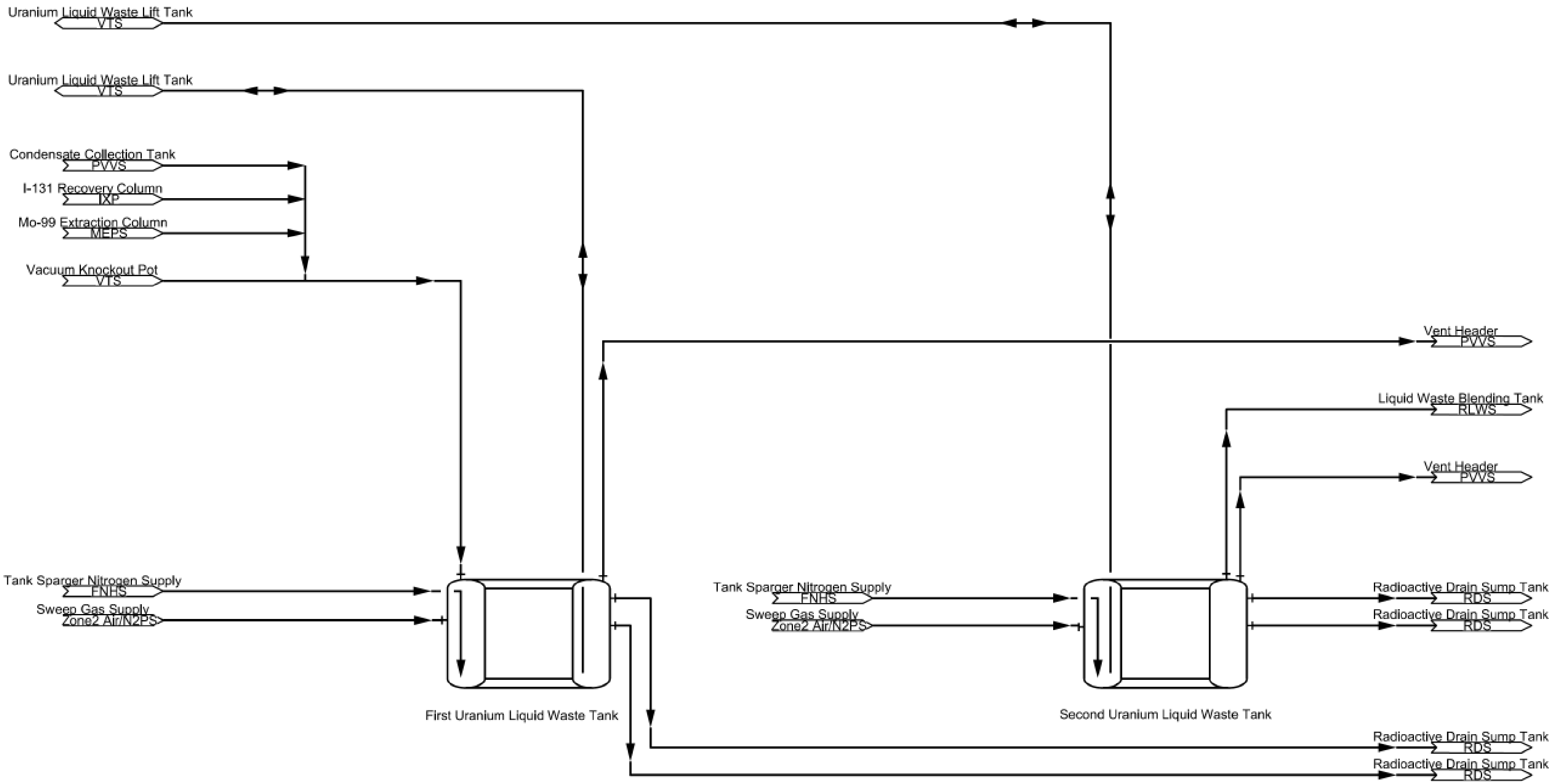
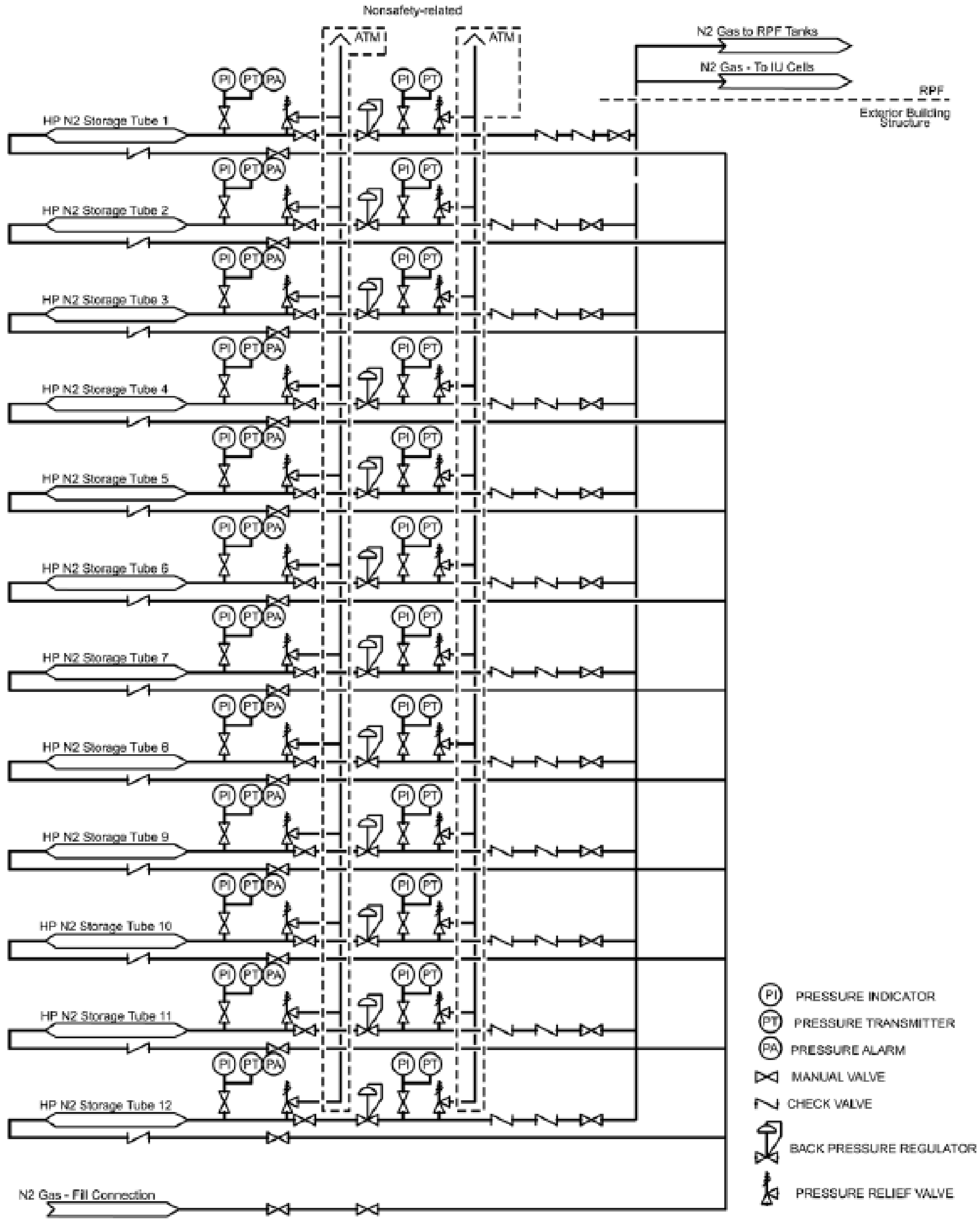


Figure 9b.6-2 – N2PS Process Flow Diagram



Summary of Application

Principal Design Criteria:

- Criteria 29 – satisfied by identifying RCA boundaries as a fourth class of boundary
- Criteria 32 – included provisions for testing and inspections
- Criteria 35 – control of releases of radioactive materials is satisfied by isolation provisions and the PVVS and N2PS
- Criteria 38 – design includes monitoring of radioactive releases
- Criteria 39 – hydrogen control provided by PVVS and N2PS N2PS

Summary of Application

Technical Specifications:

- LCO 3.4.4 addresses supercell confinement dampers.
- LCO 3.4.5 addresses IU boundary (shield plugs, RVZ1r)
- LCO 3.8.9 addresses RCA isolation dampers.
- LCO 3.5.1 addresses PVVS
- LCO 3.8.1 addresses N2PS
- LCO 3.8.7 and 3.8.8 addresses TPS

Review Procedures and Technical Evaluation

The staff compared the design features of the HVAC, PVVS, N2PS, and TPS in Chapter 9 with the descriptions in Chapter 7 and Chapter 13 and determined they were consistently applied.

The staff performed an evaluation of the technical information presented in Chapter 9 of the SHINE final safety analysis report (FSAR), including the tables and block diagrams, to assess the sufficiency of the final design and the description of the engineered safety features in support of the issuance of an operating license.

Evaluation Findings and Conclusions

- Accordingly, SHINE has met the following requirements of 10 CFR 50.57 for issuance of an operating license:

  1) Irradiation facility and radioisotope production facility HVAC systems, cover gas control systems (PVVS and N2PS) and TPS were described in sufficient detail, including the applicable principal design criteria and technical specifications.

  2) Reasonable assurance, based on Chapter 9 review, that the activities authorized by the operating license can be conducted without endangering the health and safety of the public.

TPS Backup Slides

Backup Slide -Tritium Purification System (TPS)

Table 9a2.7-1 – Tritium Purification System Interfaces

Interfacing System	Interface Description
Neutron driver assembly system (NDAS)	Tritium purification system (TPS) interfaces with the NDAS through process tubing connections that allow delivery of tritium and deuterium gas along with return of mixed tritium and deuterium exhaust gas or NDAS evacuation.
Process integrated control system (PICS)	PICS provides normal monitoring and control of all process variables and control components not important to the safe operation of the TPS.
Target solution vessel (TSV) reactivity protection system (TRPS)	The TRPS provides monitoring and indication of the TPS variables important to the safe operation of individual irradiation unit (IU) cells and provides control of all TPS isolation valves into the primary confinement boundary in the event of a design basis event.
Engineered safety features actuation system (ESFAS)	The ESFAS provides monitoring and indication of the TPS variables important to the safe operation of the TPS glovebox and glovebox stripper system. The ESFAS also provides control of all TPS isolation valves out of the TPS and the glovebox stripper system in the event of a design basis event. The ESFAS controls the position of the safety-related actuation components of the TPS.
Facility nitrogen handling system (FNHS)	Liquid nitrogen is supplied to TPS process equipment to operate cryopumps and TCAP equipment. Gaseous nitrogen is used to actuate air-operated valves throughout the TPS process.
Radiological ventilation zone 1 (RVZ1)	TPS interfaces with RVZ1 at the points of connection from the gloveboxes pressure control exhaust and the points of connection from the TPS vacuum/impurity treatment subsystem process equipment to the zone 1 header duct.
Radiological ventilation zone 2 (RVZ2)	TPS interfaces with RVZ2 at the exhaust point of the liquid nitrogen cooling lines (in the form of nitrogen gas), TPS fume hoods, and the overall ventilation of the TPS room.
Normal electrical power supply system (NPSS)	TPS interfaces with the NPSS at the following locations: the glovebox electrical penetrations and connections to equipment located external to the glovebox. Electrical power is distributed within the glovebox to operate the various pumps and heaters in the TPS, and other ancillary equipment.
Standby Generator System (SGS)	The SGS provides nonsafety-related backup power to TPS components.
Uninterruptible electrical power supply system (UPSS)	TPS interfaces with the UPSS at the connections to safety-related equipment and instrumentation that require safety-related backup power. Some nonsafety-related portions of the SEC are also on the UPSS.

Backup Slide - Tritium Purification System (TPS)

Table 9a2.7-3 – Tritium Purification System Process Equipment

Component	Description	Design/Fabrication Code or Standard
Tritium purification system (TPS) gloveboxes	The TPS gloveboxes provide a confinement barrier that prevents tritium leakage from isotope separation process equipment from releasing to the facility	AGS-G001-2007 is considered as guidance for the design of the gloveboxes. (AGS, 2007)
Cryopumps	The cryopumps recover gas from neutron driver assembly system (NDAS) units and deliver gas to the thermal cycling absorption process (TCAP) feed	Note (a)
Permeator	The permeator removes impurities from the TPS gas stream before it is delivered to TCAP for isotope separation	Note (a)
TCAP	The TCAP columns are a palladium-based column and a molecular sieve column that are thermally cycled to isotopically separate tritium and deuterium	Note (a)
TPS secondary enclosure cleanup beds	The TPS secondary enclosure cleanup beds remove tritium, moisture, and oxygen from the glovebox atmospheres to maintain an inert glovebox atmosphere with minimal tritium contamination	Note (a)
TPS isolation valves	TPS isolation valves are located on process lines to provide confinement in conjunction with the TPS glovebox and IU cells in the event a radiological release is detected in the IU cell or TPS gloveboxes	Note (a)

(a) Commercially available equipment designed to standards satisfying system operation.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Advisory Committee on Reactor Safeguards

SHINE Medical Technologies Operating License Application

Chapter 11 – Radiation Protection Program and Waste Management

May 6, 2022

Zachary Gran – Technical Reviewer
Office of Nuclear Reactor Regulation

Section 11.1.1 – Radiation Sources

- Describes two source term scenarios: Nominal and Safety Basis Values.
- Provides gaseous source term information for use in worker dose and environmental releases.
- Provides liquid and solid source terms information for use in worker dose evaluations.
- Based on staff review of calculations provided, the source terms were determined acceptable for use in dose analysis.

Section 11.1.2 – Radiation Protection (RP) Program

- Provides information to establish an RP program as well as the commitments to training and annual auditing of the RP program.
- RP program is established to meet the guidance contained in RG 8.2 and ANSI/ANS 15.11-2016.
- Commitments to RG 8.2 and ANSI/ANS 15.11 is acceptable and conforms with information stated in NUREG-1537. In addition, SHINE describes the use of procedures, training, maintaining doses ALARA, and establishment of administrative limits in the development of the RP program.

Section 11.1.3 – ALARA Program

- The ALARA program conforms with the guidance in RGs 8.2, 8.8, 8.10, 8.13, and 8.29 and complies with 10 CFR 20.1101.
- Radiation Protection Manager performs annal evaluation of the ALARA program.
- Incorporates design features to minimize radiation exposures and the spread of contamination by incorporating considerations for materials, radioactive material processing, storage and disposal, facility layout, and ALARA practices.
- Staff determined that ALARA program is acceptable and consistent with NUREG-1537.

Section 11.1.4 – Radiation Monitoring and Surveying

- Continuous effluent monitoring of noble gases, particulates, and iodine on the facility stack.
- Stack is monitored to show gaseous releases being maintained below public dose limits contained in 10 CFR 20.1301.
- TS 3.7.2 ensures releases are below regulatory limits.
- Continuous air monitoring and radiation area monitoring is provided at the facility.
- Radiation monitoring is acceptable to adequately control and monitor the radiological conditions in their facility.

Section 11.1.5 – Radiation Exposure Control and Dosimetry

- Details a program that will ensure appropriate use of signs and postings.
- Establishes restricted areas to control radiation exposures by use of interlocks and visual warnings.
- Provides information to detail expected radiation zones in the facility.
- Personnel monitoring is worn by those individuals that enter and working in the restricted areas of the facility.
- Staff performed confirmatory calculations to verify dose rates in various areas of the facility.
- Uses radiation monitoring and dosimetry to maintain doses ALARA.

Section 11.1.6 – Contamination Control Equipment and Facility Layout

- Shielded compartments and hot cells are incorporated in the design of the SHINE facility to minimize the spread of contamination.
- Control airflow patterns to reduce the spread of contamination.
- Continuous air monitors are located within the facility to detect the spread of contamination.
- Design features and monitors are acceptable to limit the spread of contamination in their facility.

Section 11.1.7 – Environmental Monitoring

- Follows the guidance contained in RG 4.1 and NUREG-1301 for developing REMP and ODCM.
- Provides monitoring for radiation exposures, inhalation, and ingestion pathways.
- Environmental monitoring is established around the facility.
  - Air sampling and direct radiation monitoring provided at each location.
  - Verifies effectiveness of effluent monitoring program.
- Surface water and biota monitoring is not anticipated.
  - Acceptable given the REMP is evaluated annually to verify if new pathways need to be monitored.
- Environmental monitoring program is acceptable to monitor and track effluent released from the facility.

Section 11.2.1 – Radioactive Waste Management Program

- Establishes a structure for the radioactive waste management program.
- Training and procedures established to ensure radioactive waste is controlled by the facility.
- Maintains records of waste management program.
- Staff determined that the Radioactive Waste Management Program is acceptable.

Section 11.2.2 –
Radioactive Waste Controls

- Provides information on estimated annual waste streams generated.
- Describes practices to minimize the generation of radioactive waste.
- Material Staging Building is used for interim storage of waste for decay and for preparation for transportation.
- Describes the sources, types, and volumes of waste generated at the facility.

Section 11.2.3 – Release of Radioactive Waste

- No radioactive liquid effluent is released. Radioactive liquid waste streams are solidified prior to disposal.
- Annual solid waste generation estimates provided along with anticipated waste classifications.
- Gaseous effluent is released from the facility stack and is continuously monitored for noble gases, particulates, iodine, and tritium to ensure compliance with effluent release limits.
- Staff confirmatory calculations verify doses from gaseous effluents are below the 10 mrem specified in 10 CFR 20.1101(d).

Section 11.3 –
Respiratory Protection Program

- SHINE will conform with NRC guidance contained in RG 8.15.
- Commitment to this RG ensures protection of personnel from airborne concentrations exceeding the limits of 10 CFR Part 20 Appendix B, and compliance with 10 CFR Part 20 Subpart H.

Acronyms

ALARA - As Low As Is Reasonably Achievable

ODCM - Offsite Dose Calculation Manual

REMP - Radiological Environmental Monitoring Program

RG - Regulatory Guide

RP - Radiation Protection

SAR - Safety Analysis Report

TS - Technical Specifications