Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Northwest Medical Isotopes Subcommittee
Open Session

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Tuesday, July 11, 2017

Work Order No.: NRC-3162 Pages 1-337

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

NORTHWEST MEDICAL ISOTOPES (NWMI) SUBCOMMITTEE

+ + + + +

OPEN SESSION

+ + + + +

TUESDAY

JULY 11, 2017

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Margaret Chu, Chairperson, presiding.

COMMITTEE MEMBERS:

MARGARET CHU, Chairperson

PETER RICCARDELLA, Member-at-Large

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR., Member

WALTER KIRCHNER, Member

JOSE MARCH-LEUBA, Member

DANA A. POWERS, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

KATHY D. WEAVER

ALSO PRESENT:

ALEXANDER ADAMS, JR., NRR

STEPHEN ALEXANDER, Information Systems Laboratories, Inc.

JOHN ATCHISON, Information Systems Laboratories, Inc.*

MICHAEL BALAZIK, NRR

GREG BOWMAN, NRR

MICHAEL CORUM, NWMI

GARY DUNFORD, NWMI

CAROLYN HAASS, NWMI

GREG HOFER, Information Systems Laboratories, Inc.*

ENVER ODAR, SC&A Inc.*

STEVEN REESE, NWMI

JAMES SERVATIUS, Information Systems Laboratories, Inc.*

SAM SWAN, NWMI*

DAVID TIKTINSKY, NMSS

CHRISTOPHER TRIPP, NMSS

ANDREA D. VEIL, Executive Director, ACRS

MASOUD ZADEH, NWMI*

*Present via telephone

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

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

(8:30 a.m.)

CHAIR CHU: This meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Northwest Medical Isotopes NWMI subcommittee. I'm Margaret Chu, Chairman of the Subcommittee. Members in attendance today are Gordon Skillman, Dana Powers, Dennis Bley, Walt Kirschner, and Charlie Brown.

Okay, the purpose of today's meeting is for the Subcommittee to hear briefings from the representatives of NWMI regarding their construction permit application for a radioisotope production facility in the city of Columbia, Missouri for producing molybdenum-99.

We also expect to hear from the NRC Staff regarding their review of this application. The following NWMI construction permit application preliminary safety analysis report chapters, namely Chapter 3, 6, 7, and 8 and the associated NRC Staff safety evaluation reports are scheduled for discussion today as noted in the agenda.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Rules for the conduct of and participation in the meeting have been published in the Federal Register as part of the notice for this meeting.

Kathy Weaver is the Designated Federal Official for this meeting. Portions of this meeting will be closed to the public to protect information proprietary to NWMI or its vendors. We have designated a portion of the afternoon sessions to discuss proprietary information toward the end of the meeting as shown on the agenda, and this session will be closed to the public.

A transcript of the meeting is being kept. Therefore, it is requested that all speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

During the open session of the meeting, a public bridge line will be open on mute so that those individuals may listen in. At the appropriate time later in the meeting, we'll have an opportunity for public comment from the bridge line and from members of the public in attendance.

During the closed portion of this meeting, the public bridge line will be closed. The Staff has asked to have an open line during both the open and closed portion of the meeting so that certain NRC contractors and staff who are a part of the safety review can respond if necessary to ACRS members' questions. We ask that you keep this line on mute unless speaking to avoid disruption of the meeting.

We'll now proceed with the meeting, and I'll call upon Greg Bowman, Deputy Director, Division of Policy and Rulemaking in the Office of Nuclear Reactor Regulation to open the presentation today.

MR. BOWMAN: Thank you, Dr. Chu. As you mentioned, my name is Greg Bowman, I'm the Acting Deputy Director for the Division of Policy and Rulemaking at the Office of Nuclear Reactor Regulations.

Our division, staff in the Office of Nuclear Material Safety and Safeguards, and Information Systems Laboratories, our technical contractor, are pleased to be here today to conduct our second briefing for you on the Staff's review of the Northwest Medical Isotopes Production, Northwest Medical Isotopes construction permit application.

In addition to the NRC Staff, Carolyn Haass, Steve Reese, and others from Northwest Medical Isotopes are here to present information on their application.

As we discussed in mid-June when we last met, the NRC Staff received the construction permit application for medical radioisotope production facility from Northwest Medical Isotopes in the summer of 2015.

At the previous meeting, the Staff presented Chapters 1, 2, 4, and 5 of our draft safety evaluation report with Northwest Medical Isotopes presenting the companion chapter of their preliminary safety analysis report.

Today, the Staff and Northwest Medical Isotopes will present on Chapters 3, 6, 7, and 8 as you mentioned. Those chapters cover structure systems and components, engineered safeguard features, instrumentation and control, and electrical systems.

Our next scheduled meeting with you is on August 22nd and 23rd where the Staff and Northwest Medical Isotopes plan to present the remaining chapters of the draft safety evaluation report and application respectively.

Before we begin today, I did want to take a moment to thank the Committee for all the feedback we got from you at our June meeting. We benefitted greatly from the discussion, I think that goes without saying. It certainly gave us some things to explore further as we complete our safety evaluation. And overall, I'm confident that feedback will result in us ending this with a better product.

Prior to today's presentations, Northwest Medical Isotopes and the Staff will address some of the open items that were identified from that meeting, and the actions we're taking or plan to take to address that feedback.

We'll plan on doing the same thing at the August meeting at which time we'll cover any remaining open items from either the June meeting or from today's meeting.

So with that, I'll turn the presentation over to Northwest Medical Isotopes.

MS. HAASS: Hi, I'm Carolyn Haass, I'm the Chief Operating Officer of Northwest Medical Isotopes, and I have Steve Reese with me, the Director of Irradiation Services, Northwest Medical Isotopes, Mike Corum who is our Specialty Engineering Lead who works with Atkins Global, and Gary Dunford who is our Process Lead who is with AEM Consulting.

The first thing that we wanted to talk briefly about today are the action items from the previous meeting. And the first action item that we'll go over has to do with NWMI's design criteria and the use of historical events. And I'm going to let Mike Corum speak to that.

MR. CORUM: Okay, for the historical event question, we're going to use the most conservative of either the regulatory NPH conditions. For seismic we'll be using the Reg Guide 1.6 with the spectra grounded to a 0.2g peak ground acceleration.

We'll be basing the facility design on normal methodology for seismic, high wind, and missiles. But then we are going to look at a worst historical accident, or the worst historical even to make sure that we can bound that for a particular site. And in particular for the seismic, the peak ground acceleration will be that used at both MURR and Calloway.

MEMBER SKILLMAN: To that point, if Calloway is adjusting their seismic response for the CEUS, the revised responses, will you be revising yours as well?

MR. CORUM: At this time we don't plan on doing that. We understand that the Calloway analysis is going to be going on for the next two to three years, and that's beyond our horizon for the analysis scope.

MS. HAASS: Also, we know that MURR has done their lessons learned from Fukushima which I know Mike Balazik was part of that team. And we can let Mike go into that further. But it did recommend and

I believe a 0.2g. But please, go on.

MR. CORUM: Yes, in the MURR analysis they did use Reg Guide 1.60 for the response spectra as well as the 0.2g peak ground acceleration.

MS. HAASS: And due to we're, you know, five miles from MURR, we felt that that was a good analysis, and that the NRC Staff has done that. And as I said, Mike can go into a bit more detail in that.

MEMBER SKILLMAN: Thank you.

MS. HAASS: The next action item had to do with transient population. And there was a question on the southwest quadrant why there weren't more people, especially because Discovery Ridge was part of that.

We did go back to the university and they did tell us that they're estimating right now about 250 people are in the Discovery Ridge park area. We would be bringing in about 125 people in the 2019 timeframe.

And they believe over the next 20 to 30 years they're going to be adding 30 to 50 transient people per year. That's what we got from the university. So that's the only way for us to determine what that transient population is.

Also, we did go back to the City of Columbia, their land use planning. There were some items that have been added since the early 2014 timeframe when we got this information. So we are updating our tables for that.

And what you're going to, what you will see is that the total transient population over the next 30 years only increases about 600 to 700 people, just based on, you know, the ebbs and flows.

But we have gone and updated that table. We have, you know, reasked those questions of the community itself. And so we are updating Chapter 2 to show that.

MEMBER BLEY: Okay, that's good. Mr. Stetkar had asked that one, but it's on the transcript now, he can see it there.

MS. HAASS: I'm sorry, what?

MEMBER BLEY: John Stetkar had asked you about that one.

MS. HAASS: Yes.

MEMBER BLEY: So we have it on the transcript, so that's good. So you are using those new estimates?

MS. HAASS: We are. And as I said, once this meeting is complete, we plan on going and updating Chapter 2 and providing that to you. We just wanted to get through the action items first.

The third question had to do with the gas pipelines. Mr. Stetkar had said that on I believe it was the Ameren that they thought that maybe we had gotten two digits reversed. Well, it's actually quite a little story. And then they wanted to know about a new pipeline.

First of all, the new pipeline is there. It wasn't constructed until 2016. And when we did our original evaluation, it wasn't in the pipeline database that he referred to because it was two years earlier.

Also, on the other two that were reversed, the inactive one is now active, so we are updating the report for that and we are verifying those numbers. And Gary, were those numbers reversed?

MR. DUNFORD: I guess I don't know the answer to that question because when we first looked at them, we found that they were both active. So we just went and --

MS. HAASS: Right, so --

MR. DUNFORD: I'm sure they were though if John said they were.

MS. HAASS: Right, so now there's three active lines, the one that's 0.4 kilometers north, and then the other two. We are now updating this table to reflect all that information.

So you know, I think we all understand that things change, you know, in a two, three year timeframe. Things change, you know, there's probably a lot of things we could update based on that. But so as we said, we've updated the tables, the text, and the calculations to determine the impacts on the RPF.

The next one had to do with the data on the number of annual flights from the Columbia Regional Airport. So the data we used I believe was 2013 data because this was written in 2014. What I did is I was able to contact the airport manager directly.

We got 2014, '15, and '16 data. We are going to use the 2016 data which states there are just over 21,500 annual flights out of the Columbia Airport, and we also got the distribution between general aviation, military, and those types of things.

And so we are updating the report for that. And if you remember, we were about 16.5 based on the 2013 data that we had gotten and what our references said. But we are upping it to the 21,500. And just, you know, updating everything to 2016. Any other questions on that?

The basis for the flights per year for the heliport. We had not been able to get any information from the heliports. You know, these have to do with the hospitals, but we believe doing a conservative estimate of five per day per heliport is extremely conservative, which is about 1,850, or how many, 1,835, something like that per year.

And so that is the data that we're going to use is that data unless we don't know how else to estimate it because they will not provide that information to us.

There was also a question on do they have a local air show. Well, I actually was wrong. I was mixed up with a different site that we were originally looking at which was in Oregon. But they do have an annual memorial air show. And those numbers are included in the Columbia Regional Airport numbers.

The historical maximum rainfall for an hour, it was asked, you know, are we going to design to the maximum rainfall per hour, and we did not have that in our report, but it is approximately the maximum is 3.5 inches. Do you want to say anything to that?

MR. CORUM: Yes, I believe we'll show later on when we talk a little bit about Chapter 3 that currently the max rainfall we're looking at is 3.14 inches per hour.

MS. HAASS: Oh, sorry.

MEMBER SKILLMAN: So having found that,

you're updating to the higher number?

MS. HAASS: Yes.

MEMBER SKILLMAN: Okay.

MS. HAASS: I'll let you do this one.

MR. CORUM: Okay, then the question about the wind and tornado induced missiles. We're conducting the external events analysis and take into consideration the high winds, tornado and tornado missiles. And we'll talk a little more about this when we get to Chapter 3. I've got the wind speeds and everything that we'll be considering for that external event analysis.

MS. HAASS: You want to -- Gary?

MR. DUNFORD: So one of the last questions in Chapter 3 was the discussion about our probability approach for the toxic events and the vapor explosion from a truck accident. And you know, we have to fess up that the analysis was incorrect.

So we have looked at that again. Our challenge is that there's not any data that people are willing to share with a third private party about trucks and stuff.

So anyway, we are reevaluating that, updating our engineering data file for that. And I think the outcome of that means we just have to include that in our accident analysis. I don't think we have any choice, just got to look at it from an accident analysis.

MS. HAASS: And then one of the questions that we've already answered is what was the peak ground acceleration that we're going to use. It is going to be a 0.2g, and it was just a separate question asked at a different time, so we're just restating that.

And then the last question had to do with what are we going to do in case of a long term plant shut down configuration. This could be a very, very long answer or it could be a very short answer.

But what we've done is we've looked at it from each unit process. But in general, we're going to assume systems are functional to allow limited processing for achieving the configuration. We're going to assume the event does not allow for material shipments in and out of the plant for any extended time.

And the facility ventilation, this is the big one, will remain functional throughout this long term shutdown. But I could go through each of the unit processes, you know, what we would do.

CHAIR CHU: I kind of missed the question. Can you repeat the issue?

PARTICIPANT: It's the layup.

MS. HAASS: Yes, it's the layup.

CHAIR CHU: Oh, the layup, okay.

MS. HAASS: Dana, I didn't know how detailed you wanted to go into what we would do for each unit process.

MEMBER POWERS: My aspiration is that you look at it.

MS. HAASS: Okay, we definitely have.

MEMBER POWERS: And your ground assumptions I think are terrific. Yes, assume your ventilation system works, assume you can't ship anything, assume that people can still go into the facility and do routine sorts of things, they just can't make product.

And you perfectly well can clean up those things that you can get access to. Those are great assumptions, and it's mostly just looking at it to make sure, at this stage, that your design doesn't get you into a situation that you can't handle.

MS. HAASS: Correct.

MEMBER POWERS: That's all we're asking right now is that you look at it and make sure that the design accommodates that eventuality because it will happen.

MS. HAASS: Right.

Do I hate to tell you, but stuff happens in this world, and especially with these kinds of facilities. You know, something probably beyond your control effects either what goes in or what goes out, and things have to shut down. And those could be proacted, shut down.

MS. HAASS: So yes, in our final design as well as what we'll write up in the operating license application is we will make sure that what we're doing doesn't preclude us from getting this long term shut down complete and in a safe mode.

MEMBER POWERS: Yes, well what you want to make sure is that when you come back up you don't have something that's busted.

MS. HAASS: Right.

MEMBER POWERS: That you don't know about.

MS. HAASS: Well, and we're also able to shut down in a safe mode to protect workers and the public environment.

MEMBER POWERS: Yes, that one think you've got in spades, but you don't want anything to break when you come back up and things like that.

MEMBER BLEY: You want to be able to come back up. I mean, there's a handful of facilities I know of that didn't plan for this and ended up being permanently shut down because they couldn't recover afterwards.

MS. HAASS: Yes, so if you want additional details, we're able to give them to you on each unit process. But I think we, under the standard contract, yes we are bringing this into our design.

MEMBER BLEY: Yes, that's all you need to do at this stage. Your final stage, your final licensing statement you probably have to have all the details.

MS. HAASS: And that's all we had on the action items. Mike? Do you want us to move, switch out?

MR. BALAZIK: Good morning, my name is Mike Balazik from the NRC Staff. Just quick introductions. I'm the project manager for the Northwest Medical Isotopes facility in the Office of Nuclear Reactor Regulations. Next to me is Dave Tiktinsky who is a senior project manager in the Office of Nuclear Material, Safety, and Safeguards.

Next to Dave is Al Adams, my branch chief in the Research and Test Reactor Licensing branch. And we would just like to go over a couple of items, take away items from the June 19th meeting, first takeaway was from Member Rempe, how's the staff going to document open items in the SER as well as developing a criteria for the information thresholds for a construction permit.

I'll answer the first part of that question is that the Staff will document in a SER appendix. The open items identified through RAI's from the staff, and that the resolution of these items is not necessary for issuance of a construction permit, but the applicant should ensure that these items are fully addressed in the final design, supporting an operating license application.

Staff will verify these items during the review of the operating license. In regards to the geotechnical report, this will be captured in that appendix as an open item. And Al, did you want to talk about the criteria for CP?

Another question was from Member Stetkar about order of magnitude, wanted the Staff to define what an order of magnitude was. This was regard to aircraft impact probability.

There wasn't much guidance when looking at NUREG 800. But order of magnitude is just within a specific decade, it has no specific cutoff. But I think if you're looking at probability, so if you have a close number like 9.8, 9.9, 9.7 to the minus seventh, then you would want to evaluate at least the consequence because you're so close and these numbers have so much uncertainty in them.

Anything close that they should evaluate the consequence of an aircraft impact. But like I said, there was no really definition on what an order of magnitude is. Dave, do you want to go over credible frequency? That was another takeaway, define credible frequency.

MR. TIKTINSKY: Yes, so I guess for credible frequency, the context was related to the hydrologic flooding event, and the words credible frequency. So I guess the word credible is an unfortunate use of terms for this.

The credible as, I think, Northwest meant it was because it was above the 500 year flood plain. So they didn't need to worry about flooding because of the elevation. But the word credible shouldn't have been used because it really doesn't fit in the context of the ISA.

So I would say in this case, we would expect that the Applicant would reevaluate the use of that word to be consistent with the ISA methodology and what they're actually doing, and that the Staff would revise its SER to change that word, talk more like something like the practical flood that was used rather than using the word credible.

MR. BALAZIK: The next takeaway was from Member Skillman. He identified a forward looking statement in the SER on Page 2-9. It was after a long outage, a water run test would be typically be performed to check the equipment and processes.

The Staff will revise the PSAR to identify that this was in response to an RAI. And the Staff will also review the PSAR to identify other such statements that are forward looking statements, and revise as necessary.

Another takeaway from Member Skillman was on Page 4-6 of the SER, the statement that the ventilation supply, air for personal comfort, how does that temperature translate to process stability.

In looking at the PSAR and the SER, the design basis of the ventilation system is to provide ventilation air conditioning to RPF facilities for workers or occupants. But additionally, the design basis is also for makeup air and condition of the RPF processes and electrical equipment.

So when I look at the ventilation layout, I look at Zone 1. Zone 1 has a majority of the equipment and processes that are within it. Now Zone 1 is not occupied during normal operation, so I would say there is a disconnect between personnel comfort and conditioning for equipment and processes.

Additionally in Chapter 5, the analysis looked at cooling for vessels, and realize that that analysis was done with no cooling. They looked at loss of all cooling. So I would say that there's not a link between personnel comfort and the chemical process stability.

So I see a difference between the two. I don't know if that fully answers your question, sir. And that's all the takeaways that we have. I can't speak on the Fukushima lessons learned for University of Missouri, Columbia Research reactor.

The Staff looked at three of the high power reactors, MIT, MURR, and NIST. And one thing that we did is we did generate a ground motion response vector for each facility.

For MURR specifically, we used the best available data, and our technical reviewers generated a ground motion response spectra. And it only exceeded a 0.2 PGA at the high frequency greater than ten hertz. So I think one to ten hertz is your main concern, but greater than ten you look at relay chatter at the facility.

So we did have a discussion with MURR on relay chatter, but we did generate a GMRS for the MURR facility. I don't know if there's any specific questions on Fukushima lessons learned. But I could probably do the document that we did that evaluation on if needed.

MR. TIKTINSKY: Can I make a comment or two?

MR. BALAZIK: Yes.

MR. TIKTINSKY: I think you tried to ask but I wanted to comment on it. I didn't catch it. So Dr. Rempe asked us about that, you know, the threshold between construction permit and operating license. You know, do we have that dialed in.

Went back and looked and, you know, going forward I felt we had, you know, we were in the right spot. And for this review, depth of review is consistent with what we did for SHINE. So we believe we're in the same place as to how deep we're going and what we're looking at as far as scope and depth and review.

And even I a couple of times, I said you know, geez, I'm reading an SER draft, I'm going geez it's that thick. And I get out the SHINE document and it reminded me that in the case of SHINE, the scope of what we were looking at, a utilization facility and a production facility.

So we were covering a lot more real estate, and we're covering sort of this real estate over the same number of days. So I don't know if that, you know, generates a feeling that the depth of review is different. But we are pretty consistent with where we were with SHINE, with small adjustments given, given, you know, the differences in technology.

The other thing I wanted to point out is the updated information that you heard from Northwest, the Staff has not received any of that information formally yet. So we have yet to review it and make a determination on it. So we still have to do that.

In the area of Chapter 2, based on the discussions that we had at the last meeting, we are going back and re-looking at portions of Chapter 2. Our contractor is taking a fresh look at that.

There was a turnover and reviewers during that review, and we think that maybe some things got through the cracks when that turnover occurred. So we are going to, once we see, you know, we're looking at it now, plus we'll look at the new information that the Applicant is giving us to take another look at Chapter 2. Did I miss anything? Any questions about any of that?

CHAIR CHU: Okay, so we're going to have NWMI presenting Chapters 7 and 8.

MR. REESE: What's interesting about sitting here is the seat's always warm. Should I proceed?

MS. HAASS: Yes, I was going to say we'll go ahead and we're going to go, we'll do Chapter 7 and we're going to go directly into Chapter 8, but we'll answer your questions as we go along. And I'm going to let Steve kick it off with Chapter 7.

MEMBER BROWN: Before he starts, Margaret, just I've gone ahead and gone through the slides, and since I've gone through the chapter as well as the SER, and due to the general lack of detail within both the Chapter 7, in other words both John and I have a number of comments. I suspect Dennis will have, maybe some of the others.

I'm going to wait until you finish instead of trying to interject with questions because in the slides there's not good points to make the specific, get the questions across and however you may want to answer them.

So if you don't hear from me for a few, I didn't want Margaret to get concerned that I was falling asleep. It may well happen, but just Walt will keep me awake. But anyway, I just wanted to let you know silence was not either agreement, acquiescence, or anything else to what is being said.

But I'll go through John's comments since he's been held up with the plane delays. And some of mine are, a good deal of mine are very repetitive with his. So if others have questions as they go along, fire away and I will then at least get them on the record, and then we'll pick up the pieces later at the end of the Chapter 7 stuff. Okay? Thank you.

MR. REESE: So I'll consider it the calm before the storm.

MEMBER BROWN: No storm, just questions.

MR. REESE: So my name is Steve Reese and I'll be walking through Chapter 7 today. We'll be going through this, and probably the most important slide is the slide, two slides later. Excuse me.

But the big picture is this, is that things that occur, processes and monitoring that occurs inside the major tank hot cell where it's normally not occupied are going to be controlled through this control room that we have set up.

Other processes or systems that involve things like processing of the moly, the initial dissolution, the unloading of the cask, all of those will be handled through local control stations and monitored by the control room. That's the bigger picture on how we're envisioning this to go forward.

So we've identified a couple of main systems. One we call facility process control system. What we're really looking at is the process systems as I just said, within the hot cell it's controlled by the system and manned in the control room.

The waste handling, the hot cell is controlled by this system as well because of the radioactive material and the radiation fields present. Process utility systems, we'll talk about this. We'll report to the PFC to give status, and critical accident alarm systems, essentially the criticality accident alarm system, the CAAS, and the radiation monitoring systems will report to the facility process control system.

Then as a subset of that we have a building management system that's going to control predominantly the ventilation system and then the fire protection system is going to report to this as well.

Now to address the elephant in the room, we most certainly do not have details at this time specifically on configuration. The vendors were going to use the specifics on the interlock permissive programming. Those kinds of details we want to, we're waiting until the final design is complete before we provide you those details. Our goal, or our --

MEMBER KIRCHNER: Steve, so functionally, what do you envision for this FPC versus the DMS? I mean, are they going to be independent systems? Are you going to be isolated from the outside because of cyber security issues, et cetera? And you know, could you give a little more detail on your functional requirements?

MR. REESE: Yes, sure. So the main system is really the facility process control system. Everything is sort of either controlled or monitored, funneled through that. That would be located in the control room.

You know, we're anticipating that a ventilation system is going to be handled by off the shelf vendor supply control systems which are more often than not PLC controlled. And we'll talk about the digital the next slide. I think it's the next slide. Yes, we'll talk about digital cyber on the next slide.

But we're trying to keep all the permissives and the interlocks and anything that has to do with engineering safety feature actuation, all analog. So relay driven, voltage relay driven to avoid those, to avoid the digital issues that crop up.

MEMBER SKILLMAN: Steve, let me ask this.

MR. REESE: Sure.

MEMBER SKILLMAN: What precautions are you taking to make sure that a system that's big enough to give you everything you want isn't going to take everything you've got?

So your FPC controls all of your main pieces. The building management system is not to different from a building management system for an apartment building or --

MR. REESE: Correct.

MEMBER SKILLMAN: -- an airplane hangar or something like that. So the real value added here is this RPF. And you have all of these subsystems either reporting to, controlled by, acted on by perhaps others?

MR. REESE: Correct.

MEMBER SKILLMAN: What thinking are you using now to make sure that this doesn't become so integrated and so entangled that a very inconsequential failure or goof in one corner of these subsystems doesn't wipe out the entire complex?

MR. REESE: So let me put it this way, it's really not that complicated, and a lot of the systems are not dependent upon each other. So the way we're envisioning this is sort of batch system, right, do the dissolution, move to the next step, move to the next step, move to the next step.

There's not a lot of other things, if any, going on at the same time. Well, I shouldn't say if any, of course there will be other things going on at the same time. But there's not a lot of independency between these systems.

So I've got a slide later on where we talk about in the control room, what's the operator going to see. And it's essentially an annunciator panel, right. It's also going to, another panel gives current conditions. And then another panel that's going to provide the control for the systems that can be controlled from the control room.

So you know, there's not a lot of, obviously there's not a lot of pressure, there's not a lot of temperature in the system, there's not a lot of interdependency between systems. So we're not necessarily, I'm not too concerned about complexity.

Is there a lot of information to be displayed? Yes, absolutely, and we'll have to work with a vendor in the end to see how that gets displayed and how the person interacts with the specific information.

But we don't see a lot of interdependency and complication in those terms. Does that help answer the question?

MEMBER SKILLMAN: It heads in the right direction. What I was really thinking about is you've got criticality monitoring, you've got radiation monitoring, you've got waste handling.

MR. REESE: Sure.

MEMBER SKILLMAN: You're going to have super-hot solutions, very high source terms.

MR. REESE: Sure.

MEMBER SKILLMAN: Consequensive leakage anywhere is going to be a real mess. So I was just kind of musing where you get all of these challenges lined up with the same process control system, how do you make sure that they don't become so entangled or infected that you end up creating a monster that's very difficult to control?

MR. REESE: So along those lines, to that example, so let's say you're moving some hot liquid inside the cell. You've got your CAS and your radiation alarm system right? Those are really sort of independent systems that are just giving you status.

So there's lots of, well I shouldn't say lots. There's several vendors that certainly we have looked at that you can buy complete package systems to provide local indication and also provide indication to the control room.

So while it's true you're pumping a very radioactive liquid behind that wall, and you're doing it from the control room, and there is information to be displayed because you want to know the status of pressures, you want to know the status of temperatures, conductivity, there's a list we'll go on a little bit later.

But we believe that there's some information to be displayed and there will be some programming in a PLC in terms of for the systems that get moved, that get controlled by the control room within the tank hot cell.

But the amount of complication between the systems isn't very great. It's not very dynamic.

MEMBER KIRCHNER: So could we probe that a little? And let me pick on one, criticality accident alarm system. How would that be different than the radiation monitoring system?

MR. REESE: Well, they're essentially doing the same function. Right?

MEMBER KIRCHNER: Oh, they are.

MR. REESE: It's just the CAS is at a much higher level. So the CAS will be looking for, you know, the much higher levels plus the neutron.

MEMBER KIRCHNER: All right.

MR. REESE: And the ARM system will be in a standard, probably will be a standard Geiger-Muller system at various locations around.

MEMBER KIRCHNER: Right. So the way specifically word it and put report in italics suggests that it's just an alarm and it's not a shutdown function.

MR. REESE: Well, that may be true. That may be true.

MEMBER KIRCHNER: That may be true, yes.

MR. REESE: So there are things that we would want to --

MEMBER KIRCHNER: This gets at Dick's point I think, you know, if indeed those are, and I don't want to make an analogy to a reactor system but in effect they're there to protect you and your personnel and the public.

You know, if they're inter -- if they shut down a process system in midstream, is that envisioned, or is that at this point these are not loop systems, they are just indications? Reports to me says you've got a problem but it doesn't do anything.

MR. REESE: Right. I don't want to commit myself now.

MEMBER KIRCHNER: Okay, all right. You're in a conceptual --

MR. REESE: But it will be more reporting it seems to me than a loop system. If there is a loop system, you know, we're envisioning some sort of indication via analog interlock system.

Regarding analog/digital, all the safety related, all the IROFS, excuse me, we're anticipating having hardwired controls, interlocks, all the permissives so we can avoid all the V&V and the digital issues.

There is going to be some safety related non-IROF systems that will be controlled by what we envision will be PLCs. That's certainly the most classic example would be ventilation fire. We're going to buy vendor packages for these things, and they're most, almost always controlled by at some point a PLC anymore.

So we realize that we're also going to have a number of data loggers that will be essentially have digital components with them. We realize that as well. You know, we don't really think that this will reach the level where we'll need an actual cyber security plan because of the amount of critical digital assets is going to be very, very small, if any.

As a matter of fact, we're trying to avoid any critical digital assets at all. But on the things that, you know, we will have some important computers, we anticipate having some computers in the control room.

And as such, we'll have to have a program that looks at, you know, air gapping those computers, especially the ones that you use for programming PLCs, how you control access to that software, how you control access to PLCs, how you control access to the computer controls on media and do you even allow media on certain devices, those kinds of issues.

I mean, these are all sort of, it's sort of hinting on the edge of a cyber security plan, but we don't, based upon what we see in the research and test reactor world, we don't anticipate really needing a cyber security plan.

And that's mostly based on the fact that we don't have much in the way of critical digital assets. Any questions on that?

MEMBER BROWN: I will break my silence unfortunately. I'm not either agreeing or disagreeing relative to the -- my problem is with identifying the overall cyber security plan as something only associated with critical digital assets thought process.

I'm far more focused on what I would call control of access to the plant in general from outside the plant via internet or other remote sourced systems. External to the plant.

So what you've done, if you kind of put a bubble around the plant where there is no connection between any of these, that either the BMS or the FPC --

MR. REESE: That's where it disbanded.

MEMBER BROWN: -- or any of these other systems such that, and I don't have any problem sending data out via what I call hardware type gateways, digital diodes, you know, whatever they're referred to as these days, but non software controlled.

MR. REESE: Right.

MEMBER BROWN: So you've talked a little bit about how you control your assets inside, and I'm just trying to make sure at least the emphasis that I'm going to be looking for in your presentation when you get some more specificity is the lack of ability for people to get into it in the first place.

MR. REESE: Correct.

MEMBER BROWN: That to me is the, reduces your cost significantly relative to what you have to watch for all the time in terms of external threats. Internal threats, no matter where you go you have to deal with internal threats.

But those can be largely controlled more administratively via either not allowing cell phones or other type of digital assets to come in, or whatever. And I don't have to debate the details of that. But I just didn't want to link digital assets to cyber security plan because I can't, the Staff, NRC may have another quad process relative to what you have to do relative to the whatever it is, 10 CFR --

MR. REESE: Correct.

MEMBER BROWN: -- 71 or 73 point whatever the magic numbers are for the cyber security program.

MR. REESE: You know, the truth is we will have a cyber security plan for our facility. But as a -- we don't think that we'll have enough digital assets to be regulatorily required to have one.

MEMBER BROWN: I got it.

MR. REESE: So just out of due diligence on the part of, you know, corporate culture, you have to do these things these days. We understand that.

MEMBER BROWN: All right, thank you.

MR. REESE: And this is the big picture diagram. So here is that process control system, it's going to be sitting in a control room along with the building management system.

Some of the more important, here we have fire. You talked about, like, a dialer. These systems will have to have the ability to report out for a couple of systems, whether they're digital or some sort of analog phone dialer systems to communicate with central alarm system.

MEMBER BROWN: Like I say, it's if you do it such that you don't have external access, but only have you know, from inside to outside. It's easy to do as long as you put it in your plan in the beginning, you know, the thought process in the beginning. If you wait until you have systems but don't accommodate that you've bought them, then it's harder if you have to modify them.

MR. REESE: In a perfect world, the only way to interface with any of these systems would be within the control room itself. And we'll have administrative controls on media and access, those kinds of things.

MEMBER BROWN: Yes, I will make one comment on this figure.

MR. REESE: Okay.

MEMBER BROWN: It is so high level --

MR. REESE: Sure.

MEMBER BROWN: -- as to be almost, I don't want to use the words unusable. But I mean, it doesn't really reflect, and I will point out in some of our questions some of the inconsistencies between your dotted lines and solid lines relative to comments within.

And John made the same observations relative to the interrelations between these. But it's when we get down to the final architecture, when you do this with the operating license application, we would really expect to see a more definitive architecture presented.

MR. REESE: And we would fully anticipate having to present that to you too.

MEMBER BROWN: Okay, thank you.

MR. REESE: Yes, absolutely. You're right, this is very, this is 10,000 foot. We don't have these details because we're trying to fold that into the final design. So you're absolutely correct.

The process utility systems located down here are primarily controlled by the process, I'm sorry, the facility process control system. Ventilation is going to be fed into the building management system.

And a lot of the systems here on the left, so for waste handling, for the high dose liquids that have to be moved around behind the wall, those have to be controlled by the control room. But we're anticipating everything else to be handled locally and monitored by the control room.

And to be honest with you, I fully anticipated hearing some criticism on some of our language on how that is worded. It is, I think we would agree it's not worded quite as well as we would have liked, let's put it that way.

But the bigger picture is what we're talking about. So like, on all these process systems within the hot cell area, target dissolution that's going to be handled by locally. And this is where some of the, I can understand where some of the confusion is.

The reason why is because, you know, we anticipate having the control room having a series of permissives and interlocks that they're also monitoring while these processes are occurring. And so there has to be communication between local interface and the control room.

And so whether you call a permissive a

control or not, I'm not quite sure. But we're anticipating handling the actual process from the local human machine interface at the hot cells themselves. As examples.

The control room, in the bigger picture we're going to have, you know, a static display showing the status of all the important variables to the process at hand. We're going to have some sort of an alarm annunciator panel that provides the operator information immediately on the status of non-normal event. And then we're also going to have to have some dynamic interface systems associated with this because they will be handling the process controls within the main tank hot cell.

There will be computers and PLCs located within this, and controlling some of these systems within the control room.

MEMBER KIRCHNER: So Steve, just to explore one, if you go back to your figure. I'm looking at areas that I would think intuitively would be the most hazardous should something go wrong. So you have target dissolution.

How do you envision this batch of targets to be done, through an automated program process or a hands-on turn valves remotely, or with switches?

How automated will this be?

MR. DUNFORD: This is Gary Dunford. So that's actually a very good example of why you'll see both a dash line and a solid line.

MEMBER KIRCHNER: Right.

MR. DUNFORD: So in the window manipulator cells where the dissolver solution, or dissolver is itself, the downdraft condenser, and the caustic scrubber are, those are all being controlled at the window. They're either going to be manual valves or human/machine interface devices right there.

However, the rest of the off gas system for the target dissolution is actually in the large remote hot cell.

So the iodine removal unit, and I think we talked about it a little bit last time, and the rest of the, excuse me, the rest of the NOx scrubbers, the primary absorber, the IROF for the pressure relief vessel we'll talk about a little bit later, all those are in the large hot cell that so the person at the control, or at the window has to work with the control room to make sure those things are set in the right conditions.

There will be permissives both ways to be allowed, those things to be set because we have three trains here. Obviously you want to make sure that valves, the correct trains valve the right way and stuff like that.

So there will be some communication back and forth. But that's a case of where the primary manipulator hot cells, we're trying to do those locally. Right?

You can see what's going on and that's where the control is and that's where, well I'll call it command and control but the reality is wherever the supervisor is going to be that's authorizing the activities will be, whether they're going to be out in the operating gallery or in the control room will actually define where that happens.

And then everything that's inside the large hot cell which is, to be honest, other than waste, it's primary liquid waste management and the uranium recovery and purification system. And then there's a few odds and ends because of their high shielding needs ended up in the large hot cell. In this case the fission product gas removal system for the dissolvers.

So we think we understand how that's going to work. But every time I talk to Steve he brings up a new nuance about cyber security or something else that we just have to continue to work. And some of those, those end up having to be worked out at the operating level procedure and what we end up as coding as what's permissives and who has to -- in my case I would think that both the person at the window and the control room is going to have to say yes before you can start a dissolution as an example.

MEMBER KIRCHNER: And just maybe this isn't as much a safety related question as a quality of product question. But it would seem to me that you would want to automate these processes as much as you could in terms of control so that you get the output quality of product or waste streams to on a repetitive basis you get the same results.

Do you see where I'm going? I don't see this as a, in the old days when you stood behind a, you know, with manipulators and you're pouring a beaker and so on. This is more on an industrial scale. So I just presume that a lot of this would be automated. But maybe that's a bad presumption.

MR. DUNFORD: There is some areas that will be. But in a lot of cases, we might be talking when we get to the moly system really not much more than a lab scale size of equipment. You know, 15 milliliter size. The large hot cell obviously is quite a bit bigger.

And even the dissolver cells and the stuff we're handling, it's piece and parts in some cases, right? You've got to handle an individual target, an individual micro surge in that target --

MEMBER KIRCHNER: But more batch than --

MR. DUNFORD: It's extremely batched.

MEMBER KIRCHNER: Okay, thank you.

MR. DUNFORD: Even what looks to me to be kind of a continuous process in that exchange process for the uranium recovery is really a series of four or twelve individual batches through the system depending on where our targets come from.

CHAIR CHU: Can I ask a related question? It's actually also related to earlier NRC's answer on what's the threshold between construction permit and operational permit. And you know, I was thinking there are a lot of things that still needs to be figured out.

And so how do you start constructing a facility when you have a lot of stuff that needs to be figured out, maybe certain things automated, certain things are manual. You know, and then the ventilation is here or there, do I need, how do they all connect up.

I have a hard time figure out, you know, before some of the details are figured out, how do you do the construction?

MS. HAASS: Well, so first of all, this is Carolyn Haass. First of all, we are completing our final design and our construction drawings. We will know that before we start construction.

You may not see some of this until the operating license aspect because in our preliminary design, there wasn't enough information to be able to go any further, like, on this, the whole I&C system configuration.

I think as Gary and Steve have been talking, you know, there's lots of discussion on this during the, you know, during this final design and things, requirements will come up such as the cyber security, exactly how you do that, or how we're going to go automate this or what's going to be automated.

I mean, as Gary has stated, you know, inside the hot cell we're very batch oriented. But when you get into other systems, they're not going to be batch oriented, you know, and more into the uranium recycle and recovery.

So we understand that we don't want to go start construction. You know, we're not going to, we may go to a vendor and say this is the type of I&C system we need, and you need to come back and provide us a package. And we're not just going to one vendor.

We're obviously going to go to several because we want the experience of that, and then we will go pick that vendor. But we will give them the overall requirements of what we're doing.

MR. DUNFORD: So just let me kind of add, just from the difference of construction, or how some of this we looked at it's do we have enough space. Have we given ourselves enough space in the HVAC room to accommodate what we think are the trains and where equipment goes.

The fact that we haven't really pinpointed whether an extra wire is going to go through that wire run or this wire run, I'm not sure that that, in my thinking that doesn't affect the construction application because we wanted to make sure that we had identified enough space that we hadn't missed some areas, really from a footprint, from a space to be able to do that because you don't want to be starting construction and then having to change walls, right?

So that's kind of where we were. So there's some of the things that, like I said, we don't have pinned down. To be honest, instrumentation and even some of the electrical stuff, those are where the wires are going to go.

I mean, I can't tell you right now where the separation is and where the wire is going to come in maybe into the building. But I know I'm going to have two for a loop for the electrical system, as an example.

And I don't think that's going to change a lot of what we're asking for permission to go forward on. And as Carolyn said, we're not going to pour that concrete until we have the final construction drawings that handle that.

But again, I don't think that's really going to affect some of this, the I&C and electrical stuff. And some of that we're going to talk about in the next hour.

CHAIR CHU: Thank you.

MR. DUNFORD: At least that's my take.

CHAIR CHU: Thank you.

MR. REESE: Yes, so the next slide talked about the special nuclear material. So this is the first bullet essentially is talking about Part 70 side which I realize is outside of the scope. But there is a lot of uranium recovery and recycle that will occur within the hot cell.

We anticipate that to be batch process for the most part, not continuous. And all of that would have to be handled and controlled and monitored by the control room because we don't anticipate people being inside there doing these things, of course.

But going back to target fabrication, that's going to be essentially going back to the paradigm of having interlocks and permissives associated with the transfer of material to the Part 70 side of the house.

And then once it's the Part 70 side of the house, it will be handled in a batch mode on the production. So taking it, taking the initial uranium, converting it into a solution, the acid deficient solution, getting it to the right temperature, dripping it through the column, and then pulling it out, doing the drying and then the baking, or the sintering rather, excuse me.

Those will all be handled in a batch fashion by a local operation. And to be honest with you, there's probably not much in the way of automation that can be done for that stuff.

MEMBER SKILLMAN: Steve, let me ask you this. When we think of processes for handling and moving material, mass balance weighing, keeping track of numbers with important precision begins to be a critical attribute in what you're going to design.

MR. REESE: Yes.

MEMBER SKILLMAN: What attention is being given to that level of detail?

MR. REESE: So we'll talk about this a little bit more when we get to Chapter 12 when we talk about our material accountability program.

MEMBER SKILLMAN: That's fair enough. Okay.

MR. REESE: But just addressing it a little bit, you know, we're anticipating, I think Gary talked about this last time, having sampling ports to each one of these positions and having the material control accountability, it allows you to go in and sample before transfers occur, those kinds of things.

So we know precisely down to the level of precision that's required where material is at all times. We can't, we realize we can't operate a facility unless we have absolute understanding of where a material is in terms of quantity and mass at any given time.

MS. HAASS: Also, from a target fabrication, I mean target receipt and disassembly perspective, this is always a good example. We know what that target is going to weigh when it comes in.

We know how much low enriched uranium is in there.

And then when we, when the low enriched uranium is poured out and put into the baskets, you know, we'll be able to go back and weigh that so we understand that control and accountability. And we will be doing it to a very specific precision or specific digits on that. Gary?

MR. DUNFORD: I was just going to add that even at the pre-conceptual design, or the conceptual design phase, we already had a draft MC&A plan where we knew where the material balance areas were going to be.

We had an idea of where those transfer points were going to be and what the level of analysis we needed to have, which turned out to be a lot lower value than I initially thought that we would have to be worried about.

So it's a very, so early on we built that into the thinking about what was going to happen. If you ask me, you know, what the precision of a scale is right now, I couldn't tell you what that is but it's probably three digits.

MS. HAASS: Right.

MR. DUNFORD: At least two behind the decimal point.

MS. HAASS: We will also be working with some software programs that will be tracking, you know, your MC&A throughout the facility where we always know where everything is, just like, you know, we would always know what valves are on and off.

And if a valve, something goes wrong with a valve, we're going to understand how that impacts the system, you know, from that perspective. And we could go into our software programs and how we're going to go manage that. Later on we've got a presentation for that if you ever want to see that.

MEMBER BLEY: From what you just said, are all process system valves monitored? You were saying you know the position of all your valves. Is everything in the process system monitored? I wouldn't have thought so.

MR. DUNFORD: No, it's not. Actually, what some --

MEMBER BLEY: So you know some valve --

MR. DUNFORD: That Carolyn was talking about was actually a program we have to do what ifs and evaluate different conditions in the facility. It's actually an Atkins GLASS program.

But as far as the P&IDs identify, okay this is a manual valve, does this have any indication on it, does this? So not all valves are monitored with position indicators. Everything in the hot cell though has, and the large hot cell has to be, the stuff you can see you can say well no, I can turn that valve to the stop and know it's shut.

MEMBER BROWN: One interjection that I didn't have in my notes but you just brought up. The permissives and interlocks that may be instituted from the main control room for the batch, for certain parts of the batch operations, if your, I guess one of the things I would have in mind if I had a remote permissive interlock from another control system, independent control system, theoretically independent, if it fails then there's got to be some backup process or procedure that you're not stuck in the middle of something.

But yet there's no mention of how failures of that, those interlocks or permissives would impact the batch, the movement of batch processes or whatever it's called as you're going from the disassembly and then the dissolution and et cetera, et cetera through and then over to the hot cells, et cetera.

There's nothing mentioned or talked about in that, at least in Chapter 7. I don't know if it's anyplace else.

MR. DUNFORD: Steve, let me grab that.

You're right, there's not much in Chapter 7. This is Gary Dunford, by the way. But in Chapter 13, the HAZOPS, we actually went through that level of detail, valves, open valves, closed, low pressure, high temperature and stuff, looking at that.

So we end up with, in some systems, two trains. Some systems we decide we didn't need two trains there. There's a couple where we have, well we have either 100 percent spare. Some we have two out of three mentality meaning you got three systems, you'll need two to carry the load and therefore you have one offline or one spare.

And those will be identified if they have safety implications. Those will be identified as part of the tech specs as limiting condition of operation if they relate to the IROFs and the control and the safety of the facility.

But for right now, you're correct. We do not have identified the individual failures in the I&C, but we will end up doing that as part of our updated PHA, our process hazard analysis.

And as the details of, for engine and safety features for each chapter or for each IROF, we'll have to have logic show with that is, understand the heuristics of whatever the instrumentation is we're going to use for set points and stuff like that. So there's still work to be done both in 7 and in 6, and in actually Chapter 13 that relate, I think, to your question.

MEMBER BROWN: Okay, I recognize it wasn't in the details here. But I mean, that was really talking as more high level in terms of thought processes as you're going into this, and having it identified as to how failures happen, and if it's going to be covered, that's fine. Thank you.

MEMBER BLEY: Both Steve and Gary have said some things, and Charlie did too that got me thinking. I haven't got the whole system in my head, and of course it's not all out there anywhere. But I keep hearing permissives and interlocks, which you need.

But then I hear reset from the control room. Is it planned that for different activities you're going to have to change permissive and interlocks as you operate this system, or are they only going to be changed, like, once unless you have some design change or something else going on?

MR. REESE: Well, I envision the interlocks being you have to meet the interlock, whatever that interlock is because you can't operate it without it. But the permissives are a different story, so that's a manual, that's something that will be actuated probably routinely as on a batch by batch basis.

So the control room will, you know, you got two people who can check to make sure everything's lined up the way it is in addition to any software or PLCs that you have that looks at the interlocks to make sure things are fine. Once everybody is satisfied, then a permissive can be actuated that allows function to occur.

MEMBER BLEY: Okay, I'm still not quite where I want to be with this. I can interpret that in one way that we have to make sure we've met the permissive conditions to go ahead.

MR. REESE: Interlock --

(Simultaneous speaking.)

MEMBER BLEY: Or, I could interpret it that you're reconfiguring the permissives and interlocks for different activities. And that troubles me if that's what's going on.

MR. DUNFORD: As you ask the question, I'm trying to go through my head if there's any modes or operations where we actually would, what you're concerned about we would actually make a change, and nothing comes to mind right now.

MEMBER BLEY: It's the kind of thing that's very vulnerable to human error --

MR. DUNFORD: Yes.

MEMBER BLEY: -- and get you into real trouble sometimes.

MR. REESE: I don't imagine or envision even the interlocks every changing except for the first time you set them.

MEMBER BLEY: Okay, I'm reading things into what I've heard that I shouldn't be. But I'll watch --

MR. REESE: Permissive is a different thing, right, because permissive is a device that is going to allow an operation to occur because a supervisor has said go forward and do this batch process. So a permissive is simply a human way of saying okay, I'm going to allow you to start this process.

MEMBER BLEY: Okay, and let me tell you --

MR. REESE: But an interlock --

MEMBER BLEY: -- what permissives meant to me in other systems, both in nuclear power plants and in other process systems. When I have a permissive on the system that says this pump can't be started until the temperature in this loop is above 80 degrees.

Now that's a locked in permissive and it's hardwired into the control system. So you try to start that pump, it just won't start until you reach the permissive condition.

What you're saying, Steve, sounds like these are administrative permissives that are set up by the whoever's managing the process today.

MR. REESE: I envision -- so my apologies on the vernacular. My use of permissives and interlocks, when you just spoke about permissives, I envision that as the interlock. You have to satisfy the interlocks for the process to occur. A permissive I view as a manual operation that allows permission for the system to operate at all. So it's an administrative or management function.

MEMBER BLEY: Okay, that's different than most facilities. But okay.

MEMBER BLEY: Yes, I apologize about the vernacular.

MR. CORUM: Yes, one of the permissives that come to mind, and Gary, correct me if I'm wrong, is the transfer that we're going from a safe geometry to an unsafe geometry, from a criticality safety standpoint.

And in one case we use double block and bleed valves with a flange to prevent any type of transfer until you get that permissive from at least the supervisor and the operator. And that would be, you know, a sampling more than likely. It would be a sample result, or dual sample results actually, independent samples.

MEMBER BLEY: Well, I think I understand how you're using them now, although it seems odd that we're talking about administrative permissives in the design of the I&C system. So I'm a little confused here too. But go ahead. I'll look for clarity, in this as time goes forward.

MEMBER BROWN: Well, I agree with you when you -- it's one thing to have an administrative thing to say I say it's okay and you say it's okay. It's like, you know, only two guys have to say it's okay to launch the ICBM or something like that, you know, the football process.

It's a different thing if you have to have not just the physical oral agreement to do something as opposed to a switch gets turned somewhere else that says now you were enabled to go do that.

That would almost fall into your permissive, although I would kind of think that's a manual interlock in my own mind. You know, in other words it's a control room initiated, manually --

MR. REESE: That's correct.

MEMBER BROWN: -- interlocked. You would say I'm now giving you physical permission, but I'm doing it by allowing something to happen with the hardware.

MR. REESE: It's almost as if I've used the two words backwards, or in replace of each other.

MEMBER BROWN: It would be useful if these get defined somewhere in the final.

MEMBER POWERS: I think you're using the words the way I understand it, having designed a lot of these facilities. I mean --

MR. REESE: We will definitely define them to clarify this and make sure that we're specific on this.

MS. HAASS: Right. So we'll take the action, make sure it's defined so everyone's, you know --

MR. REESE: Clear on that.

MS. HAASS: -- reading from the same page. And it sounds like there are various ways, I mean, we want to be consistent in our report and how we design, but we want to make sure that you understand what we're using. And there are various ways to define things.

MEMBER BLEY: Will this be defined within the I&C system, Chapter 7 sort of thing? So will it be defined in a conduct of ops kind of --

MR. REESE: The answer is yes for both.

MS. HAASS: Well yes, I think --

MEMBER BLEY: All right, so --

MS. HAASS: -- and this may be true for other chapters --

MEMBER BLEY: And these won't really be defined until you go for your operating license?

MR. REESE: Right.

MEMBER BLEY: Okay.

MS. HAASS: Right. And there may be other chapters we're going to find that. We'll have to go define some definitions. And I mean, there already are chapters within the PSAR that have definitions in them. But we will take that action, make sure that those things are done in whatever chapter it may be.

MEMBER BLEY: Very good.

MR. REESE: I'm a little bit of a victim of my own environment in the RTR world. So some of that vernacular comes out from the RTR world. So maybe --

(Simultaneous speaking.)

MEMBER BROWN: What's RTR?

MR. REESE: I'm sorry, research and test reactor world.

MEMBER BROWN: Thank you. Thank you, thank you. Priority isn't always where you think it is.

MR. REESE: In the research and test reactor world, you know, in the tech specs, the interlocks that need to be satisfied for operation are defined, and the permissives are usually an administrative switch that allows authority for a system to be operated. So we will definitely clarify that, I can appreciate the confusion.

This is really redundant information, to be honest with you, talking about the previous slide and talking about where the human interface interlocks are going to be in surveillance from the control room.

All of these things, sans the high level waste at the bottom, are going to involve the human machine interface locally, and being monitored and surveilled from the control room.

MEMBER BROWN: Yes, just let me make one observation. This is a nit in a way in that I forgot what page it is, but you talk about a waste handling control room in addition to a control room.

And I don't know, I can go back here and tell you what page it's on, but if you take waste handling control room, you can key word it, you can go find it. If there's two control rooms, you ought to say so. If it's not, that's all right, we don't need to misspoke that one any, just difference in terminology.

MS. HAASS: Yes, and we will make sure that it's very clear there's only one control room.

MEMBER BROWN: Okay.

MEMBER KIRCHNER: It seems to me, Steve, that at least for the first three processes, they will not be controlled from the control room, they'll be just monitored, or surveillance as you say. So any discussion of interlock, or interaction from the control room to the local floor operator, are you envisioning interlocks that are preventive someone starting one of these three batches without approval from the control room?

MR. REESE: Yes, so a classic example --

MEMBER KIRCHNER: That's where the interlock would be, right?

MR. REESE: -- ventilation is at operable, the interlock has to exist if it's not, if you don't satisfy the DP or the flow rate or how that is finally interlocked, you can't start the dissolution process. It is the vacuum tank that serves as the emergency purge system in the event of loss of ventilation, loss of power is at an operable condition and maintained at the proper pressure, or vacuum rather.

You know, those are the kinds of interlocks that need to be satisfied before the system can actually serve its function.

MEMBER KIRCHNER: So going back to my earlier point, it seems to me that the waste handling system may be the only system that's "automated" or "controlled," remote controlled.

MR. REESE: That's correct.

MEMBER KIRCHNER: And everything else would be local batch operation.

MR. REESE: That's not true. Yes, so it's really it's three systems, and Gary eluded to them earlier. One is the process off gas system because it's behind the wall. When I say behind the wall, I'm really referring to that large hot cell where the tanks are.

Process off gas, the uranium recovery, all those have to be done with the control room. And also the high dose waste has to be handled by the control room.

MEMBER KIRCHNER: Thank you.

MR. REESE: This is a little bit redundant too. This is more of what we've discussed before. You know, we intend to buy essentially integrated vendor packages for the CAS system, and probably a lesser extent for the RAD systems.

We'll probably instead of buying an integrated package, we'll probably -- well I should take that back. We'll probably buy an integrated package and have it installed. But I have to imagine that the RAM and the CAM systems we would likely buy from the same vendor.

MEMBER SKILLMAN: Steve, let me ask this.

MR. REESE: Sure, absolutely.

MEMBER SKILLMAN: It has nothing to do with safety, but spent a lot of time at plants, many, many years. It seems that NWMI team needs to be vigilant of buying so many different types of devices.

You've got permutations and combinations that kill your spare parts problem, or generate your spare parts problem. So if you're not careful, you get all these nifty, dandy custom packages. Then, quite candidly, the operation can become hostage to the service capability of whoever you bought that from.

MR. REESE: So to that point, you know,

all of the CAM and the RAM system, that's all off the shelf stuff. X unit here, we know that this X unit is going to be supplied, you know, definitely because it's used by the industry. We can just plug and play a new unit if we need to. That's how I envision it.

I don't want to buy some unique that's special for our facility that's sort of magnum to how we want to go forward on that.

MEMBER SKILLMAN: Like I said, that's not a safety issue.

MR. REESE: Yes, no, I understand.

MEMBER SKILLMAN: I'm almost embarrassed to raise it, but those of us who spent years and years in this area know we can become entrapped because we've been so clever.

MR. REESE: Yes, so the RAM systems, or the CAM systems and that, really envisioning that will be much of a problem. Where I've seen that in the discussions that I'm at least talking about this morning is maybe more on the, like, the data loggers.

There are a couple brands that have been pretty consistent for the last 20 years. There's a couple that have come and gone. Certain PLCs, it looks like there's two sort of main manufacturers of PLCs anymore and they get subdivided into other companies and installed in their systems.

So yes, I guess not to beat a dead horse, we recognize that that's an issue. So there -- I'm sorry, yes, sir.

MEMBER BROWN: The vendor packages systems is what you referred to, almost, it's probably half a dozen of those or more, I don't know, I didn't count them up but there was a bunch of them listed in various places.

But they always finished with but integrated into the FTC. And all of these, here's a package system from Vendor A, from Vendor B, from Vendor C, on and on for the half a dozen or so processes that you're using.

Their outputs may or may not be consistent. In other words, when you integrate, you can destroy your independence and you can also set up a tremendous number of different ways for your system to get corrupted based on the nature of their output.

So there's no discussion of how those are going to be integrated. John had similar question. I'm jumping ahead of myself a little bit, but since it was brought up, I thought I would go ahead and interject.

That is a, I don't have any problem with a vendor package, I mean, that's obviously the smart way to go. But how you integrate those is going to be interesting to make sure there aren't any circumstances where it could corrupt your overall FTC, that's all.

MR. REESE: Yes, so you know, when we ask for vendor systems, what we're going to have to do is stipulate what that signal output for these systems is. So, like, when we want a CAM, we want to know all right, are you a one to ten volts signal indication or what have you.

But we're going to have to stipulate what that signal indication is because you're absolutely right, when we have that system integrated into that control room, it has to be able to read and process all of those different information.

So effort will have to be made that when we put out the request for proposals on the systems is that we stipulate what that signal is back to the system integration, what that looks like.

(Simultaneous speaking.)

MEMBER BROWN: Fundamental to my point, I guess, to get right down to the nitty gritty, if these vendor package systems result in serial data being transmitted out, you may not want serial data in order because you're going to have a difficult time integrating five, four or five different vendors' data path or communications path as it comes in to your overall PLC or FTC system, digital distributed control system, whatever, however you end up doing it.

So if you're doing an analog way, like you say zero to one mil or one to ten volts or whatever you want to do, that's easy because it's literally a, it's a software independent matter of transmitting data which you can deal very easily with in your FTC.

Not trying to tell you how to do it. I'm just saying we ought to understand how that's being done. So we'll just see where, how you intend to do it, that's all.

MR. REESE: So this slide and the next slide are just snapshots of some large tables that appear in Chapter 7. The first one looks at what we anticipated the monitoring parameters that we were going to have to look at, and who is, where that primary control is going to be located.

So if you look at the one that I provide you here in the slide is the start, I believe, of the table, the main table in Chapter 7. You can see almost all of these are out of the operating gallery because these are the initial dissolution fission gas treatment, waste collection on the, excuse me, on the low side.

So what we've done, and as Gary correctly stated, is during the phase where we're looking at the ISA and all the things that could go wrong, this illustrates some of the monitoring parameters that we knew that we were going to have to look at because it feeds into the next table which looks at --

(Simultaneous speaking.)

MR. REESE: I'm sorry.

MEMBER BROWN: What is the operating gallery?

MR. REESE: So this is the --

MEMBER BROWN: Is that opposed to the control room?

MR. REESE: The hot cells. So the hot cells for, like, dissolution hot cell, moly process hot cell. There is a gallery that sits, we call it an operating gallery that sits in front of those hot cells.

MEMBER BROWN: Okay, I had no -- I read through the entire section and I had no idea what the operating gallery was.

MS. HAASS: That was defined.

MEMBER BROWN: It might have been defined and I missed it.

MS. HAASS: Yes.

MEMBER BROWN: It could have been at 11 o'clock at night when I was reading this.

(Simultaneous speaking.)

MS. HAASS: Yes, I was going to say it's defined in Chapter 4. I apologize we didn't redefine that in Chapter 7.

MEMBER BROWN: Good point.

MS. HAASS: Thank you.

MR. REESE: These are some of the engineering safety feature --

MEMBER BROWN: Oh, one other --

MR. REESE: Oh, I'm sorry.

MEMBER BROWN: Just can anything be done? Is this just people watching what's going on? Or can they do, is there any control function in the operating gallery?

MR. REESE: Absolutely.

MS. HAASS: That's where you would actually have used these as manipulators.

MEMBER BROWN: I understand the hot cell. I'm just trying, so the hot cells are, I envision guys standing in front of things with little bags or controls that have arms coming around, manipulators and stuff like that. So where all those people are standing, that's the operating gallery?

MR. REESE: That is correct.

MEMBER BROWN: Okay, I got it. I understand. It's really over here where the hot cells are, not over here.

MR. REESE: Yes.

MEMBER BROWN: Okay.

MR. REESE: That's correct.

MEMBER BROWN: I got it now. I may even remember this. Thank you.

MR. REESE: All right. So these are some of the I&C engineering features that we anticipate having to have interlocks on and the systems that they're feeding. This is a very long list. You can see that the IROF number has been identified.

Some of those are criticality safety IROFs, some of those are radiation safety IROFs. But we've identified these IROFs and what we think the safety feature is that needs to be provided in terms of an interlock, in our terminology, the interlock that prevents you from operating unless this actually exists.

MEMBER BLEY: So would you, we're going to get to electric power later. But you know, the headlines here are similar to the text in the chapter where it talks about the ESF systems will operate independently from the FPC as hardwired controls.

So when they're independent of the FPC, clearly that means the FPC is not controlling them. But also does that hint that they're electrically independent in some way?

MR. REESE: Yes, yes. So when we say that, we -- well, go ahead.

MEMBER BLEY: Do you want a break? I'm sorry, Gary, go ahead.

MR. DUNFORD: Yes, so when you say electrically independent, you're talking about different power supplies, different -- yes, no. Right now we have not identified where we need that level of IEEE control in systems and those --

(Simultaneous speaking.)

MEMBER BLEY: So in Chapter 7 when you say they operate independently of the FPC, that means the FPC is not controlling them, they have their own independent --

MR. DUNFORD: The FPC is not controlling it.

MEMBER BLEY: -- controllers?

MR. DUNFORD: Or it may mean that there's a set of contacts run off an interlock that's going to shut that fan down because the hardwire interlock went off. It doesn't matter what the FPC can do because we already dumped the system, and it can't restart --

(Simultaneous speaking.)

MEMBER BLEY: That's really what's he's talking about.

MR. DUNFORD: That's what he's --

(Simultaneous speaking.)

MEMBER BLEY: -- understood what it meant. However, the ESF's so integrated into the FPC systems and provide a common point of HMI --

MR. DUNFORD: So the operator needs to know that an interlock was actuated.

MEMBER BLEY: Okay. So there will be --

MR. DUNFORD: An annunciator panel.

MEMBER BLEY: -- something will light up for him and say --

MR. DUNFORD: But that's not, other than the annunciator panel, there's no control

MEMBER BLEY: So by integrating, we don't, it's really simpler than that. It just means --

MR. DUNFORD: Very, very simple.

MEMBER BLEY: -- there's an output from ESF that comes over on a panel so the guy can see what's happening. Okay. Thanks. I wasn't completely sure what those words meant.

MEMBER KIRCHNER: Would you walk through the first example, because the relief system strikes me as just a relief valve to a pressure discharge, a pressure relief tank.

So what happens here if you just, you exceed the pressure, it dumps. You get an alarm and you get a pressure indication in the reserve tank that you've got high dissolver pressure during the dissolution? I mean, could you just walk through --

(Simultaneous speaking.)

MEMBER KIRCHNER: Just walk through the table and say, tell us what happens here in the I&C world?

MR. REESE: You want me to get it, or you?

MR. DUNFORD: I'll take it, Steve.

MR. REESE: Okay.

MR. DUNFORD: So let's just --

MEMBER KIRCHNER: I raise it because the first one happens to be, to me, a passive system. You've got a relief valve on a process line. So what happens in I&C space?

MR. DUNFORD: So this system has a large tank, relatively large tank that can, we'll talk about this actually in later sessions, I believe. And Carolyn, if I start getting proprietary, just slap me.

So you actually start, this would be an LCO, limiting condition of operation that the tank is set in a vacuum within whatever the parameters are identified, that the equipment is, preventative maintenance has been done, it's been calibrated. So all those type of activities, which I believe in this system also includes some instrumentation dealing with the actual pressure itself.

And I cannot tell you off the top of my head whether this thing is actuated as an off of the pressure indication and then that triggers a valve, or the valve itself is an interval unit. I don't know that right now, I don't think we have that defined.

I think on P&ID they're separate unit operator, or separate instrument pieces of equipment. So you start the dissolution. If for some reason we lost power, it's pretty straightforward. We've lost power to the whole facility, the valve's going to go to its failsafe which would mean it would open so that it would suck in all of the material that's coming out of the dissolver.

If you had a just some other type of process condition where you had lost your pressure indication, then that's not going to -- what we're trying to say is that indicator, the pressure indicator is not going to go to the distributed control system and then out of their alarm back and say turn that valve.

Now you may have that ability to say open that valve at the control system. But what should be happening there is there should be a direct hard wire, an analog signal that's going right from that transducer to that valve so it opens up.

Fails that way, and on signal it opens up without having to go through the distributor process control system.

MR. REESE: This is actually a case where you probably have two because what you're really, I mean, it covers you a couple places, but the major one is loss of power, loss of ventilation. So the gas needs to, the off gas needs to go someplace.

And so you're going to have an interlock, how we define an interlock. You're going to have an interlock that looks at the pressure to make sure the vacuum exists. If it doesn't exist, you don't satisfy that, you can't dissolve.

And you also have to have BP on the ventilation. If that doesn't exist, then you can't, the interlock should prevent you from, the interlock is not satisfied and prevents you from initiating this dissolution.

MEMBER KIRCHNER: Thank you.

MEMBER BLEY: Can I just sneak in one?

MR. REESE: Absolutely.

MEMBER BLEY: Just because the way my notes were. In the beginning of the system description in Chapter 7 it says the FPC will be a digital control system. But from what you told us earlier, that's not what you intend at this point. You intend it to be mostly analog?

MR. REESE: Mostly analog, yes.

MEMBER BROWN: I agree with Dennis. I'm not sure I would go that far. It says the preliminary concept, this is on Page 118, shown in Figure 7-1, the green circles indicate that the FPC and the BMS distributed process control or programmable logic controller systems.

MR. REESE: Yes.

MEMBER BROWN: And that to me means digital circuits. That means software. It can be FPGA type software depending on what type of --

MR. REESE: That's probably what it would be, yes.

MEMBER BROWN: -- stuff you get which is, you know, it's not software per se, it's burned in hardware. It's burned in, it's combinational logic burned into --

MR. REESE: Correct.

MEMBER BROWN: -- the hardware, okay, which is, you know, it's not modifiable --

MR. REESE: Correct.

MEMBER BROWN: -- as you go through your entire processing loop. But I mean, this is not an analog system by any stretch of the imagination.

MR. REESE: I thought we were talking about the interlock system again. I apologize.

MEMBER BROWN: Oh, I'm sorry. No, it's --

MR. REESE: The --

MEMBER BROWN: My impression was when you began the whole discussion, you said the FPC will not be a digital system. But the application says it will be?

MR. REESE: IT will be a digital system. I apologize if I said that.

MEMBER BROWN: Okay. It's just you really meant it won't be a PLC I think.

MR. REESE: I don't know. I apologize, I don't recall what I said.

MEMBER BROWN: Well, you can read it later.

MR. REESE: Yes, yes. The FPC system will most assuredly contain either FPGA or a PLC of some kind. It has to. I this day and age it pretty much has to.

MEMBER BLEY: And that's why I was wondering how you were --

MR. REESE: And I apologize if I misspoke.

MEMBER BLEY: -- what you said earlier on.

MR. REESE: So to, yes, okay. So high level approach necessary, interlocks permissive and developed for safety relay systems, monitoring parameters have been identified, we think, when we've gone through the accident analysis which ones are important for safety in terms of monitoring and interlocking.

Safety systems will be analog, minimize issues with VNB and cyber security. Systems within the tank waste hot cells will be controlled via the control room.

MEMBER BROWN: That's, your third bullet is an interesting conclusion based on our discussions. You say all the safety related systems are going to be analog, and yet when I get into my little comments here relative to some other paragraphs in your PSAR that I'll let you go on, but just be aware of that particular bullet when I speak up in a few minutes.

MR. REESE: Okay. The rest is locally monitored. The important thing is that obviously we don't have final design on this, and a lot of the information obviously is not here. So with that, I will turn it over to you.

MEMBER BROWN: No, does anybody else -- I was going to go through John's comments. Does that step over everybody else?

MEMBER BLEY: I think some of them are just his notes. So probably can go through them all, unless there's questions imbedded in them. Whatever you want. Charlie, go ahead.

MEMBER BROWN: Well, I've got a couple of them. No, it's not that extensive for Chapter 7. It's really not that bad. This is not standard 45 minute dissertation. So I think I can make this fairly straightforward.

When we talk about the FPC system is a digital control, blah, blah, independently and electrically isolated from power systems, that's what the PSAR Section 7.2.3 says, that if it's isolated from the power systems, John had the same question I did, how do you power the FPC if its isolated from the power system?

MR. REESE: Mental note, yes.

MS. HAASS: Yes, got it.

MEMBER BROWN: There's references to if, I'll just bring this up now, there's references to UPSs for that you got a design area for figuring out where you need it and where you don't, which is just fine.

But I'll transition to Chapter 8 and just let you know there's no UPSs shown anywhere on the electrical diagram of UPSs feeding any of the main control room or any type functions. It's all just the switchgear fundamentally, unless I missed something.

Okay, so that's question one, what is the FPC power supply, because we're assuming there is one somewhere. The second one is relative to Section 724.2.1. 2.2, 2.6, et cetera, ad nauseam.

We were talking about the FPC being separate and all these standalone systems are going to perform the various protection functions. But yet 724.2.1 states the FPC system will perform a trip as a protected function as part of the RPF safety analysis.

We kind of advertise throughout this they're independent of the FPC. Section 724.2.2 states the FPC systems will initiate and control ESF actuation and isolation when the system detects an off-normal event appropriate for activation which stands inconsistent with the statement that the APSF systems are independent from the FPC.

Section 724.2.6 notes that the FPC system will have the ability to perform a manual activation of ESF. So there's a number of -- I'm not disagreeing with a manual actuation somewhere if you can do it without interfering.

There's a bunch of inconsistencies relative to the entire discussion we've had in terms of how independent they are from the FPC. So all we're asking is the other section in here, 7.4.1 notes it will operate independently as hardwired controls. That's 7.4.1.

So anyway, that's one of my comments, that's one of John's. I just think that we would like to have some clarification and understanding of how this independence is maintained, or even designed into the system when we did it.

Where's the next one? Okay, Table 7-4 indicates that there was safety interlocks for the uranium recycle and recovery system, and that they're hardwired and not processed to the programmable logical controller.

It notes that based on other discussions you may reposition some valves based on that, if I can talk a little bit about that. It's not apparent whether these controls are automatic or manual. So if there are processes and they're going to be automatic, then it ought to be specified. That's fundamentally the point.

We already talked about cyber guidance, 5.7.1. Oh, Section 7.1 you state that that the ESF will operate independently again from FTC or BMS. Now all of a sudden BMS is thrown into this jumble of how are they integrated with the ESO. So that's kind of an open question there, make sure there's clarity on how these things are done.

You all noted in here that you all, and we don't disagree with this in general, I think the Staff did, I'm not going to speak to the Staff. But the design is not complete. And if you all had not developed the details to support the detail design, it would only provide an overall strategy.

And I think, if I remember the SER that Staff made that statement about 12 or 13 times throughout the SER, that it was adequate for the -- and I'll let them, you know, for construction permits, so I'll let them come to their own conclusions. But that's the generally, he and I both agree, generally that as long as we get our concerns thrown in here for the final thing, it's not all that bad.

Does the FPC system initiate automatic protection? That's a general comment. If so, that's a repeat. Do the hardwired interlocks automatically reposition, automatically reposition, not manually tell somebody. That's what we were told before reading this.

And then are they done all in the FPC or are they done with the local HMI type system for the control systems. And data transfers between the ESF and FPC, are they done via one way? Your diagram has some parts of it solid lines with arrows going in both directions. Other places it's dash lines.

You have to go look at the words and then go look at the diagram. Sometimes those dash lines imply that they're bi-directional based on the words, not necessarily the figure. And how are those one way communications implemented? I already commented on that, the one way stuff ought to be hardware and not software controlled.

And then the external stuff, we did that. Those were his. And most of mine are, I'm just going to follow through these, they're duplicates.

CHAIR CHU: Charlie?

MEMBER BROWN: Yes.

CHAIR CHU: Can I make a suggestion? You know, I'm going to, we are running late. So it can --

(Simultaneous speaking.)

CHAIR CHU: No, you know, according to the agenda we're going to do, you do Chapter 7 and 8, and NRC comes to 7 and 8.

MEMBER BROWN: Oh, okay.

CHAIR CHU: But we're going to take a break now. And then I suggest, you know, I don't want to disrupt the momentum. Charlie still has comments and stuff. We'll have the NRC people come back, do the Chapter 7.

MEMBER BROWN: Let me make one comment.

CHAIR CHU: Okay.

MEMBER BROWN: Okay.

CHAIR CHU: And then you do 8 and the NRC, okay, is that okay? Okay, Charlie, thanks.

MEMBER BROWN: I can be finished if I can make one more observation, and then we can, if you want to take a break we can take a break, whatever.

There was one point in here that was on Page 132 that stated that the control room of the FPC system operates with a synchronized hot standby redundant system architecture. That's all it says. And --

MS. HAASS: Pretty cool.

MEMBER BROWN: Yes, that's really slick.

CHAIR CHU: What page is that?

MEMBER BROWN: Page 132 of the Chapter 7. Well, excuse me, it's Page 132 of Chapter 5 through 8. It's that one package that had Chapter 5, 6, 7, and -- yes, 5, 6, 7, and 8. It had four chapters in it, the package we got.

PARTICIPANT: I don't really know what you're talking about.

(Simultaneous speaking.)

MEMBER BLEY: You wouldn't.

MEMBER BROWN: Whatever it is, okay, it's how it was transmitted to us in terms of the PSAR, how it was transmitted. And the other question was on fire protection systems, can they be manually actuated from the main control rooms if the fire protection system failed.

So other than that, the coordinated issue of synchronized raises some really issues relative to how you maintain control of your processes if these systems are controlled via the FTC which totally destroys your independence. So it's a lot of inconsistencies. I'll stop right there. The rest of it is not --

CHAIR CHU: Okay, let's take a 12 minute break. Let's come back at 10:30. Thank you.

(Whereupon, the above-entitled matter went off the record at 10:17 a.m. and resumed at 10:36 a.m.)

CHAIR CHU: We're going to resume the meeting.

MR. BALAZIK: Good morning, this is Mike Balazik again, Project Manager for Northwest Medical Isotopes. And, today, the staff will be presenting Chapter 7, Instrumentation and Control.

And, I've already introduced Al Adams, but I just want to do one other quick introduction and his name is Jim Servatius. And, he couldn't be here with us in person, so he is on the bridge line and he did a review of a Chapter 7 and he will be doing the presentation.

But, Al, you wanted to say something real quick before we start?

MR. ADAMS: Yes, just, you know, it was a comment, Dr. Chu, about, again, the, you know, the construction permit versus operating license.

And, just, you know, a fact that came out during the SHINE Commission hearing is a question was asked, what point was their final design? And their answer was 15 percent. I don't know what the yardstick was of 15 percent.

But, so, you know, construction permit application that, you know, that we approved was about 15 percent of the final design was fixed.

So, just, you know, it gives you an idea of, you know, where you're at in solidifying a design when, you know, meeting the regulatory requirements of 34, 35, 40.

MEMBER BLEY: Well, if I could try, because, you know, I don't know what's written down for sure, but the way we behaved the last time with one of these and the thing that makes sense to me is when we're convinced, you're convinced, that they've thought of all the things that could go wrong and they've thought of the systems they need to operate and protect the facility, even though they haven't designed them fully, that gives you pretty good confidence that they can get from where they are to a final design, which I guess is what we're really after when we let people start to build.

MR. ADAMS: Does that -- it's the 50.35 standards which are, you know, very high level, very broad. You can have research programs going on and still, you know, figuring out things that --

The dimensions, you know, dimensions and numbers can be approximate. You know, so there's, it's, as you said, I think it's showing that you are thinking about the right things that you are, you know, you're -- you know which way the design is going.

And, you know, it was something when we first approached this that we spent a lot of time thinking about it because, you know, I'll admit, our guide, you know, our guidance wasn't written that do these three things if you want a construction permit and do these other 14 things when you want your operating license.

Because, you know, this is a, you know, you know, these construction permits we've used, as we all know, is, you know, we're looking at something that hasn't, you know, hasn't been done in a long time.

MEMBER BLEY: Now, one other thing, I would think that on the research and development issues, they ought not be pure blue sky. They ought to be things that you have reasonable confidence they'll be able to solve and fit the solutions within the buildings they're trying to construct.

MR. ADAMS: Right, I agree. You know, it's a difficult question and I think, you know, the, you know, the applicant understands that there is, you know, they move forward with some risk that, you know, when the operating license comes in, that, you know, all, you know, all the details are going to be there and, you know, we take a, you know, we look at it for what the application is worth against, you know, against the -- our, you know, our review guidance.

So, you know, a lot of, you know, a lot more to come, I guess.

MEMBER SKILLMAN: Yes, my view is that our role here is to review the NWMI product and your actions and via a letter report from the Full Committee, communicate to the Commission that we either believe proceeding at the construction permit level is or is not amicable to the health and safety of the public.

And, our goal would be to hear enough and know enough to communicate that it is not amicable, it's okay to go ahead.

And, that involves the applicant following the ground rules, but also hearing some of the lessons learned and industry experience that will shape a very successful outcome.

MR. ADAMS: I agree.

MEMBER SKILLMAN: Okay, thanks.

MR. BALAZIK: This is Mike Balazik.

Jim Servatius, can you hear me? Jim, are you on the bridge line?

MR. SERVATIUS: Hello?

MR. BALAZIK: Hi, Jim.

MR. SERVATIUS: Hey.

MR. BALAZIK: This is Mike Balazik, we're going to be starting on slide 3.

MR. SERVATIUS: Slide 3? Okay.

Can you hear me okay?

MR. BALAZIK: Yes, sir, we can. Thank you.

MR. SERVATIUS: Okay.

Slide 3 shows the applicable regulatory requirements and acceptance criteria for the safety evaluation of Chapter 7.

Three 10 CFR Part 50 requirements apply to the various aspects of the construction permit application for a radioisotope production facility.

Part 50.34 Paragraph A specifies minimum information in a preliminary safety analysis report.

50.35 contains the various requirements that must be met to issue a construction permit.

And, Part 50.40 contains considerations and guidance when issuing a construction permit.

Acceptance criteria, two documents,

NUREG-1537 Part 2 and Interim Staff Guidance that augments that document. Those specify acceptance criteria for preparing and reviewing license applications.

NUREG-1537 applies generally to all non-power reactors while the Interim Staff Guidance updates and expands the content to a radioisotope product facility.

Slide 4, the principle purpose of the I&C systems in a radioisotope production facility is to monitor and control the various facility processes.

To achieve this purpose, the I&C systems comprise sensors, electronic circuitry, displays, actuating devices, permissives, interlocks, as discussed previously.

Basically, provide the information and means to safely control the facility and to avoid or mitigate accidents.

The proposed facility houses special nuclear material, preparation and handling processes. Radioisotope extraction and purification processes, utility systems, a criticality accident alarm system and radiation monitoring system.

All these systems and processes require instrumentation to safely control and monitor facility operation.

The SNM preparation and handling process are enclosed by hot cells and glovebox, except for the target fabrication area.

And, criticality safety throughout the facility is controlled through the use of geometrically safe designs and the control of process variables.

Slide 5, as discussed on this slide, the main subsystems in the proposed facility are the Facility Process Control System, or FPC, and the Building Management System, BMS.

The FPC system provides for monitoring the safety related components within the facility, all those discussed earlier. That gets a little confusing in the write-up.

The FPC system also provides for monitoring and control of the overall production processes, including process fluid transfers and interequipment pump transfers.

The BMS is stated to be a subset of the FPC system. And, it monitors and controls the facility ventilation system and mechanical utility system, such as the chilled water system.

Although not listed on this slide, other subsystems comprised is local human machine interfaces, fire protection system, control room and an engineering safety feature actuation system.

MEMBER BROWN: Can I ask a question?

MR. SERVATIUS: Yes, sir.

MEMBER BROWN: This is Charlie Brown.

I understand the words the building BMS is a subset, but I guess in my reading of the chapter, the Northwest Chapter, that it implied to me that the BMS was not a subset, it was an independent system so that it wasn't integrated into the same electronics that is going to be the FPC. It would be a separate set of stuff.

Is that consistent with your understanding, Steve?

MR. SERVATIUS: You're asking me that question?

MEMBER BROWN: Is that Jim? I'm sorry, who's on the phone? Oh, Jim, I'm sorry. Okay, I'm sorry. I apologize for that.

MR. SERVATIUS: My understanding was that it was a separate, independent system that just reported back to the FPC.

MEMBER BROWN: Okay, all right. That's what I thought also, I just wanted to confirm based on the way the slide was worded. Okay, thank you.

MR. SERVATIUS: And, I agree with you. There's a lot of inconsistencies in the chapter, so we issued a lot of RAIs. But, a lot of the details will be provided later.

MEMBER BROWN: That's okay, fine. Thank you.

MR. SERVATIUS: Okay.

Slide 6?

Slide 6 summarizes the scope of my review. I performed the safety evaluation of Chapter 7 as supplemented by responses to RAIs to assess primarily the sufficiency of the preliminary design and performance of the I&C systems and whether the design and performance meets the acceptance criteria to support issuance of a construction permit.

I should note in the second bullet there, the review focused on the I&C system preliminary design criteria, design bases, system descriptions and design and operating characteristics to provide reasonable assurance that the final design will conform to the design basis.

The ISG that augments NUREG-1537 Part 2 states that, for a radioisotope production facility, the I&C system should be designed to perform functions commensurate with the complexity of the processes in the facility.

And, I think we've heard a little of this discussion earlier, but the proposed facility is designed with batch or semi-batch processes with relatively simple control steps.

So, a simple I&C system as proposed in Chapter 7 is consistent with that operational philosophy and complies with the statement in the ISG.

The specific areas of review included, in addition to the summary description of the facility's I&C system, it consisted of individual descriptions of the process control systems, the engineering safety feature actuation and alarming systems, the control console and display instruments and radiation monitoring systems.

Within those review areas, the staff assessed whether the design criteria and design bases were sufficiently described to provide reasonable assurance that the final design will conform to the stated design basis with adequate margin for safety.

Since there was a lack of technical information, the review was focused on that.

Slide 7?

Chapter 7 as submitted by Northwest as part of the PSAR is a very high level preliminary I&C system configuration including high level physical descriptions of the I&C subsystems along with tables of design criteria, design bases and how the design intends to comply with the requirements.

The overall organization of PSAR Chapter 7 is as follows, Section 7.1 is a summary description of the system; 7.2 contains the design criteria and design bases and compliance.

Section 7.3 through 6 discuss the four primary system functions shown on the second bullet. These functions include engineering safety feature actuation, process controls, control console and display and radiation monitoring.

And, in the next slides, we'll go through each of those sections individually.

So, slide 8 concerns the summary description of the facility. The preliminary I&C configuration is functional and at a conceptual level as Northwest has stated.

The intent of Northwest in Chapter 7 is to describe the design methodology and provide reasonable assurance that the final design will conform to the design basis.

Technical aspects such as redundancy, diversity and isolation of functions and detailed discussions of permissive and interlocks will be part of the final SAR.

As shown in the second bullet there, Section 7.1 discussed operator interfaces and identifies that processes will be controlled by operators through both local human machine interfaces and from the control room.

And, when describing these local stations, Northwest used several different terms in the PSAR such as operator interface displays, operator interface terminals and human machine interfaces.

And, when I read that, to me, it implied a possible functional difference between those different stations. So, I investigated that through an RAI. And, in response, Northwest stated that, for consistency, they would replace those operate interface displays and operator interface terminals with just a single term, HMI, in the safety analysis report.

And, final details on the HMI designs will be part of the final SAR.

The staff finds basically this RAI response adequate to clarify the design basis of the HMIs and we also find the summary description of the I&C system acceptable based on the I&C system being designed to perform function commensurate with the complexity of the facility processes and based on the summary providing -- describing the various subsystems and how they interact as stated in the ISG Section 7B.1.

Slide 9 is a summary of the facility's overall I&C design.

Section 7.2 of the PSAR discusses the I&C system design criteria, design bases and compliance with the requirements.

The discussion in Section 7.2 is supported by tables of requirements from many standards, IEEE and ANSI standards, some NUREG documents and contract reports, regulatory guides and other documents and how the design will comply with those requirements.

As shown in the first bullet, Section 7.2 discusses the ability of the facility's I&C system to manage, monitor and actuate engineering safety features and, I think as Charlie Brown discussed this before.

There was a lot of confusion, I believe, in Chapter 7, at least I was confused. Both Section 7.1 and 2 state that engineering safety features will operate independently from the FPC system, will operate independently from the BMS and that the I&C system will monitor engineering safety features when required.

However, other part of Chapter 7, Section 7.2 states that the FPC system will manage items relied on for safety and that the FPC system will have the ability to manually actuate engineering safety features.

Again, these were kind of confusing so an RAI was issued to clarify that. And, in response, Northwest stated that the PSAR will be amended to state that engineering safety features will operate upon actuation of an alarm set point reached for a specific monitoring instrument or device.

And that, in addition, the FPC system or BMS will have the ability to actuate engineering safety features as needed based on information displayed by the I&C system.

And, the latest version of the PSAR chapter does include this change.

MEMBER KIRCHNER: Jim, this is Walt Kirchner.

MR. SERVATIUS: Yes.

MEMBER KIRCHNER: What are the implications of the ESF systems being integrated with the FPC, in particular, for -- I mean, what does that entail in terms of code requirements, for example? Does that get you into IEEE power systems behind the ESFs, et cetera?

MR. SERVATIUS: The amount of integration, in my mind, was -- is sketchy. Upon first read, my opinion --

MEMBER BLEY: Oops, Jim, we've lost you.

MEMBER BROWN: That's okay. While he's -- while you're trying to get him back on, I'll make one observation.

I would have -- when we see the final -- how they want to do it -- is he back -- I would expect that the ability to -- for the FPC system or the BMS to actuate the ESF as need, that it would be actuated independent of the local whatever alarm set point or aberrations where they're handled, you wouldn't want to go into a system that's failed and now you've got manual operate -- in other words, it has to be independent.

So, you have to bypass the failed potentially system that's not doing what it's supposed to do. I mean, that's consistent with what we --

I'm not saying -- you're talking about redundancy and all this other, I'm just saying you ought to be able to operate it independently.

MR. ADAMS: Well, if you reach the point where that system is --

MEMBER BROWN: It's not working.

MR. ADAMS: If you reach the point where

that system is called to perform an actuation, that means something else hasn't done its job --

MEMBER BROWN: Yes.

MR. ADAMS: -- for some reason.

MEMBER BROWN: Right.

MR. ADAMS: And, you don't want it to end up going right back into that.

MEMBER BROWN: Okay. So, that -- I mean, that's in your all's thought process when you all would be looking at this later, right?

MR. ADAMS: Yes.

MEMBER BROWN: Okay, thank you.

MEMBER BLEY: Jim, did you come back online?

While you're looking for him, let me sneak in a question that maybe you guys can answer for me.

The one place in Chapter 7 there was specificity was in which control parameters would be monitored -- I'll ask Jim, assuming he's here.

MR. BALAZIK: Jim, this is Mike Balazik, are you online? Are you on the bridge line? Jim, can you hear me? Jim, this is Mike Balazik, are you on the bridge line?

MR. SERVATIUS: Yes, I just rejoined.

MR. BALAZIK: Welcome back, welcome back, that's okay.

MEMBER BLEY: I think we were in the middle of a Walt question.

MR. ADAMS: He was about to give his opinion on something.

MR. BALAZIK: Yes, Jim, do you remember where you're at? We were talking about the ESF integration.

MR. SERVATIUS: About the independence?

MR. BALAZIK: Yes, and code requirements.

MR. SERVATIUS: Yes.

MR. BALAZIK: Okay. Do you want to keep going or are you --

(Simultaneous speaking.)

MEMBER KIRCHNER: Let me try it again.

So, what I'm curious about is what the implications are if, indeed, the FPC system is relied on to actuate engineering safety features or vice versa, whether they're passive or active?

And, how does that increase the complexity, I guess, of the analysis when we get to Chapter 13 and the expectations of the safety classification of equipment that's relied if these systems are integrated?

MR. SERVATIUS: I agree those are all good questions and, I basically had the same questions. I don't think there's enough detail in the chapter to be able to answer that right now.

It depends on how much the integrate the system into the FPC. It wasn't even clear when I first read it that the ability to manually activate it was going to be built in.

I agree that if it's fully integrated, then all the IEEE standards and reg guide requirements are going to be much more difficult to comply with.

And, I believe the philosophy of Northwest was to try to keep it very simple and minimize use of digital equipment. And, I think you talked about this before, but I think they're trying to eliminate all digital features from the safety related or items relied on for safety.

I believe it's definitely going to be more complex, depending on how much it is integrated. And, it's going to take a much more detailed review.

MEMBER BLEY: Let me follow up on that, Jim.

Earlier this morning, we were told that the degree of integration would be limited to indications from ESFs showing that various features had actuated or not. Is that your understanding? Did you have an RAI that, you know, was that consistent with what you heard back from RAIs in this area?

MR. SERVATIUS: I did have an RAI to discuss that and the results was we'll provide details later.

MEMBER BLEY: Oh, okay.

MR. SERVATIUS: Didn't really discuss it.

MEMBER BLEY: Okay.

MR. SERVATIUS: But, my original understanding was that it was one way and the engineering safety actuation and parameters being monitored would only be displayed, i.e., integrated into the FPC for that purpose of just reporting and displaying.

And, I haven't heard anything to the contrary to change that position.

MEMBER BLEY: Okay. Are you done, Walt?

MEMBER KIRCHNER: I think so.

MEMBER BLEY: I had one that kind of fits on this slide.

The one place in Chapter 7 there was a fair amount of specificity was in the tabulation of the parameters that would be monitored in the ESF actuation and monitoring features as well.

In your review, were you able to gain some confidence that that list was as complete as it needed to be? Did you refer to the ISA or any other backup sources to give you confidence that that set of parameters was the appropriate set?

MR. SERVATIUS: What I did is I compared the list of proposed parameters which is, I think, the way it's worded. It's not a final list. So, I treated it as preliminary and possible parameters being monitored.

But, I did compare those to what SHINE is monitoring, which is an already approved design, and they were pretty consistent. So, I felt confident that they had the right information there.

MEMBER BLEY: Okay.

And, Charlie had started a question while you were offline, but is that one you wanted to finish with Jim or --

MEMBER BROWN: Well, I'll just repeat it for Jim. And, my point, really, when I was discussing it with Al and Michael was that, you would -- this was in the ability of the FPC to actuate and ESF function as needed in the second bullet in that the ability of the FPC to do that, it would have to bypass the ESF set up that's there so you don't rely on the system it may not be -- that may have failed in order to do that manual actuation.

So, I presume that would be part -- that's like all the other stuff we've dealt with in the past from safety functions that you don't rely on this system that's not working to perform your manual actuation.

And, Al indicated, yes, that was all in your all's thought process. So, I presume my question was answered at that time. But, that's -- I did bring that up.

MR. SERVATIUS: Yes, that's my understanding is that it would be completely independent --

MEMBER BROWN: Okay.

MR. SERVATIUS: -- from the automatic actuation.

MEMBER BROWN: All right. I'm done. Thanks.

MR. BALAZIK: Jim, this is Mike Balazik, just go ahead and continue on with your presentation.

MR. SERVATIUS: Okay.

So, at the end of slide 9, I found that the response in the RAI was acceptable because it clarified the design basis for the engineering safety feature actuation, didn't provide the details, but it clarified the design basis.

And, I also found the level of detail in the design acceptable because it demonstrates an adequate design basis and meets the acceptance criteria of ISG NUREG-1537 Part 2, Section 7B.2.

Slide 10, Section 7.3 of the PSAR discussed the facility's process control systems.

And, further technical details including a system description and system performance analysis was not provided in the preliminary SAR and will be part of the final SAR.

As discussed in the first bullet, the process control system for the proposed facility include the SNM preparation and handling process and radioisotope production processes.

The SNM preparation and handling processes include uranium recovery, uranium recycling and target fabrication.

And, the radioisotope production processes include target receipt, target assembly, target dissolution, moly recovery, moly purification and waste handling.

And, the facility's process control is administered by the FPC system and it will provide two main functions as I saw it.

First, it will monitor valve positions that control interprocess fluid transfers and it would also control pumps that move fluid during that interprocess transfer and provide permissive signals to allow the pumps to be started.

And, whether that's an interlock or permissive signal, I agree with the ACRS on that, it kind of needs clarification.

MEMBER BROWN: Can I --

MR. SERVATIUS: So, I found --

MEMBER BROWN: Jim? Control pumps that move fluid during interprocess transfers, this sounds to me like there's a local operator that's doing stuff and then all of sudden somebody else has to control another part of the process then it goes back to local operators again, which it --

MR. SERVATIUS: The last thought is that -- I'm sorry?

MEMBER BROWN: It just seemed to be incongruous to move from one set of operators to another set of operators in terms of control and in terms of getting the timing -- I don't know, it just seems to be different, unusual for me, that's all.

MR. SERVATIUS: The way I understood it, and I could be wrong, but the way I understood it is that the main operations are being controlled locally at the HMI with a local operator.

And, he would -- all the things going on would be monitored by the control room and when all the valves and everything have been positioned properly by the local person at the HMI, the FPC system and the person in the control room would monitor that and when everything was okay, he would basically send a permissive signal.

So, it could be thought of as a transfer of operations, but I saw it as a supervisory monitoring of the operator at the local control panel and then giving him the permission to go do what he needs to do.

MEMBER BROWN: Okay. We had that discussion earlier relative to permissives and stuff, in terms of how that's used. Okay, thank you.

MR. SERVATIUS: Okay.

I found that the level of detail in the process control system description was acceptable because it demonstrates an adequate design basis that provides, in my mind, reasonable assurance that the Northwest final design will meet the acceptance criteria of NUREG-1537 Part 2 Section 7B.3 for process control systems.

Slide 11, Section 7.4 discusses the

actuation and monitoring of the facilities engineering safety features.

Again, as previously mentioned, engineering safety features operate independently from the FPC system and will be actuated automatically through the use of analog hardwired controls when parameters monitored by the I&C system reach established set points.

The actuation of an engineering safety feature will be displayed on the FPC system and locally at the affected system, an audible alarm.

Section 7.4 does not discuss manual actuation of the engineering safety features, but, as I mentioned earlier, in response to an RAI, Northwest stated that the FPC system or the BMS will have the ability to actuate engineering safety features as need based on information displayed.

No details as to how that will design and the independence and all that has to be worked out in the final safety analysis report.

MEMBER BROWN: Jim?

MR. SERVATIUS: Yes?

MEMBER BROWN: I didn't ask the question of Northwest, and I guess it slipped through my brain, are any of these ESF systems comparable in terms of say redundancy and/or voting between multiple monitoring systems similar to a, you know, reactor trip or the engineering safeguards in a plant? Or, are they all single monitor, single actuation?

Did it -- I forgot to ask that question whether there's any redundancy and/or voting done before an ESF is performed? Did you get any of that out of that in your RAIs or other discussions?

MR. SERVATIUS: No, I did not receive any information to clarify the redundancy separation, independence.

MEMBER BROWN: Or whether there's any voting?

MR. SERVATIUS: Or whether there's any voting.

The only voting that was discussed in the chapter was the FPC system as a dual channel --

MEMBER BROWN: That's the synchronized thing?

MR. SERVATIUS: -- support system.

MEMBER BROWN: That's the synchronized issue?

MR. SERVATIUS: Yes, when you mention synchronized earlier, it brought up that paragraph where it talks about the two independent systems that talk to each other and if one fails to talk to the other, then it triggers a one channel operation.

But, a lot of the details are still missing.

MEMBER BROWN: Yes, who's in control is a big question when you have redundant controls sitting there --

MR. SERVATIUS: Absolutely, yes.

MEMBER BROWN: -- talking to each other. Okay, all right.

So, there's no voting before an actuation is done as far as you know?

MR. SERVATIUS: As far as I know, it was -- right, it was not discussed.

MEMBER BROWN: Okay. We might put --

MR. SERVATIUS: They might provide it in an RAI.

MEMBER BROWN: Okay. We might put that on the list of things to think about.

MR. SERVATIUS: That would be good.

MEMBER BROWN: Okay, thanks.

MR. SERVATIUS: Okay.

Slide 12, Section 7.5 discusses the facility's control room and HMIs.

The facility will house a control room that provides overall process controls, monitoring alarms and alarm acknowledgment.

The facility's control room will consist of a control console, two or three HMI stations, redundant programmable logic controllers and all related necessary cabinetry and subcomponents such as I/O boards, gateways, power supplies, et cetera.

The BMS system, BMS will control the ventilation system from the control room and will monitor process vessel ventilation and will monitor the fire protection system central alarm from the control room.

Further details on the control console and display will be provided in the final safety analysis report including arrangement and orientation and accessibility of the operator.

Nonetheless, I found that the level of detail in the facility control room design acceptable because it demonstrates an adequate design basis that, if designed to the design basis, will provide reasonable assurance that the design meets the acceptance criteria of NUREG-1537 Part 2 Section 7.6.

MEMBER BROWN: Jim?

MR. SERVATIUS: Yes?

MEMBER BROWN: The one other question relative to the BMS, if you look at the -- Figure 7.1, the fire protection system had information being fed into the BMS. And, it had a couple of different channels, a couple of boxes related to fire protection.

Do they actuate all the fire protections features or is the BMS relied on to provide, once it's triggered, does it provide information back to actually actuate any fire protection features?

There was no clarity on that or at least that I could figure out. I got the feeling they were independent. They would do their job and they were just reporting.

MR. SERVATIUS: That's my understanding also.

MEMBER BROWN: Okay.

MR. SERVATIUS: It would be a one way just reporting and the BMS would not be able to initiate fire protection.

MEMBER BROWN: Okay. Then, my next question was, is there, in the ability of an individual that's in the plant reports a fire and there has not been any operation of the fire protection system, can the fire protection system be manually actuated from the main control room?

MR. SERVATIUS: My understanding was no.

MEMBER BROWN: Okay. Very, very

interesting. Okay.

MR. SERVATIUS: Yes.

MEMBER BROWN: I don't know --

MR. SERVATIUS: Yes, my understanding was the fire protection systems could only be manually actuated from the local HMI.

MEMBER BROWN: Okay. Is that -- oh, okay. Is that consistent with other plants? I don't know and I'm not familiar with the power reactors whether the fire protection systems don't have the ability to actuate if some of the other independent local systems don't operate.

Dennis, do you have any memory of that?

MEMBER BLEY: I would say it varies.

MEMBER BROWN: It varies?

MEMBER BLEY: Yes, if you're looking at spray systems, that sort of installed sprays, most of those, yes.

MEMBER BROWN: You can actuate those from some other location other than the local?

MEMBER BLEY: Some are -- well, I'm sorry, some are automatic.

MEMBER BROWN: No, I -- well, if the automatic doesn't go, that's all I'm saying.

MEMBER BLEY: Oh, I don't --

MEMBER BROWN: And, I'm just not familiar with the power plants, what they do.

MEMBER BLEY: I started to say I don't know, but I think it varies. I think there are some where you have general panels in the control room where you can do it.

MEMBER BROWN: Okay.

MEMBER BLEY: Or you can -- or at least you can monitor it. I'm not positive.

MEMBER BROWN: Okay.

MEMBER SKILLMAN: Normally, ESF panel will let you actuate spraying manually if you have to. And, for the fire remains, they're normally constantly pressurized throughout the whole plant. They're normally redundant.

MEMBER BROWN: So, if the local -- I'm just thinking, if these look like the local panels that, you know, individually actuate within some areas, it just looks like that's an area of definition that ought to be looked at to make sure we have fire protection covered.

MR. ADAMS: For research reactors, it varies but --

MEMBER BROWN: Is that right?

MR. ADAMS: -- it tends to be more towards automatic actuation.

MEMBER BROWN: And, if the automatic doesn't actuate then somebody runs in there with a fire extinguisher?

MR. ADAMS: Pretty much.

MEMBER BROWN: Thank you. Doesn't sound like a good plan in this case, that's all, based on the material we're dealing with.

MR. SERVATIUS: My plan is for the final SAR to compare the entire fire protection system actuation capability with SHINE.

MEMBER BROWN: Okay. You can go on.

MR. BALAZIK: Jim, it's Mike Balazik, go ahead with your presentation.

MR. SERVATIUS: Let's see.

MEMBER BROWN: Slide 13, I think.

MR. SERVATIUS: Slide 13, yes.

Section 7.6 of the PSAR discusses the facility's radiation monitoring systems.

The radiation monitoring systems include continuous air monitors, radiation area monitoring, monitoring at the exhaust stacks, process control instruments to analyze for uranium concentrations and a variety of personnel monitoring and dosimetry.

The objection of the radiation monitoring system is to provide the control room personnel with a continuous record and indication of radiation levels at selected locations where radioactive materials may be present, stored, handled or somehow inadvertently introduced.

The performance analysis of the radiation monitoring system is not provided in the preliminary SAR and will be provided in the final SAR.

I found the level of detail acceptable in the PSAR because it demonstrates an adequate design basis and if designed to that design basis, will meet the acceptance criteria of Section 7.7 of NUREG-1537 Part 2.

Slide 14, the last two slides here discuss the findings and conclusions of the Chapter 7 safety evaluation.

The preliminary I&C system described in the PSAR meets regulatory requirements and the acceptance criteria for the issuance of a construction permit.

Based on engineering judgment, I conclude that the level of detail in the proposed I&C systems in the PSAR is adequate for the issuance of a construction permit because any required modifications to the system design and operating procedures can readily be implemented after the facility construction activities have been completed.

There is a lot of risk associated with that, but I believe it's acceptable and meets the criteria for issuing a construction permit.

Slide 15, accordingly, Northwest has met the following requirements of 10 CFR 50.35 for issuance of a construction permit with respect to the I&C systems.

One is the systems have been described including, but not limited to the principle architecture and engineering criteria for the design and major features and core components have been identified.

Two, further technical or design information may reasonably be left for later in the final safety analysis report.

And, finally, there is reasonable assurance that the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

That concludes my presentation.

CHAIR CHU: Any questions?

MEMBER KIRCHNER: Jim, this is Walt Kirchner.

You didn't specifically mention the criticality of the CAAS system. Any specific expectations there or is that just something one leads to the FSAR stage?

MR. SERVATIUS: I decided to leave it to the FSAR stage. The only thing that they said was that it was going to be an off-the-shelf purchase. They didn't provide many details other --

I think I did issue an RAI and asked about the monitoring of uranium concentration to prevent a criticality, but again, it was deferred to the final SAR.

MR. BALAZIK: This is Mike Balazik.

That ends the NRC presentation. Any other questions?

MR. SERVATIUS: Mike, do you want me to stay on the line for the rest of the day?

MR. BALAZIK: We can talk about that offline.

MR. SERVATIUS: Okay.

MR. BALAZIK: I'll call you in a minute.

MR. SERVATIUS: Okay.

CHAIR CHU: Okay, now we can start Chapter 8.

MR. BALAZIK: Jim, this is Mike Balazik,

and if you could just put your phone on mute so we don't catch any background noise. Thank you.

CHAIR CHU: So, we're going to go ahead and start our presentation on Chapter 8 and I'm going to hand it over to Gary.

MR. DUNFORD: Okay, I need to preface this, I know if my lamp doesn't work, I either have to plug it in and check the light bulb, that's about the extent of my electrical knowledge.

But, I also have a mandate to try to get through this a little bit quicker than what we have here.

So, I think what you'll find and I think you'll probably come to similar conclusions that, at the construction application, there is not an extraordinary amount of detail. So, we'll just kind of start with that.

So, we have two basic systems that we've identified consistent with 15.37 which is our normal electric power and we have a standby power system or emergency power system also. And, we'll kind of walk through those.

There is some upper level diagrams. The next slides actually just a load diagram. We'll walk through those, talk a little bit -- try to get through quickly and then really just try to respond to questions that you may have in this area.

In response to your last question, though, on voting, there actually is one IROF that's a voting that we'll talk about during Chapter 6, so we can bring that up in there. There's the uranium monitoring system as a criticality safety feature.

That slide's just showing where we are as far as our loads, the type of systems. It's really the center column there that's called the UPS system.

Where it has a yes, that means that we have determined that those systems need uninterruptible power either as part of co-compliance issue or a safety shutdown on a loss of power.

And so, what those are, are radiation and criticality systems. To be honest, I'm not sure what this general facility electrical power meaning yes means. I'm just assuming that means the control pieces of bringing up the standby generators.

And so, there's a piece there that's going to get some power.

And then, the other things are fire protection, we talked about that. That actually has, I think, a 24-hour UPS, it's quite a bit longer.

The facility process control system that we just talked about in the last session and then we have safeguards and security measures will also have to have UPS.

MEMBER BLEY: Yes, Gary? What's the criteria for having decided except for fire protection that the UPSs are 120 minutes, 2 hours?

MR. DUNFORD: Right now, I'll tell you, it's a little bit tenuous, but it goes back to the kind of the worst accident we have and how long that takes is really kind of our 2 hours of dissolution happening.

And, that event kind of gets -- is a 2-hour type of an event. So, that's pretty much where we have come from through our qualitative risk assessments.

If there's something else that says this system needs more --

MEMBER BLEY: You think this needs less than that?

MR. DUNFORD: Yes. If we think there's something more then we'll put that in.

The stack monitoring system is an example may end up being more than that. But, it doesn't necessarily have to be.

The other thing that would kind of don't take credit for but that exists is a backup emergency generator. I'm sorry, a standby power, excuse me.

And we don't really have that because there's a monetary value to our product and the time to our product. So, that's what that generator is there really for.

It's not --

MEMBER BLEY: Save that one, I want to get to that. But, I'm going to stay with the UPSs for a second.

MR. DUNFORD: All right.

MEMBER BLEY: The 24-hour criteria for the fire system UPS, the basis for that?

MR. DUNFORD: From my understanding, it's a code requirement not an analysis that we've done.

MEMBER BLEY: Okay. So, it came externally?

MR. DUNFORD: Yes.

MEMBER BLEY: We'll have to look at that at some point.

And, you think all the others are, you know, you might need to revisit, but 2 hours seems pretty reasonable for those.

You don't -- Chapter 8, I don't think, talks about the batteries for the UPSs. Are they local at each UPS? Is there a battery room and they all draw off the same batteries? How is that going to be arranged? Have you thought about that even at this point?

MR. DUNFORD: There's been some discussion about it. I believe in our facility layout there's actually a battery room by the control room, but I also think there are standalone UPS systems around the facility.

MEMBER BLEY: With their built in batteries?

MR. DUNFORD: Yes.

MEMBER BLEY: That's what I've usually seen, but okay.

Your standby electric power, at least according to the one line that's in the book, it's not on --

MR. DUNFORD: Yes.

MEMBER BLEY: -- the one line you've --

MR. DUNFORD: It's below this diagram, yes.

MEMBER BLEY: -- feeds -- it appears to me it only feeds switchboard number two and MCCs number three and four. So, I take it that means all the loads you consider most important are loaded on to those three boards?

MR. DUNFORD: Yes, sir.

MEMBER BLEY: Well, the two MCCs come off of the same board. So, all off of switchboard number two.

Which kind of gets to a related question that I had and John Stetkar raised in some notes he sent to us since he wasn't going to be here.

The load balance among the MCCs and the switchgears look a little peculiar to us, but that's usually -- that's because we usually see people balance the loads out in case you have only power to part of the system.

All of the chillers are fed from switchboard number one which doesn't get the diesel. So, I take it that means the chillers aren't on your list of important things.

MR. DUNFORD: That's correct, Chapter 5 is actually the discussion where we showed why we don't need those chillers --

MEMBER BLEY: Okay.

MR. DUNFORD: -- process chillers in the analysis.

MEMBER BLEY: Okay. And, all your ventilation systems appear to - or most appear to come off of switchboard number two for the MCCs that feeds which will get the standby diesel supplying them power?

MEMBER BROWN: You mean the HVAC?

MEMBER BLEY: I did. What did I say?
MEMBER BROWN: You said -- you just said ventilation, I didn't know whether you had AC in there, but the --
MEMBER BLEY: But the exhaust fans and the --
MEMBER BROWN: Well, I was looking at John's comments also and it says the HVAC chillers and process chillers only have one power supply.
MEMBER BLEY: Well, that's what --
MEMBER BROWN: You probably meant?
MEMBER BLEY: -- that's the chillers.
MEMBER BROWN: Yes, but then the HVAC part of it, is that both --
MEMBER BLEY: The fans.
MEMBER BROWN: Oh, so that's different?
MEMBER BLEY: Yes.
MEMBER BROWN: They're --
MEMBER BLEY: The fans all come off of --
MEMBER BROWN: Yes, I just didn't --
MEMBER BLEY: -- several different boards.
MEMBER BROWN: Okay, I didn't have --
MEMBER BLEY: But the chillers all come off of one, which seemed odd.
MEMBER BROWN: And only one power supply

and it's --

MEMBER BLEY: Yes, which seemed odd except the reason they've told us is that they don't need those chillers.

MEMBER BROWN: Either one of them?

MEMBER BLEY: Any of them. There's more than two.

MR. DUNFORD: From a safety aspect.

MEMBER BLEY: Okay. And, you didn't think it worth balancing them from a productivity or a production standpoint?

MR. DUNFORD: I suspect there will be some balancing happening as part of the final design.

MEMBER BLEY: Okay. But as you balance then --

MR. DUNFORD: Then you have to figure out --

MEMBER BLEY: -- you've got all these other loads over there that are --

MR. DUNFORD: That's correct. That's --

MEMBER BLEY: -- more important. So you --

MR. DUNFORD: That's why --

MEMBER BLEY: -- can't --

MR. DUNFORD: -- it is right now, but I

suspect we can -- we'll evaluate where we get in the final design and any of the accident analysis change.

MEMBER BLEY: Or you might go to a bigger diesel if we -- the diesel capacity is a little less than the total loads we see added up.

And, John had a question and I would have the same one, does the diesel take on all its loads at one time? In which case, you'd have a lot of surge current from motors and things starting up.

MR. DUNFORD: Yes.

MEMBER BLEY: It's got a load sequencer of some kind on it?

MR. DUNFORD: Yes, we've talked about that requirement or that need --

MEMBER BLEY: Okay, but that's not in the chapter now I don't think.

MR. DUNFORD: I don't think it's written up.

MEMBER BLEY: Okay. So, you will be --

MR. DUNFORD: I don't think we have a diagram either.

MEMBER BLEY: No, I didn't see it anywhere. I was looking for that. Okay.

MEMBER BROWN: Yes, the other point in that was that the diesel is a 1000 kilowatts as you show it.

MR. DUNFORD: Yes.

MEMBER BROWN: And the total peak load is about 1100 or almost 1180 kilowatts.

MEMBER BLEY: The diesel only supplies one of the two boards.

MEMBER BROWN: It's the point being of John's note in here was there was can the diesel supply all the load that's necessary whereas they talk, about the peak load for the SEP standby, electric power for the whole RPF is almost 1200 kilowatts, whether it's one board, two boards or whatever, it if only supplies one, but it just was an inconsistency the way I read the comment, that's all. So, interesting.

MEMBER BLEY: Anyway, they've got to work that out.

MEMBER BROWN: Yes, the details are missing.

MR. DUNFORD: And, actually, the chapter kind of identifies that in there, tells you your load and it tells your peak load right there in the next section and it says and we recognize that.

MEMBER BROWN: Okay.

MR. DUNFORD: Let's see, let's go to slide -- Steve, the one that has the diagram, the one line.

Yes, which we've kind of just talked about.

MEMBER BLEY: Well, we talked about the stuff down below this.

MR. DUNFORD: Right.

So, the idea here is that we would have two feeds to the site, actually, I should say to the ones are underground utility feeds. We would split the -- two of those two are administrative building that's not part of the application, it's just another building onsite.

And then, the three heads off into the radioactive processing facility. And, as you see, how they're -- it's split. There is a multiple -- so it splits into two main feeders coming into the building.

And then, as you can't see, but you can see in the chapter, it shows the MCCs and where the various loads go. And, you don't see the transfer switchgear for the standby power on here either.

MEMBER BLEY: Right, that's down lower than this.

MR. DUNFORD: Yes.

MEMBER BLEY: But the breaker that ties together the left and right halves here, that's normally open? That -- let me read the number of it -- it's the -- it's labeled 400CAF.

MR. DUNFORD: Yes.

MEMBER BLEY: That's normally open. If you lose one of the feeds, do you have the capability to rearrange the power loads? You can close that breaker but somehow you need to control the way you pick up other loads. Have you addressed that as yet or is that something you'll work on later?

MR. DUNFORD: I don't believe we have that amount of detail.

MEMBER BLEY: Okay.

MR. DUNFORD: I'm sure the EE guy can tell you what his thinking was on that. I'm just not able to articulate it.

MEMBER BLEY: Okay. It did say that breaker is normally open which makes sense.

MR. DUNFORD: Yes.

MEMBER BLEY: But, no automatic closing of it if you lose one feed or the feed's a 100 percent, can they pick up the opposite half?

MR. DUNFORD: Well, to me, that would make sense. So --

MEMBER BLEY: It would make sense, too.

MR. DUNFORD: So, I'm thinking that would be automatic, but I don't know if there was a pitfall that I was going to fall in there when you asked that question.

MEMBER BLEY: I didn't set a trap --

MR. DUNFORD: Okay.

MEMBER BLEY: -- on purpose anyway.

MR. DUNFORD: So, safe shutdown slide?

The -- so a loss of -- and we'll talk quite a bit more about loss of power when we talk in Chapter 6. It's the initiating for a number of events -- really in Chapter 13, we'll talk about it, too. But, we'll also talk about it coming forward into Chapter 6 and there's a little bit here in the back end about what we expect to happen on a loss of power for the facility.

And, excluding, there is no standby generator, that's how we walk through it from a safety analysis perspective.

So, UPS, we've talked a little bit about. So, the process control systems, communication systems, security, emergency lighting, fire protection, the radiological protection and CAAS and I'll just add the stack monitoring system also becomes part of that. It was mentioned in Steve's report, it's not on this bullet, though.

Okay, so, it talks about unit devices, rack-mounted or a large cabinet. Like I said, I believe there's a battery -- large battery location close to the facility process control room and then, there's locals.

So, go ahead, Steve.

MEMBER KIRCHNER: And, Gary, by implication then, the engineered safety features, putting aside those that are passive features, will just fail on loss of power to the safe shutdown configuration?

MR. DUNFORD: Yes.

MEMBER KIRCHNER: Okay.

MR. DUNFORD: So, that would mean inlet dampers, bubble-tight dampers would close. The tank we talked about on the dissolver, that automatically opens.

On the uranium monitoring system, valves open. It goes right back to a recycle mode so it doesn't go over to the waste management, or I'm sorry, the waste management tanks and stuff like that. So, yes, sir.

In fact, I think that's probably what this next slide is going to tell me, which is, on lost off normal power, the Zone 1 bubble-tight dampers will close.

The HVAC system -- so, the fans are not on the UPS, they would eat up a UPS supply quite rapidly, so they're not on there, but the system gets set to a passive mode.

The process ventilation system has the same thing. The heaters would stop running, the valves would open or close as they've been identified for their failure mode. In most cases, the main valves would fail open so that it's still hooked up to Zone 1, but individual inlets potentially could shutdown -- dampers could all actually close. But most of them would open up in the process vent system.

We talked about the pressure relief system.

The other real active system we have is our emergency vessel purge system. And, that's a hydrogen gas generation concern.

So, if we were to lose our air compressors, which, as you look, they're not actually on the -- well, they don't have UPS. So, we have modeled nitrogen gas that opens up and changes the vent system.

Uranium transfer we talked about which are the concentrators right there. And, effectively, our mode of force is really seize. Right? The pumps shutdown, cooling jackets, everything goes pretty much to a static condition.

The next slide, Steve? Thank you.

There's the site to the emergency power system of the chapter. And so, the emergency power pieces are the UPS and the standby power as we talk about. And, one of our conclusions is that it is there for monetary aspects, not there for safety.

The UPS, again, safety-related instrumentation, effluent, process and area radiation monitors, physical security.

Based on our Chapter 5 analysis, emergency cooling water is not required. So, that hasn't changed.

MEMBER BLEY: Why is it called emergency cooling water?

MR. DUNFORD: That's from the chapter, from 1537, I believe we're using.

MEMBER SKILLMAN: From the NUREG?

MR. DUNFORD: From the NUREG, yes.

MEMBER SKILLMAN: Gary, let me ask this. Your Figure A1 in your PSAR is the only real sketch we have or image that we have of your system. Would we be accurate in presuming that there is going to be another revision that will show the uninterruptible power supplies and other add-ons so that we have a more thorough understanding --

MR. DUNFORD: Yes.

MEMBER SKILLMAN: -- of how the emergency power fits into the overall --

MR. DUNFORD: Definitely.

MEMBER SKILLMAN: -- thing?

MR. DUNFORD: Well, and even when we write the FSAR, a lot of that has to show up in Chapter 6 for each of the individual EFS so you can identify where it's getting its, power, what's happening in those events.

MEMBER SKILLMAN: Okay.

MR. DUNFORD: So, we'd have to have those diagrams, those figures and stuff that also looks at that pinpoint.

MEMBER SKILLMAN: Thank you, thank you.

MR. DUNFORD: So, the first conclusion, let me reword that. We evaluated the loss of power on radiological and criticality and consequences and accidents.

And so, we'll just start with that.

And, loss of power is not an unlikely event, meaning it's a probable event and, in my choice of words.

So, the EFS power will activate. We'll go to fail-safe which I guess we've really already talked about.

So, if there's an EFS that requires power, so an emergency purge system, the valves automatically open up. Same thing conversely, the dampers will shut and the relief tanks opens up.

As we go to Chapter 6, there is most of our EFS are passive. There's not a lot of active controls, but we'll go through those more and you'll be able to see that.

MEMBER BLEY: Do you have any historical information on the local grid and your likelihood of losing power and the durations that are likely to happen?

MR. DUNFORD: Yes. I don't know the answer to that, but I know in the QRA, the author went and did some checking to confirm that this is what we should be expecting.

MEMBER BLEY: Okay. I haven't looked through that yet but we -- so that should be in the QRA now?

MR. DUNFORD: I believe that's in the QRA on external events.

MEMBER BLEY: Okay.

MR. DUNFORD: So, we --

MEMBER SKILLMAN: Let me jump in there just for a second.

MR. DUNFORD: Okay.

MEMBER SKILLMAN: That has to do with the write-up in your PSAR where you, in 8.1.1, describe your normal power supply and you communicate you'll have sufficient and reliable power supply.

What dimensions have you considered for reliable? I ask because, if you are at the dead-end of a long single line, you may have power factor issues that will affect all of your inductive equipment.

You see out in farm territories large capacitor banks that are on poles to correct the power factor to ensure that the final customer has the power factor of about .85 to protect the inductive equipment.

You've got a lot of inductive equipment in this facility. So, I'm curious if you've thought through what you say sufficient and reliable power, what do you intend as reliable power from your vendor?

MR. DUNFORD: Yes.

MEMBER SKILLMAN: That can become a safety issue because you can burn out a lot of equipment if you don't have the power factor that you should have for that inductive equipment.

MR. DUNFORD: Well, it trips UPS when they shouldn't.

And, I've heard discussions, the electrical engineers talking about the power conditioning and stuff that we'll have to have. And, I do not know what they have selected.

MEMBER SKILLMAN: But, it sounds like they're thinking about it or --

MR. DUNFORD: They have, yes, definitely.

MEMBER SKILLMAN: Okay, thanks.

MR. DUNFORD: Because we're actually almost exactly what you said, we're pretty close to the end right now of that loop.

MEMBER SKILLMAN: Okay, thanks. As long as you've considered it.

MR. DUNFORD: Okay.

The last -- the second to the last bullet on this slide says no IROFS for loss -- for this event. What I'm trying to say there is we've identified a bunch of IROFS already for spill accidents and dissolver offgas accidents.

When we got down to a what is loss of power create? Well, loss of power is actually an initiating event to lots of the other accidents. So, when we actually got to looking at loss of power by itself, it did not create any new IROFS in our evaluation.

So, and then, again, some of the loss of the normal electrical power doesn't create worker safety or public issue which was kind of our takeaway which would make sense where we got to.

MEMBER BROWN: Question. What's still in

an electric plant, this was brought up earlier that the Figure 8-1 or whatever it was, whichever the appropriate figure is, did not show any UPSs. And then, we talked a little bit about UPSs.

Part of the discussion here, is, and there's a number of them.

MR. DUNFORD: Yes.

MEMBER BROWN: Did the UPSs, each individual UPS, have its own battery or is there a larger station battery that supplies all UPSs or has that been thought through as to how you're going to do that?

MR. DUNFORD: I believe -- from looking at the floor plan and the discussions I have heard, I think that both of those things are happening.

There are a -- a larger battery location, but there are also individual UPS power around the facility.

MEMBER BROWN: Okay, let me -- I didn't see it. So, each -- if a process has a UPS associated with it, because you all identified several processes that would have their own -- that would have UPSs, some don't. Is that an individual battery for that process?

If I go look at your Figure 7-whatever it is, you've got them shown out in terms of the specific batch process or whatever they are, do they have their own individual battery or is there a station battery or facility battery that you have for that? Or, if you don't know, that's just fine.

MS. HAASS: I'm going to say that we don't know that answer right now. And, I'll be honest, I'm not sure if we could answer that right now without finalizing our design.

MEMBER BROWN: Okay. I would just suggest that that be, you know, identified --

MS. HAASS: Yes.

MEMBER BROWN: -- in whatever the appropriate chapter is, either 7 or 8 or --

MS. HAASS: Okay.

MEMBER BROWN: -- whatever. Okay?

MR. DUNFORD: Yes, I was just kind of reacting to the word process. So, when I talk -- think process, the dissolution process, the moly removal -- or moly separation process, none of those actually have UPS requirements to it. It's the supporting systems that do, the radiological protection systems, as an example or the criticality alarm system.

So, some of those can make sense that those would be centralized. And, looking at some of the others makes some sense that, obviously, emergency lighting, you can either go off of a large battery system or you can just have individual.

MEMBER BROWN: Okay, the reason -- one of the reasons for my question is that I did not see, and I didn't say this back in Chapter 7, I missed this one again, is that is there a set of design criteria or selection criteria for which you make a determination which ones need or do not need?

You talk about two or three of them that you don't have a UPS for. I don't remember whether there was anything that says why you don't need it for this.

MS. HAASS: There was no selection criteria right now in the PSAR. But --

MEMBER BROWN: That's -- so, my only point being --

MS. HAASS: Right, so but we will have to --

MEMBER BROWN: -- is there going to be one when we get there?

MS. HAASS: That selection criteria is necessary for us to make that decision, yes.

MEMBER BROWN: Okay.

MS. HAASS: I don't know it off the top of my head.

MEMBER BROWN: Well, it would be nice if

that was in the FSAR.

MS. HAASS: Okay.

MEMBER BROWN: When you finally do your final thing for the OLA, for the operating license application or whatever the next piece of paper is, it would be good to have the, you know, some selection criteria as to which ones need them and which ones don't and why or I guess that's redundant.

MS. HAASS: Okay.

MEMBER BROWN: Or it became redundant on that.

MS. HAASS: We will do that.

MEMBER BROWN: And, again, whether they're going to be individual or whether you make the -- and I don't know whether you have five batteries or whatever, it'd just be nice to know the decision process why you have what you have.

MS. HAASS: Okay.

MEMBER BROWN: That's all. Okay, thank you.

MS. HAASS: We are done with our presentation, Margaret.

CHAIR CHU: If there's no more questions, then NRC?

(No audible response.)

CHAIR CHU: Thank you.

MR. BALAZIK: I think if nobody objects, if we just do this manually. Is that okay? Or I could just flip through the other -- never mind. Two out of three is pretty good, right?

All right, good morning, again this is Mike Balazik, Project Manager.

Right now we'll be presenting Chapter 8, which is electrical systems. And, with us today, we have Steve Alexander from Information Systems Lab and he will be -- and he was the reviewer for Chapter 8 and he will be doing the presentation.

All right, Steve.

MR. ALEXANDER: Can you hear me? All right.

As Mike said, I'm Steve Alexander with ISL. I'm formally with NRC for two years. And, I reviewed Chapter 8, so I'll be summarizing our review and evaluation of Chapter 8.0 of the Northwest Medical Isotope's preliminary safety evaluation report on electrical power systems.

The regulatory requirements are similar to other chapters. 10 CFR 50.34 which talks about what has to be in the applications and what's supposed to be in a PSAR.

50.35 requirements for issuance of construction permits. And, again, some guidance in the common standards of 50.40 apply to Chapter 8 as well.

NUREG-1537 Part 2 and the Interim Staff Guidance.

Now, I'll note that for Chapter 8, it's very simple. The Interim Staff Guidance for Part 2 pretty much says just use 1537. So, there's no additional information in the ISG for Chapter 8. It just refers back to the criteria that are found in 1537 Part 2.

Of course, we also use 1537 Part 1 as some guidance in looking at the form and content for the application.

And, clearly, there are a number of items of regulatory guidance and codes and standards and so on that are referenced both 1537 and in the PSAR that were looked at.

Slide 4, please?

For the electrical system provide electrical power for electrical and I&C equipment during normal operation and to support safe shutdown, maintaining it in a safe shutdown condition and preventing offsite release of radioactivity and the existing regulatory guidelines upon loss of normal power and any other postulated design basis event.

Electrical systems are designed for for high reliability and durability through redundancy and diversity using quality assurance and design manufacturing procurement installation and regulatory oversight during the design and construction phase.

And, this is something that's worth elaborating on a little bit. Based on the maturity of the preliminary design at this point, and then how much of the blanks have been filled in and not filled in, we get the feeling that it's going to rely pretty heavily on construction inspection, depending on how far the construction gets relative to the design completion.

And, this is a risk that I think that Northwest has recognized and seemed to be okay with. But, it's going to put a pretty heavy burden on regulatory oversight during construction.

Next slide, please?

So, the normal electric power comes from the local utility, Columbia Water and Light via the Grindstone Substation. Standby backup electric power is provided onsite diesel generator and the emergency power provided to critical electrical and I&C equipment provided by UPSs which we've talked about at some length.

And, at this point, I think let's go to slide 6 if we could.

So, we evaluated the technical information presented in Chapter 8 supplemented by responses to RAIs to assess the sufficiency of preliminary design and performance of RPF electrical systems for the issuance of a construction permit.

Considered design criteria, design bases and relevant design information to provide reasonable assurance the final design will conform to the design basis.

The review included the normal electric power systems, the standby electric power system and the uninterruptible power supplies to the extent that they are described and their loads, seismic and environmental qualification, at the kind of the approach level because those are highly dependent upon individual equipments.

And so, we just took a look at their approach to seismic and environmental qualification independent of single failure criterion, safe shutdown and probable subject for technical specifications, which we'll get to.

For Chapter 8, the technical specifications, there are some technical specifications related to some of the systems supported by the electric power system, in particular, the UPSs.

There may -- the chapter discusses that these are going to be fleshed out during the final safety analysis report as to exactly which things in the electrical area are going to need tech specs.

But, at this point, the normal electric power system doesn't require any according to the PSAR, but there's an implication that there may be tech specs associated with some of the -- certainly the loads off the UPSs and maybe something related to the UPSs themselves such as the requirement for if there's a station battery.

And, again, that hasn't been fleshed out whether there's going to be one station or facility battery or individual distributed batteries among all the UPSs.

Next slide, please?

MEMBER SKILLMAN: Steve, before you proceed --

MR. ALEXANDER: Yes?

MEMBER SKILLMAN: -- please go back to slide 4.

MR. ALEXANDER: Yes, sir.

MEMBER SKILLMAN: And, I would like to you amplify on your emphasis on that second bullet. And, the reason I'm requesting this is, we've just witnessed this exact type of issue at the four new builds, or to two plants in the south.

And so, I'm wondering if you are emphasizing this just from years of experience or because of recent operating experience or recognizing the potential that this design that might be classified as quite simple is not as simple as it might seem.

MR. ALEXANDER: Yes, sir, exactly right. And, most -- it's not based on recent experience, it's based on previous years of experience.

And, one of the things that I had learned over the years at NRC is that the further the construction gets ahead of the design, the more things like field change requests and that sort of thing come through, it puts a big burden on going back through the whole design process and rethinking things.

And, sometimes, it ends up costing the applicant a lot of time and money and blood, sweat and tears to fix stuff that wasn't fully thought out beforehand.

So, it's just basically making the overall comment that the more these problems can be worked out in advance of pouring concrete, or the finalization of the construction, the better off we'll be.

And, it is going to require some onsite scrutiny to make sure this stuff gets done that way. And, again, that's based on just years of previous experience.

MEMBER SKILLMAN: And, I think I heard you say that you are aware that the licensee and the applicant is aware of this as well?

MR. ALEXANDER: There have been numerous discussions back and forth about this and I'm confident that they're aware of the need to complete the design to the extent possible at each stage.

They're assuming a lot of risk by being able to get a lot of construction done before the final details are worked out.

MEMBER SKILLMAN: Thank you, let's go to 6. Thank you.

MR. ALEXANDER: Yes, sir.

Let's see, okay, I think we're done with 6 then if we can go to 7, please.

So, PSAR Section 8.1 provides a high level description of the preliminary design of the RPF normal electric power system.

The normal electric power system is to receive 480-vole, 3 phase, 60-hertz alternating current from the local utility, Columbia Water and Light via the Grindstone Substation.

The normal electric power system is to be used for normal operation and normal shutdown of the RPF.

Total power requirement is just under 3 megawatts.

8.1 states the design basis of this system is to provide sufficient and reliable power to all systems and components requiring electric power for normal operations and normal shutdown including electrical requirements of the system equipment, I&C, communications and devices related to the safety function.

And, in looking at this thing, one of the first things I noticed about Figure 8-1 is the conspicuous absence of the UPSs. And, basically, I decided that the need for UPSs was generally identified, although there were no specific selection criteria as to what's going to need UPSs.

But, for construction permit and looking at what's going to require uninterruptible power, I thought that the level of detail was adequate there at this stage.

If you look at -- if you all have access to Figure 8-1, a couple of other points that were brought up earlier and I wanted to mention here, according to the note, Note 5, or excuse me, Note 4 on Figure 8-1, both of the input power transformers to the facility are full capacity transformers, as are all of the associated wiring and switchgear.

The breaker, the tiebreaker is normally open and the note says that, in the event that there's a need for this, that the tiebreaker can be closed after -- and the full power can be supplied from side or the other.

It doesn't indicate whether that's automatic, it just says can be closed and it'll carry the full building load.

The other thing I noticed here is that, on standby switchboard, switchboard number two, there are some breakers shown on there that don't have any loads.

And, again, we don't know this level of detail but it appears that, if there were a whole separate -- a whole other level of detail distribution system to supply power to the battery charges and the UPSs.

And so, this is one place it could come from because the description says that the standby electric diesel generator will provide power to the UPSs to extend their operability, presumably to the battery charge and of the UPS.

Okay, next slide, please?

MEMBER BLEY: You didn't see anything about if you close that crosstie breaker, if you can close that with all the loads still sitting on the equipment.

MR. ALEXANDER: No, sir. That's a good question.

MEMBER BLEY: I didn't see anything about that either.

MR. ALEXANDER: Right. If you wanted to shutdown let's say one side of that for maintenance, one would presume that the equipment would be available to either drop the loads with the facility shutdown and shut the breaker on the dead bus and then re-energize by shutting the breaker or you should have the ability to parallel across transfer load and then open the breaker supply side to the other side, whichever way you're going to do it.

The note doesn't go into that much detail, but if you have, you know, voltage in current instrumentation and synchroscopes and that sort of thing, you should be able to parallel across if you need to or de-energize the loads on one side and then pick it up from the other side and pick up a dead bus.

But, that level of detail is not in the PSAR.

MEMBER BLEY: Right. And, if they lost a feed, there's no discussion. They'd have to open all those -- disconnect all the loads before they close that.

MR. ALEXANDER: All it says is that, if you lost a feed, you have the capability of cross-tying and providing the power from the other side. The detail of whether you'd have to de-energize everything or can you pick up the loads or is there a load sequencer.

There is supposed to be, my understanding, a load sequencer on the standby diesel generator.

But, on these other loads, we don't have that information.

MEMBER BLEY: Right. Yes, they confirmed that this morning.

MR. ALEXANDER: Although it's not specifically stated. But, that's their plan, we understand.

Let's see, okay, so, PSAR Section 8.2

describes the RPF standby electric power and emergency electric power systems.

In the event of loss of normal power, several safety-related UPSs provide power to certain safety-related systems and components, some of which considered items relied on for safety, for protection of workers and the public until the standby diesel generator automatically comes online and the automatic transfer switch shifts the SEP loads to the SPG bus.

Then the SPG power to the SEP system which supplies certain SEP loads to allow the RPF to continue to operate on a limited basis and also extends the supply of power, as I said before, to the UPS loads.

So, emergency electric power is the temporary substitute as defined in the NUREG for the normal electric power system in the event of a loss of offsite power.

Emergency electrical systems are designed to support systems that prevent damage to the RPF and releases of radioactivity to the environment.

If you'll notice again on system -- on, excuse me, on Figure 8-1, we may be used to seeing loads that are powered normally and then are powered alternatively from a diesel bus.

In this case, we've got all of the loads that require standby electric power are on switchboard number two which is either powered from the main switchgear or from the diesel.

So, it's a pretty straightforward general representation and presumably then also there will be loads on switchboard two that will eventually be used to power the battery chargers of all the UPSs or the station battery, if there's a separate one.

Okay, next slide, please, sir?

So, Table 8.1 lists the electrical loads of the systems and equipment served by the normal electric power, standby electric power and the UPSs.

The UPSs supply power to facility process, control and communication, fire protection, radiation monitoring and the criticality accident alarm system.

Safeguards to security in certain part of the general facility electrical system, and someone asked about this earlier, but one of those is emergency lighting.

UPSs are typically comprised direct current storage batteries, battery chargers and inverters with supply distribution panels for safety related loads.

PSAR Figure 8-1 is the one line schematic diagram for the RPF electrical system which, of course, does not cover that level of detail of the power to the UPSs and then the loads that are specifically powered from the UPSs.

All other systems are designed to fail-safe. This is an important point because, it supports finding this level of detail acceptable for the construction permit, in my estimation, because all the other systems are designed to fail-safe in the event of a loss of offsite power which the applicant has discussed.

RPF operation on a limited basis can continue once the SDG comes online because many of the NEP loads can be powered by the SEP which then also takes over to provide power to the UPSs and their loads.

And, I should emphasize that means through the UPSs to their loads which are normally connected to UPSs.

So, one of the questions that occurred to me was in a limited basis, and it's somewhat explained in the PSAR, that there would be certain operations that would need to be done in order to stabilize all of the processes and set them up for prolonged shutdown greater than the ability of the diesel to supply power.

So, that's I think what they're getting at when they talk about continuing on a limited basis.

And, perhaps the Northwest folks can clarify this, but I don't think the intent was to continue operation, normal operation on the SEP loads because on loss of offsite power, all the process loads that are not safety-related are going to be shut down.

So, those things that need to be stabilized to keep the plant shutdown in a safe condition then would be able to continue for, well, approximately 11 to 14 hours according to their revised PSAR.

MEMBER SKILLMAN: Steve, let me make a point here --

MR. ALEXANDER: Yes, sir.

MEMBER SKILLMAN: -- if I could. You were keyed in on the notes that are on Figure 8-1, which I think is important.

And, what is important in talking about this switchgear is that note one is underground utility feed to be determined if two feeds can be provided to the site from sources that have redundancy.

Just holding that thought for a second, right now, it appears as though, at least in the diagram, the two feeds come into the same place.

MR. ALEXANDER: They're coming from the same place, yes, sir.

MEMBER SKILLMAN: Well, what I'm

suggesting is kind of going back to the prior discussion about, if you could do -- if you go too far in construction without thinking through what you really want as your end point, you can end up doing a lot of rework that's very costly.

MR. ALEXANDER: Indeed.

MEMBER SKILLMAN: If NWMI were to say, you know, we're going to make the decision now, we're probably going to have two feeds that are going to be redundant and we're going to bring them in to different places in the building, that would reduce the fire risk if you had a fire in that switchgear.

MR. ALEXANDER: Absolutely.

MEMBER SKILLMAN: So, it is the application of thinking along those lines if you will preemptively, knowing that if you did have a fire in your switchgear, you would take out this whole facility for what Dana was pointing to which could be an extended shutdown.

But, you could be forced into it in an afternoon.

MR. ALEXANDER: Absolutely.

MEMBER SKILLMAN: And, all I'm saying is, there is a little marker even this early on in the design that might suggest a magnifying glass review, particularly of the electrical system.

MR. ALEXANDER: Absolutely.

And, one of the things that struck me about the design philosophy here is, if you have a single feed coming into the site, and then you split that feed out and provide two redundant transformers, it's not to provide redundancy for loss of offsite power so much as its perhaps to provide redundancy in case of equipment problems on one side or the other internal to the plant.

MEMBER SKILLMAN: Okay, thanks.

MR. ALEXANDER: But, it doesn't help you with the problems that could be given from like a fire somewhere upstream of these two separate input transformers. As you mentioned, that could ruin your whole day instead of just half of it.

Okay, very strong hint taken in terms of our review.

Next one?

So, the staff found a few inconsistencies between PSAR Chapter 8 and PSAR Chapter 3 in the information presented on the emergency electrical power systems.

We issued RAIs to address these including the mission time of the UPSs other than fire protection that at one point one part of the PSAR talked about 90 minutes and then the other part talked about 120.

And, they changed everything to 120. Our response to that was that that was an acceptable approach, assuming that the 120 was right. And, we recognize that, in reviewing the FSAR, we're going to have to go back and look at where that 120 minutes comes from.

And, is it based on analysis? Is it based on code? And, the applicant did mention this morning that some of those may have to be lengthened for various reasons. For instance, the stack monitoring system might require a UPS that will last longer than 2 hours.

So, we're going to be looking very carefully at the chain of design decisions and where the input argument is and then what has to follow from that. A lot of detail will have to be looked at there in the next review.

But, that was one of the responses.

The fire protection, of course, is 24 hours. And, again, we understand that that's from a code requirement.

Another issue that came up was the capacity of the standby diesel generator. It's characterized as a 1000 kW diesel generator in several places and in the PSAR. If you add up the peak loads, it comes up to 1178.6 and one of the -- so I asked about that and in terms of an RAI.

And, we also then got into the question of the fuel capacity. There's a 1000 gallon tank in the current preliminary design envisioned and that's supposed to last for 12 hours, according to the PSAR.

And so, my question was, well, if the peak load was really 200 kW more than this full load normal running capacity of the diesel, how are you going to get 12 hours out of the 1000 gallons?

So, their response was to, depending on the actual load on the diesel, that the run time would be anywhere between 11 and 14 hours.

Our response to that was that that's acceptable at this point, as long as those numbers that were used to come up with the original parameters are correct and what's that based on.

So, a lot of information on how on the mission times and overlapping missions of various equipment that's powered from the diesel are going to have to be looked at to find out if they have to have a bigger tank or a bigger diesel or both. Or be able to get away with less than 12 hours of diesel run time.

So, those will have to be worked out.

So, in the RAI responses and, I have to mention also in subsequent conferences, the Northwest explained how it intended to resolve the discrepancies, revised the PSAR, which I just mentioned.

For the purposes of issuing a construction permit, we found that the proposed resolutions or the approach to this problem are acceptable at this time.

So, demonstrated in the PSAR an adequate design basis for the electrical systems and is sufficient for satisfying the standards for issuance of a construction permit.

Did we mention there's not a whole lot of detail?

It is -- there isn't, but again, the design bases were described as required.

Next slide, please?

We evaluated the descriptions and discussions of the Northwest Medical Isotopes RPF electric power systems including probably subject of technical specifications as described in PSAR Chapter 8 and supplemented by the applicant's responses to RAIs and the staff finds that the preliminary design of the electrical power systems including the principle design criteria and design bases and information relating to general arrangement, major structures and systems and components and a high level functional description provides reasonable assurance the final design will conform to the design basis, meets the applicable regulatory requirements and acceptance criteria in or referenced in NUREG-1537.

The design of the electrical systems as documented in the PSAR is sufficient for satisfying the standards for issuance of a construction permit.

Certain parts of the electrical system provided electrical power for items relied on for safety and the preliminary design provides reasonable assurance that the electrical system IROFS should remain functional for the protection and health and safety facility of the public.

And, of course, keep in mind that, for example, in the engineering safety features area, most of the engineering safety features as they're described in Chapter 6 are passive and fail-safe kind of things don't require deliberate positive actuation, but those parts of the chapter does say specifically that those parts of the engineering safety feature system that do require electric power to perform their functions will have UPS supplied power to them.

Based on engineering judgment, the staff concludes that the level of detail in the electrical systems of the PSAR is adequate for the issuance of a construction permit.

Accordingly, Northwest Medical Isotopes has met the following requirements of 10 CFR 50.35 for issuance of a construction permit with respect to the electrical power systems.

The RPF electrical power systems including but not limited to their principle architectural engineering criteria for the design and has identified the major features and/or components.

Further technical or design information may be reasonably left for later consideration in the FSAR.

There is reasonable assurance that the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

And, any further questions?

CHAIR CHU: Any questions?

MR. ADAMS: Can I ask Northwest a question because -- I just want to understand something here. If you're in the process of doing a batch run of making some moly and you lose power, would you try to finish running that batch on the emergency - on the diesel generator or not?

MR. DUNFORD: So, I guess there's two answers to that.

You'd have to evaluate that you were within your Safety Envelope of your tech specs before you could continue to go forward.

So, if when we end up on the standby power system puts the system back in to a condition that meets your tech specs, then that would possibly be something the management could want to do, but that's not where we are right now.

We haven't done enough work to say whether we could do that.

The thought processes early on was, yes, if we just had -- wanted to load moly out so we get it out of the system, then that would be a good thing to do.

But, you couldn't -- I don't think you would even think about doing uranium processing or target fabrication, but to get the final moly out if it was, you know, ready to be loaded or just right there at very small part of the system, not a lot of power.

So, that part, you know, conceptually, sounds real easy. It's just you've got to make sure the rest of the system that were identified is set up that would allow you to do that.

MR. ALEXANDER: And, very easily there could be a tech spec that says, no, right, you've got to have normal power and then everything else after that.

But, right now, that's -- could be an opportunity --

MR. ADAMS: I just wanted to understand what the word limited, you know, limited --

MR. ALEXANDER: And, by -- I'd have to, Steve, correct me if I'm wrong, but my understanding of the way that the loads are distributed in this diagram, you can't do that.

MR. DUNFORD: Yes, because there's no pump power.

MR. ALEXANDER: There's no pump power.

MR. DUNFORD: Yes, but you --

MR. ALEXANDER: And so, those loads that come off the standby diesel generator or those that are needed to stabilize the plant to shut everything down.

MR. DUNFORD: Yes, but so, effectively, you potentially still could load out moly, get it out of the facility.

MS. HAASS: I wanted to just say one thing, you know, I mean Northwest Medical Isotope does recognize that, you know, Chapter 7 and 8 are conceptual in nature just because you do have to be further in your design to really understand, you know, what your total loads are or exactly what I&C systems you will exactly need.

And, our goal is not to go out there and start constructing without having a much better definition and, you know, getting to your final design.

You know, we agree, we don't want to be taking that risk either because it is time and money if you don't do that. So, we do recognize that and I know that we've had discussions with the NRC staff about that.

I mean, there are some basic construction stuff that you can do that don't impact these types of things but there is a point where it does start to impact it.

And so, we understand how to draw that fine line.

Thank you.

CHAIR CHU: Any questions?

(No audible response.)

CHAIR CHU: If no more questions, I would like to have a lunch break until 1:15 and then we can start Chapter 3.

Thank you.

(Whereupon, the above-entitled matter went off the record at 12:19 p.m. and resumed at 1:18 p.m.)

CHAIR CHU: Meeting resuming. Okay. We have two new members joined us. Pete Riccardella and Jose March-Leuba.

And we're going to start with Chapter 3 presentations by NWMI.

Okay. Also, John Stetkar will be joining us in a few minutes. So three new.

MS. HAASS: I'm Carolyn Haass with Northwest Medical Isotopes. And we're going to be doing our overview of Chapter 3. Which is, just as a design of SSCs.

MEMBER BROWN: Careful of the mic. The microphone and your paper. No, no, keep it on. Just don't let your papers hit it.

MS. HAASS: No, no, no. I got it. Thank you.

MEMBER BROWN: Shredding eardrums back there.

MS. HAASS: So I'm going to be giving part of this presentation. Then I'm going to hand it over to Mike Corum.

So, the first thing I want to do is go over the facility design strategy we've been using for the design of our radiological production facility. And the first thing is, is we are identifying describing all of the principal architecture and engineering criteria needed for the facility SSCs.

We also believe it's very important that we emphasize, you know, what the safety protective function and related design features that help provide defense in depth against any uncontrolled releases to the environment.

And then one of the key things is we apply defense in depth from the onset of when we started our pre-conceptual and conceptuals through preliminary. And it will continue through the final design of our facility.

So, we're designing our facility based on applicable standards, guides, codes and criteria. Which will provide us reasonable assurance that the SSCs are built and will function to -- are built and function as designed and required by Chapter 13.

And they ensure acceptable protection of the workers, the public, and the environment. We're going to protect against hydrological damage, seismic, and we're also going to provide surveillance activity and technical specs to help us respond or mitigate any consequences to seismic damage or even other type of damage to the facility.

And the final one is, and I know we'll go more in depth in Chapter 14, but part of our design is we're also going to be developing technical specifications that will support us. Or ensure that our safety-related functions, systems and components will operate to protect workers, public and the environment.

So, the design criteria we use, I think, all of us are very familiar with. And you know, we're -- Chapter 3 starts dealing with, you know, the top level functions.

And as we go through our design we're getting more specificity on each of those criteria sources. And those sources include the Code of Federal Regulations, the NRC NUREG Guides, other Federal Regulations, and that could be, you know, EPA or items like that.

We have local and State standards as well. And one of the key ones that we have, because this is a University property, we also have University requirements.

A lot of those are more outside buildings. You know, facade, landscaping, things like that that we have to keep within the designs of what they would like to see.

So, the next that we're going to talk about, and we're going to start getting into the detail of Chapter 3, is natural phenomena. And we'll be walking through Chapter 3.

And I'm going to hand it over to Mike.

MR. CORUM: Hi. As Carolyn said, I'm Mike Corum. And I'll be giving the rest of the presentation for Chapter 3.

Fortunately for me and for you guys, I've got two of my experts are listening in on the line. So, if you have any questions that I won't be able to answer, which will more than likely be the majority of them, we can open that line for them to help us out.

MS. HAASS: Can you introduce who's on the line?

MR. CORUM: I'm sorry, Sam Swan is one of the analysts. And Masoud Zadeh is the other, so okay.

So, under the natural phenomena, the meteorological accidents with radiological consequences that the RPF had been evaluated in the QRA that's listed there. From that the structural design basis will be to withstand a highly unlikely event.

And demands on structural elements due to applied loads were evaluated. The effect of each load case is determined separately. And the total demand is determined by combining the load effects using load combinations for evaluating strength and serviceability criteria.

Four categories of load were evaluated. Those are listed here. Normal loads, severe environmental loads, extreme environmental loads, and abnormal loads. We'll go to slide 29.

The normal wind loading criteria are based on the American Society of Civil Engineers standard there. Some of the load criteria, among the load criteria include the basic wind of 120 miles an hour, and Risk Category Four.

The tornado load requirements are --

MEMBER STETKAR: Before you get to tornados, how do you categorize a 120 mile per hour wind as a highly unlikely event given the meteorological evidence of Boone County where I see two events in the last 60 and two-thirds years where the wind speed was 114 miles an hour?

MR. CORUM: These are normal wind load criteria, not accident wind load criteria.

MEMBER STETKAR: Well, then explain to me the difference between normal wind load criteria and accident wind load criteria. Because 114 mile an hour wind is a 114 mile an hour wind. And it doesn't know.

MR. CORUM: Understood. Okay. I'm going to open the line and see if Masoud can help us on that.

MS. HAASS: Masoud, are you on?

MR. ZADEH: Hello, this is Masoud Zadeh.

MS. HAASS: So, ask him the question.

MR. CORUM: Masoud, the question is how are we using the wind speed of 120 miles per hour when the area seems to warrant a much higher wind speed?

MR. ZADEH: Yes. You are right. This is not the high and unlikely event.

This is the basic design for SSCs. But as -- in the build it under is the highest strength. That's again the SD of that.

And they are discussed this internally. Hello, can you hear me?

MR. CORUM: Yes. We can hear you Masoud.

MR. ZADEH: Oh, okay.

MEMBER STETKAR: Masoud?

MR. ZADEH: Yes.

MEMBER STETKAR: Do you have more to add? I looked -- I read your safety report. The Safety 011 Rev. A. And in there it has actual scenarios that you quantify. There's a Table 3-2.

And it says the initiating event is straight line winds with a return frequency of 5.88 times 10 to the minus 4 per year, strike the facility. And then it goes on to say it's a Risk Category Four structure like this slide says here.

I'm curious, I don't understand in Table 3-24 of Chapter 3 it says the design basis straight line wind speed of the facility is 120 miles per hour. Which is this.

So, what is your 5.88 times 10 to the minus 4, if you want to call it an accident wind speed, what is that wind speed?

MR. ZADEH: That is 120 miles per hour. An accident is 1700 --

MEMBER STETKAR: Okay. Okay. Thank you. We have you on the record for that.

How do you justify the fact that there have been two events in the last 60 and two-thirds year where the wind speed, straight line wind speed measured at the airport is 114 miles per hour?

This is only six miles per hour more than that. And this is less than one in a hundred. It's about, one in, I don't know, whatever 1 over 5.88 times 10 to the minus 4 is. It's less than one in a thousand.

It's curious to me how you get that given the historical meteorological data at the airport.

MR. ZADEH: Yes. And I agree with you. This is a -- when you compare that with tornado winds, a tornado wind where you're using Reg Guide 176, we are suggesting to use that.

And that was dominate of the wind criteria. That will be a -- if it was a 10 to minus 7, that's not a 30 mile per hour.

MEMBER STETKAR: Let's not confuse straight line winds and tornados. Because I have questions about tornados. So let's wait for tornados until we get to tornados.

I'm talking about straight line winds. And I'm trying to read your reports and understand the numbers in terms of frequency that you're using.

And the 120 mile per hour wind speed that you're using for straight line winds, and the historical evidence from the airport at Columbia. Which seems to indicate to me that 120 miles per hour may occur. It hasn't occurred yet.

But it may occur more frequently than once in a thousand years. And I don't want to confuse this with tornados. Because tornados are a different subject.

MR. CORUM: And I'm not confusing it with tornados. I think the point is that this is based on the criteria in ASCE 7.

And I think we'll need to look at the historical data for the area and determine that.

MEMBER STETKAR: Well, and you did. See the numbers that I'm reading off, you did, are tabulated in Table 2-31 of your PSAR.

I didn't make these numbers up. I took them from that table. I actually plotted out a trend. And of course you have to extrapolate.

MS. HAASS: Right. And you are correct. They are in 231 where we showed the historical data. Chapter 3 though is identifying which Regulation we are initially using to do our analysis with.

Which is ASCE 7. And we're bringing in the historical side. But we understand that. That you do have those two.

MEMBER STETKAR: But your -- the NRC staff and we, are trying to understand how this facility will be designed and constructed. This is a construction permit.

And it strikes me that wind loading X implies a certain structural design. And wind loading Y implies a different structural design. I'm not a structural engineer.

And I have a hard time reconciling this fact that well, we picked this number out of some ASCE standard. And yet we didn't account for that historical evidence that we have in Chapter 2.

MS. HAASS: So we are in the process of doing this structural analysis for the facility viewing the whole natural phenomena analysis. You know, which includes wind loading, precipitation, whether it's snow, rain, whatever.

And we will be taking into account that historical data that is provided in Table 2-31.

MEMBER STETKAR: But when will you do that? Between --

MS. HAASS: We are in the process of doing that now. We will not be constructing the facility until that is completed.

MEMBER STETKAR: Okay. I guess I'll ask the staff how they thought about this. Thanks.

MR. CORUM: Okay. The tornado load requirements we based on Regulatory Guide 1.76. With annual accedence probability of 10 to the minus 7.

MEMBER STETKAR: Well --

MR. CORUM: Go ahead.

MEMBER STETKAR: There too --

MR. CORUM: Okay.

MEMBER STETKAR: If I read -- I don't know, did we have a discussion about Rev 1 versus Rev 0 of the PSI this morning?

MEMBER BROWN: We did not.

MEMBER STETKAR: Okay. When -- is it okay if I refer to Rev 1 of the PSAR?

MS. HAASS: Yes.

MEMBER STETKAR: It is? Okay.

MS. HAASS: The one that you received in the last week.

MEMBER STETKAR: Yes.

MS. HAASS: Okay.

MEMBER STETKAR: Because the discussion of tornados changed somewhat from Rev 0 to Rev 1.

MS. HAASS: Correct.

MEMBER STETKAR: In Rev 1 of the PSAR, if I -- bear with me here. I'm less organized then I normally am. I'm sorry, I got caught up in last night's FAA debacle.

MS. HAASS: So in Rev 1, you're right about the report.

MEMBER STETKAR: In Rev 1 there's one place that says for the RPF preliminary safety analysis, the maximum tornado wind speed from Reg Guide 1.76 for

Region One will be used.

As is indicted on this slide here. And those are the wind speeds, 230 and those things.

But it also says the tornado load criteria will be updated using tornado loading in accordance with 10 to the minutes 5 annual probability of accedence in the operating license application. Now, a 10 to the minus 5 probability of accedence has wind speeds lower then these.

So what are you going to design it to? This is in the same paragraph. It's in the same paragraph.

MR. CORUM: Yes. That should be changed.

MEMBER STETKAR: When I read earlier in Rev 0, it was anchored to the highly unlikely 10 to the minus 5.

MS. HAASS: You're correct.

MR. CORUM: You're right.

MEMBER STETKAR: And that's a moot point. Because we've moved onto Rev 1.

MR. CORUM: Yes. Rev 1 should --

MEMBER STETKAR: But Rev 1 --

MR. CORUM: Should have eliminated that.

MEMBER STETKAR: Okay. It should?

MS. HAASS: Yes.

MR. CORUM: It should. Yes.

MEMBER STETKAR: The intention is that you're going to go with --

MS. HAASS: 1.76.

MR. CORUM: 1.76 with the 230.

MEMBER STETKAR: Thank you.

MR. CORUM: Yes.

MEMBER STETKAR: That obviously affects my earlier comment about the straight line wind speeds also.

MR. CORUM: Right.

MEMBER STETKAR: But, they were integrated because of this 10 to the minus 5 thing. Thank you.

MR. CORUM: Okay. Masoud, did you have a comment?

MR. ZADEH: Yes. This is Masoud. I think my suggestion has been to use 10 to the minus 5 when we received the -- I thought it was coming from NRC to use Reg Guide 1.76.

And Reg Guide 1.76 as we all know, is going past the line, which is anchored to 10 to the minus 7. Which is very extreme loading.

And we will have problems with the missed ones as well. So, my suggestion is to use 10 to the minus 5, but still use the background data to Reg Guide

1.76 for 10 to the minus 5.

And I believe that it comes out too about a wind speed of 160 miles per hour. So, I'm just turning to Reg Guide 4461 that if you look at for our area, for 10 to the minus 5, it comes out to be about 160 miles per hour.

So, the reason you have this was 1.76, I thought that was coming from NRC requirements. But my suggestion is to actually use 10 to the minus 5 and use the data for 10 to the minus 5 to come up to 160 miles per hour and corresponding with that as well.

MR. CORUM: Okay. Thanks Masoud.

So, then for high straight line winds, we've got the RPF design for a Risk Category Four structure. And in accordance with ASCE 7, that return frequency is a wind speed of 5.88 times 10 to the minus 4.

The maximum probability of failure targeted for the Risk Category Four is a 5 times 10 to the minus 6.

MEMBER STETKAR: But that's a -- that's a -- it's always used targeted. I'm not familiar with ASCE. Is that a goal?

So you design the -- you take a wind speed and you design the buildings with a fragility such that at that wind speed it has that conditional probability of failure. I don't know how you do that.

MR. CORUM: Yes. That's --

MEMBER STETKAR: So that's the way it's done?

MR. CORUM: That's how it works. Yes.

Then the tornado generated missile impact effects are based on Reg Guide 1.76. And those tornado wind driven missile criteria are shown here in this Table.

MR. ZADEH: Masoud Zadeh. If they go with the 10 to the minus 5, the wind speeds for tornados will be lower. And accordingly these missiles will go lower.

But these are straight absolutes with the 10 to the minus 7, 230 miles per hour winds, tornado winds.

MR. CORUM: Thanks Masoud. Okay. If there's no questions, we'll move onto rain, snow, and ice loading.

The rain loads are based on the estimate weight of a 48 hour --

MEMBER KIRCHNER: Sorry.

MR. CORUM: Okay. Go ahead.

MEMBER KIRCHNER: I'm a little confused.

So, the slide 30 is the adaptation for 10 to the minus 5 from Reg Guide 1.76? I don't have the Reg Guide memorized.

Or is it the 10 to the minus 7 values? That's what I thought.

MR. CORUM: It's the 10 to the minus 7 values.

MEMBER STETKAR: That's not -- it's translated into impact frequency. It's not necessarily the likelihood that anywhere in Boone County it would happen.

MEMBER KIRCHNER: Right. Right.

MEMBER STETKAR: A tornado of that severity.

MEMBER KIRCHNER: Okay.

MR. CORUM: The rain loads are based on estimate weight of a 48-hour probable maximum precipitation. The rain load estimates compared with local building code rain load, and the greater of the value will be used for the roof design.

The rain load criteria that we've got listed here, the rain fall intensity is 3.14 inch per hour. For normal snow load, that's based on the 100 year ground snow.

And that's modified using the procedures in ASCE 7 to determine the roof snow load. Including the snow drifting.

And the 100 year ground snow load is calculated by factoring the ground snow load stipulated in the City of Columbia Code of Ordinances, Amendments, and the 2012 International Building Code.

MEMBER STETKAR: In the discussion of the roof loading, there's a couple of places that it says -- it's assumed that the normal drainage system is blocked.

And the secondary drainage system has its design flow rate. What's the secondary drainage system? Do you know yet?

MR. CORUM: Yes. I think it's just over the top of that.

MEMBER STETKAR: I was hoping you were going to say that.

MR. CORUM: Yes.

MEMBER STETKAR: Okay. I was just curious.

MR. CORUM: Okay.

MEMBER STETKAR: Because it shows up in a couple of places in there. And I'm thinking, if it is overflow, obviously you can't collect any more.

MR. CORUM: Correct. Thank you. The

extreme -- well, let's go to slide 32. Okay.

The extreme winter precipitation load is the normal snow load plus the liquid weight of the 48-hour probable maximum winter precipitation. And for the SSCs to be considered sensitive to ice, ice thickness and concurrent wind loads are determined using the guidance in ASCE 7.

So, for extreme winter precipitation load criteria the weight of the 48-hour probable maximum winter precipitation is 106 pounds per square foot. Slide 33.

Flooding from precipitation events. The flood loads are based on the water level of the 100 year flood. And the RPF site has been determined to be above both the 100 year and the 500-year flood plain.

The site will be graded to direct storm water from localized downpours with the rain fall intensity for the 100 year storm for a one hour duration around and away from the RPF. And there's no flooding from local downpours expected based on the standard industrial design.

Compartment flooding from fire protection discharge. The design of the fire protection system using water includes elements such as grading and channeling of floors, raising of equipment mounts above floors, shelving and floor drains, and other passive means.

These features will ensure sufficient capacity for gravity driven collection and drainage of maximum water discharge rate and duration to avoid localized flooding and resulting water damage to equipment or surrounding area.

And the safety-related systems and components were protected from external water damage by being enclosed in reinforced concrete safety-related structures.

Continuing on. Any water sensitive safety-related equipment will be installed above the floor slab at grade to ensure that the equipment remains above flooded floor during any sprinkler discharge. The total discharge from the failure, the fire protection piping consists of the combined volume from any sprinkler and hose systems.

And in accordance with NFPA 801, the credible volume of the discharge is sized for suppression system operation during a duration of 30 minutes.

And the design of water sensitive safety-related equipment will ensure that potential flooding from the sprinkler discharge will not adversely affect safety features. And outside of the radiologically controlled area there will be limited water discharge from fire protection systems.

Okay. And this is in the safety report, not in the PSAR. But there is a discussion about pipe breaks and leaks internal to the plan. And there's a discussion about the fire protection system.

And --

MEMBER STETKAR: I'm confused enough.

MR. CORUM: I'm sorry.

MEMBER STETKAR: There -- as I read that analysis, it seems to be based on -- there's a comparison between spurious actuation of sprinkler heads and breaks in pipes.

And it -- there's a statement that says there's a common failure frequency quoted in the literature for spurious actuation of sprinkler heads of one head in 16 million installed per year.

And then it says for the facility given the number of sprinkler heads that you have, this would equate to about 2.5 times 10 to the minus 5 per year. Which is less frequent then the pipe break frequency of 3.5 times 10 to the minus 4 by more than an order of magnitude.

Is that really consistent with industrial experience? That fire protection pipes break ten times more frequently then sprinkler heads go off for whatever reason?

You may want to go back and look at those numbers.

MR. CORUM: Sure.

MEMBER STETKAR: I don't know about that -- where that 1 in 16 million sprinkler head per year came from.

But, I don't care so much about the precise values of the numbers. It's the fact that you're claiming that it's ten times more likely that a pipe breaks --

MR. CORUM: A pipe breaks then --

MEMBER STETKAR: Then a sprinkler head goes off. And that doesn't -- it just doesn't seem right.

MR. CORUM: Right. Thanks. Okay. Moving onto slide 35.

The seismic analysis criteria is going to conform to the IAEA document listed there. NUREG 800 and other NRC regulatory guides will provide additional detailed guidance for seismic analysis and design.

The safe shutdown earthquake. I believe we've mentioned it a couple of times. We're going to use the Reg Guide 1.60 for the spectra anchored to a .2 G peak ground acceleration.

For this, the composition of the soil will be included in the soil structure interaction analysis as part of the building response analysis. But it's not a parameter that will be used to determine design response spectra.

The peak ground acceleration matches that of the University of Missouri Research Reactor and the Calloway Nuclear Generating Station. And --

MEMBER RICCARDELLA: Does the peak -- you want to ask him?

MEMBER STETKAR: Go ahead. Go Pete.

MEMBER RICCARDELLA: You know, there's a new report out --

MEMBER STETKAR: Microphone.

MEMBER RICCARDELLA: I'm sorry. So, the report, NUREG 2115 describes the new CS approach to estimating ground motion response spectra.

And for Calloway, the preliminary GMRS associated with that is .4, is anchored at about .4 G. And it's about twice as large and an eight to 10 hertz range.

You know, existing plants like Calloway, they're not updating their SSE. They're instead doing a seismic margins analysis or a seismic PRA.

MR. CORUM: Yes.

MEMBER RICCARDELLA: But new plants would use this to establish their -- the new GMRS to establish their design basis.

I'm just curious as to where you fit into that category?

MR. CORUM: Well, you know, we're not a reactor.

MEMBER RICCARDELLA: I know.

MR. CORUM: And if you look at guidance in 1520, it does allow for this type of analysis. I don't think we want to do a full blown seismic hazards analysis or a seismic PRA for this particular facility.

So, --

MS. HAASS: Yes, the MURR analysis.

MR. CORUM: Right. And we do have the MURR analysis, which was a post-Fukushima analysis that we're kind of anchoring our evaluation on as well.

MEMBER RICCARDELLA: So you don't intend to address the CS work at all?

MR. CORUM: We don't intend to at this point.

MEMBER RICCARDELLA: I mean, it would seem to me it would be -- shouldn't be that major an effort to use a higher response factor when you're in the initial design stages.

MR. CORUM: Right. Sam, could you guys address that for us? I know we've had some discussion about that. And what kind of effort that would be to generate the GMRS from the CE -- CEUS's database?

MR. SWAN: Okay. Thank you. This is Sam Swan. I think the seismology analysis if it were site specific would be a huge undertaking. As of course it has been for each of the commercial nuclear plants.

I think the best answer we can provide is if you take the Calloway plant as an example, it's design basis is .2 G peak ground acceleration. Which is also what we're suggesting here.

And in general, there's adequate margin for at least a factor of two. A pretty significant chance of failure. And that's just a general observation.

And much of that is based on actual work site experience we've complied over the years. A .2 G peak ground acceleration is very typical for power plants for example, we're not talking nuclear.

But they've been through much stronger earthquakes. And typically with no serious damage whatsoever. That's probably the -- by the way, can you hear me?

MEMBER RICCARDELLA: Yeah, we can.

MR. CORUM: Yes. Yes, we can hear you.

MR. SWAN: All right.

MEMBER STETKAR: We can't now if you're still speaking.

MR. SWAN: No. I'm not.

MEMBER STETKAR: Okay.

MEMBER RICCARDELLA: Just so you know though, those new GMRSs, they're supposed to be about a 10 to the minus 4 to 10 to the minus 5 probably.

MEMBER STETKAR: Also, I happen to have the 2014 USGS seismic map. And if you pull up the coordinates, which I did, of the site, recognizing these are joint point values.

But they're characterized as USGS -- they're characterized by the USGS as means. A 10 to the minus 5 accedence frequency for this site is .66 G.

Which is pretty consistent with the .4 to .5 revised PGA for Calloway.

MEMBER RICCARDELLA: Yes.

MEMBER STETKAR: And you wouldn't expect the seismology to be all that much different over about a 25 mile --

MEMBER RICCARDELLA: That meets. If I were designing a plant, I would sure take a look at that new Calloway GMRS.

I mean, when you're at the design stage, it's not that big of deal to design for a little bit higher response amount.

MEMBER STETKAR: Here also there were arguments -- here's -- there are differences between Rev 0 and Rev 1 of the PSAR here too. Because Rev 0 talked about a conditional failure probability of fragility at the .2 G.

And that starts to answer the questions that we were starting to ask in terms of seismic margins. But it only starts.

Because having a low probability of failure at a relatively low acceleration does not mean necessarily that you have a zero probability of failure at high acceleration. You have to look at the com -- you know, it's the rate of change of the hazard curve and the fragility curves over the range of interest.

So that calculation that was in Rev 0 doesn't completely answer the question either.

MS. HAASS: Right. So we are looking at what is going on at Calloway. We know that's not going to be done for several years.

But we're also taking into account what the NRC staff did for the MURR post-Fukushima work that they have done. Which they have said that that is a .2.

And so -- and that's only five miles away.

MEMBER STETKAR: Yes. Well, no. It's a lot closer.

MS. HAASS: Right.

MEMBER STETKAR: We'll ask the staff about that certainly. Because they have not said anything yet.

MS. HAASS: Great. All right. Thank you.

MR. CORUM: All right. Let's go to the next slide, please.

So the soil structure interaction and dynamic soil pressures, the structure is supported on a shallow foundation system on stiff competent soils. Phase one assessment stated the site is classified as a site Class C.

And typical shear wave velocities for soils present at the site are between 12 hundred to 25 hundred feet per second. And typical practices to define the competent soil as having a shear wave velocity greater than a thousand feet per second.

The analysis of the RPF building structure to safe shutdown during earthquake will include the effects of the soil structure interaction analysis. And the dynamic soil pressures would be determined using the American Society of Civil Engineer's Four. And applied to the earth retaining walls and the hot cells as well.

The operating basis earthquake is selected to be one-third the safe shut down earthquake defined previously. And since this option was selected, the explicit design analysis of the RPF structure for the operating basis, the earthquake ground motion is not required.

The direction of seismic loading, we're on slide 37. The design of the IROTHs, item to rely on for safety will consider seismic loads in all three directions using a combination of square root of the sum of the squares, or the 10/40/40 methodologies per Reg Guide 192.

The 10/40/40 methodology will be used in the development of the RPF final design. And the dynamic of status analysis, dynamic analysis will only be used for the evaluation of the structural competence.

Static analysis will be completed during final design by using a combination of static load computations to ensure that SSCs remain in place and intact. And a combination of existing shake table test data and earthquake experience to ensure that equipment functions following an earthquake.

The seismic qualifications of subsystems and equipment. Based on the characteristics and the complexities of the subsystem or equipment, seismic qualification will be done by a combination of static load complications to ensure that the SSCs remain in place and intact.

And a combination of the existing shake table test data and earthquake experience to ensure that equipment functions following the earthquake.

For seismic instrumentation, recording instrumentation will be triaxial digital systems that record acceleration versus time accurately for periods between zero and ten seconds. The recorders will have rechargeable batteries such that if there is a loss of power, recording will still continue.

All instrumentation will be housed in appropriate weather and creature proof enclosures. Systems will have the capability to produce motion timed histories.

The response specter will be computed separately. And the purpose of the instrumentation is to permit a comparison of measured responses of C-1 structures and selected components with predetermined results and analysis that predict when damage might occur.

Also, permit the facility operators to understand the possible extent of the damage within the RPF immediately following an earthquake. And be able to determine when a safe shutdown earthquake event has occurred that would require the emptying of tanks for inspection.

The seismic instrumentation will not be considered an item relied on for safety. And will be treated as a safety related Quality Level 2.

Certain RPF systems and components are considered important to safety because they perform safety functions during normal operations. Or are required to prevent or mitigate consequences of abnormal operational transients or accidents.

Safety related is a classification applied to items relied on to remain functional during or following a design basis event to ensure the items provide a safety-related function. The safety related also applies to documentation and services associating with the safety-related item.

The SSC functionalities relied on during or following a design basis event to provide integrity of the facility infrastructure. To give it a capability shutdown, the facility maintain in a safe shutdown condition.

To give it the capability to prevent or mitigate the consequences of postulated accidents identified through accident analysis that could result in potential offsite and worker exposures comparable to applicable guideline exposures set forth in 57.270.61, 70.61(c) and 70.61(d).

The RPF operations without undue risk to workers public and environment to meet 10 CFR 20. The normal release or exposure limits for radiation dose isn't applicable. And that's for chemical exposures.

SSCs in the RPF are classified as safety related and non-safety related. This gives us the definitions of safety related, safety-related IROFs, safety-related non-IROFs, and non-safety related equipment.

The safety related is a classification applied to items relied on to remain functional during or following a postulated design basis event. And it ensures everything that we talked about previously on the previous slide.

The safety-related IROFs are SSCs

identified through accident analysis that are required to meet the performance requirements in 70.61(b), (c), (d) and (e). And then safety related non-items relied on for safety or SSCs that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of workers, the public and environment and includes SSCs that meet the 10 CFR 20 normal release or exposure limits.

And non-safety related SSCs related to the production and delivery of products or services that are not in the above safety classifications.

MEMBER RICCARDELLA: So is that generally the pecking order? It goes from the highest of the safety-related IROFs then the safety-related non-IROFs and then non-safety related?

I was a little confused about that when I was reading.

MR. DUNFORD: NO. I see how you got that confusion. So there's safety related, and we've broken the safety related into two safety-related IROFs and safety related.

So it's not that safe -- so the safety related includes all those.

MEMBER RICCARDELLA: I understand.

MR. DUNFORD: Okay.

MEMBER RICCARDELLA: Both of those.

MR. DUNFORD: Yes. Both of those.

MEMBER RICCARDELLA: Yes. Um-hum.

MR. CORUM: Then the different quality levels are defined on slide 41. QL 1 will implement the full measure of the quality assurance program plan.

And will be applied to safety-related SSCs and items relied on for safety. Including items in which failure to malfunction could directly or indirectly result in a condition that adversely affects workers, the public, and where the environment as described in 10 CFR 70.61.

These include --

MEMBER STETKAR: To follow up on Pete's though, just to make sure I understand it. QL 1 will be applied to safety-related IROFs and only safety related IROFs. Is that true?

MR. DUNFORD: Yes.

MEMBER STETKAR: Thank you. It's a -- we don't have video. And QL 2, you haven't said it, will be applied to safety-related non-IROFs?

MR. DUNFORD: Non-IROFs. Yes.

MEMBER STETKAR: Okay.

MR. CORUM: So -- go ahead.

MR. DUNFORD: And anything we decide to

upgrade to that level.

MEMBER STETKAR: Yes. Yes. But it's -- yes. Whatever you throw in that bin.

MEMBER BLEY: But then I don't quite understand your response to Pete. That safety related IROFs and then next to safety-related non-IROFs that they aren't in order of importance.

They are because you're requiring a lower quality level for the second bunch.

MR. DUNFORD: I'm sorry. I wasn't trying -- what I was trying to say is there's not really four categories --

MEMBER BLEY: Oh. Okay.

MR. DUNFORD: Of safety related, safety IROFs.

MEMBER BLEY: Now I got you. There's only three categories.

MR. DUNFORD: There's only three.

MEMBER RICCARDELLA: Okay. That's what confused me.

MEMBER STETKAR: Yes. It's easier to see it --

MEMBER RICCARDELLA: As I was reading it, I thought safety related was the highest. And then IROFs came in below that.

MR. DUNFORD: Oh. Okay. I misunderstood your question. Okay.

MEMBER STETKAR: It's a lot easier to understand it when you see the quality levels. As long as you don't get confused by SSCs and that sort of stuff.

MEMBER RICCARDELLA: Okay. All right.

MR. CORUM: So then QL 3 will include non-safety related quality activities that are deemed necessary to ensure manufacture and delivery of highly reliable products and services to meet or exceed customer expectations and requirements.

MEMBER RICCARDELLA: So then if I take those three quality levels and I go back to the previous slide, is it just basically the bottom three bullets, the top -- the third from the bottom is QL 1, the second from the bottom is QL 2 and the third from the bottom is QL 3?

Is that -- unless you arbitrarily decide to increase --

MR. DUNFORD: Unless you -- once you get to three, that's right.

MEMBER RICCARDELLA: Yes. Got it.

MR. DUNFORD: Correct. Yes.

MEMBER BLEY: I want to just clarify the categorization. We talked about this in an earlier meeting as well.

A non-IROF is a -- so an IROF is a thing that comes out of the ISA that really has a safety impact you think. A non-IROF is a criteria that comes from somewhere that doesn't have an ISA element associated with it.

Is that right?

MR. CORUM: An IROF, correct me if I'm wrong, the IROFs is there to meet the performance criteria in 70.61. Okay?

The non-IROFs could be safety-related equipment that is not necessary to meet the performance criteria.

MR. REESE: But if I could add, you still need it to meet Part -- like Part 20.

MR. CORUM: Right. Okay.

MR. REESE: But it doesn't because there's a big jump between 70.60 and Part 20. And so we're trying to capture all of the stuff with safety-related non-IROFs in that QL 2 category.

MEMBER KIRCHNER: Pragmatically --

MEMBER BLEY: When you -- can I finish this one first?

When you come up with your list of IROFs, I thought that list came out of the ISA? That's correct, isn't it?

MR. DUNFORD: You're correct. Um-hum. Yes.

MEMBER BLEY: Okay. So regardless of what regulation or whatever we point to, you did the ISA and the things you needed to make the ISA consistent with those are IROFs.

MR. DUNFORD: Correct.

MEMBER BLEY: A non-IROF is something that comes from other source then the ISA. Which might be Part 20 or somewhere else.

MR. DUNFORD: Generally, yes.

MEMBER BLEY: It might be all Part 20. I don't know if they're all Part 20.

MEMBER STETKAR: I think it's the difference between Part 20 and 70. You know that --

MR. REESE: Essentially it's trying to capture that difference. Yes.

MEMBER BLEY: Okay. God, I wish we'd called them something like Part 20s or something like else.

(Laughter.)

MEMBER BLEY: No, no, no. This just drives me crazy. But, back to your story.

MEMBER KIRCHNER: But no. But, part of

the -- some of the items in that second category aren't under 10 CFR 20.

MR. DUNFORD: That's correct. That's correct. Not all of them.

MEMBER KIRCHNER: So just pragmatically, what's quality level 2? I mean, in implementation. It seems to me like when you buy a fire protection system, that's going to be commercial grade equipment.

So are you just splitting hairs here? Or creating a paperwork monster for yourself? Or is this -- is this put upon you by the regulations in conforming with the interim staff guidance?

MR. REESE: Well, the problem is --

MEMBER KIRCHNER: I can't remember the number, 1370 whatever it is.

MR. REESE: I shouldn't say the problem, I should say the issue is, is that the part 70.61 criteria that formed the basis of the ISA are much higher then Part 20. And Part -- we still have to meet Part 20.

So, it's clear that, you know, we're getting rid of the large accidents in the 70.61. But the normal operations are still important to safety, right? Because we can't exceed the values in Part 20.

So, we need to have some quality level

associated with those systems that keep us at Part 20. But perhaps don't have the same rigor as 70.61, IROF, excuse me.

MEMBER KIRCHNER: I'm just -- again, to repeat myself, pragmatically, what does this mean? You just adapt a quality program for these components and/or systems that fall in this interim -- in this in between space?

I'm just testing you.

MR. REESE: Okay.

MEMBER KIRCHNER: I want to -- I'm curious to see how you're going to implement this three-tiered quality assurance program.

MR. DUNFORD: Well, it's something I've lived with. It's actually, I'll use the wrong acronym here, but it's DOE-based from the standpoint of your tech spec controls, IROFs, that's the level that you're putting the most emphasis on, the most quality on.

It doesn't mean you don't want oversight and quality control and quality assurance on the next level tier defense in depth controls or industrial safety controls, or fire protection controls, as opposed to being saying if it's QL level 3, you may have some QL level 3 where it's going to be skill to craft to go fix.

As opposed to a 2 and a 1 are going to have written guidance and procedures and oversight to confirm that it's been brought back into the system the way you -- it needs to be brought back into the system after the repair is done as an example.

MEMBER KIRCHNER: Okay.

MR. CORUM: Yes. And there are circumstances where for instance defense in depth will have -- they won't be defined as IROFs, but they're still items are -- they're still safety related, but they're not classified as IROFS, so they'll get QL 2, so.

MEMBER KIRCHNER: I'm with you. I just think it creates something of a conundrum or problems when you -- with re -- this is -- I don't know how to say this.

When DOE took on ASME NQA-1, they didn't -- let me say, they did not improve it.

(Laughter.)

MEMBER KIRCHNER: I would not -- I would not use DOE as a model. I would keep your life simpler.

MR. CORUM: And obvi --

MEMBER KIRCHNER: Yes. I hear what you're trying to do.

MR. CORUM: Yes. In operational space,

safety related is safety related. And there's really no graded, you know, --

MEMBER KIRCHNER: Precisely. Yes.

MR. CORUM: Approach there. So, so, yes. A safety-related item is a safety-related item in operational space. And it will be treated accordingly once we get to that point.

Okay. Slide 42, this deals with seismic classification for SSCs. Those SSCs that are identified as IROFs will be designed to satisfy the general seismic criteria to withstand the effects of natural phenomena, without the loss of capability to perform their safety functions.

And the Chapter 11 in ASCE sets forth criteria to which plant design basis demonstrate capability to function during and after vibratory ground-motion associated with safe shutdown earthquake conditions. The seismic classification methodology used complies with the proceeding criteria and with recommendations stated in Reg Guide 1.29.

And the methodology classifies SSCs into three categories, Seismic Category I, II, and III. And Category I applies to IROFs.

Category II applies to SSCs that are designed to prevent collapse under the safe shutdown earthquake from an integrity perspective, and SSCs to preclude structural failure during a safe shutdown earthquake or where interaction with Category I items could degrade the functioning of a safety-related SSC to an unacceptable level. Or it could result in an incapacitating injury to occupants of the main control room.

And SSCs -- non-seismic SSCs are those that are not classified as Category I or Category II. So, that's what Category III is, non-seismic.

This shows a table of the system safety and seismic classification, and the associated quality level group that we've assigned so far. This could and will possibly change as we go forward in the final design phase.

But for now we've got the IROFs, most IROFs are listed as -- or all IROFs are listed as the Category Is. And we've got some safety related equipment as Category IIs.

And we do have some non-safety related equipment also as a Category II as well.

MEMBER RICCARDELLA: There appears to be a footnote C on that facility ventilation item. About halfway down.

MR. CORUM: Yes.

MEMBER RICCARDELLA: What is that?

MR. CORUM: What is that? Hold on, I've got that --

MS. HAASS: I can look. It is ventilation zone classifications vary between one through four.

MEMBER RICCARDELLA: Okay.

MS. HAASS: And so it was just citing if the ventilation three and four are considered non-safety related Category II, quality level 2.

MEMBER RICCARDELLA: Okay. Thank you.

MEMBER BLEY: I'm sorry. Go back to the definitions of these things. There are a few Category II qualities for IROFs. At least on that table.

And I kind of would have thought -- well, I'm not sure. How do you -- when and where do you make the designation of what's safety related and not safety related?

So you use the ISA to help in that process? Or is it set by some other process?

MR. DUNFORD: Let me take the first thing. I don't see the first observation you made other then the --

MEMBER BLEY: Emergency purge gas.

MR. DUNFORD: Emergency purge gas --

MS. HAASS: Where you have -- it's called

--

MEMBER BLEY: And facility ventilation has a Category I/II.

MR. DUNFORD: Oh. That's an error. That's supposed to be --

MS. HAASS: Yes. I agree.

MR. DUNFORD: That's supposed to be a C I.

MEMBER BLEY: Okay. Then I don't have a question.

MR. DUNFORD: Okay.

(Laughter.)

MEMBER BLEY: I was trying to come up with a justification for something that didn't make sense to me.

MR. DUNFORD: No. All IROFs should be, yes.

MEMBER BLEY: To be safety related.

MS. HAASS: Yes.

MEMBER BLEY: That's what I thought. That's why I was confused by that.

MR. DUNFORD: Yes. Yes, because we'd want -- that safety function would need to be performed.

MEMBER KIRCHNER: Now, going back to this morning's session, the very last item, going back to

I&C. So if that facility process control does have the capability to operate an engineered safety feature, doesn't that then kick it over into a higher quality level and seismic classification?

MR. DUNFORD: But we haven't accredited that function in the safety analysis or the ISA. We've accredited it at the analog or the interlock function.

MEMBER KIRCHNER: Per Chapter 13.

MR. DUNFORD: It's not an additional.

MEMBER KIRCHNER: But you're not crediting.

MR. DUNFORD: Yes. This wouldn't be the safety channel.

MEMBER KIRCHNER: Okay. Thank you.

MEMBER BLEY: So let me flag something I had. Because it's -- when we get to Chapter 6, this is going to come up.

And I'm going to -- at that point I'm going to ask the staff how they became convinced of -- that your set of ESFs was complete. And at least for me that comes from studying the ISA and making sure the ISA is complete.

And therefore that the IROFs coming out of it are a good set. And that the things we call ESFs later are well established.

We have a Chapter on analysis later we're covering. We don't have a session scheduled on the ISA.

MS. HAASS: It's supposed to be on the 22nd and 23rd time frame. But the ISA will be spoken to.

But I think Mike can speak more to that.

MR. BALAZIK: This is Mike Balazik. I think we're going to incorporate that into Chapter 13, talking about the ISA.

MEMBER BLEY: Okay.

MR. BALAZIK: But we can --

MEMBER BLEY: Well I knew we were doing Chapter 13. I didn't know we were going to really delve into the ISA.

And I hope we do. Because it's going to be really important.

MS. HAASS: Yes. I asked for it. I asked for it, to have that.

MR. BALAZIK: And then we can have that separate from 13 if needed. I mean, I don't see that --

MEMBER BLEY: Well, you can tie them all together. That's okay. But I really want us to get a good handle on the ISA.

Because I think much of everything else

hinges on being convinced that a good job was done there. And if we've got gaps there, then everything else we've said that we're good to go on construction, is questionable.

So, I'm glad to hear that that is part of Chapter 13. I thought it was just by inference that also Chapter 6 is by inference. And to me that's the -- I don't know, if there's a suspect part.

The most important link there to being convinced on Chapter 6 to me is that same thing as the ISA. Okay, then I'm happy.

We'll go ahead. And I'll look forward to that session.

MR. BALAZIK: Member Bley, just for --

MEMBER BLEY: Go ahead.

MR. BALAZIK: Just a quick correction. What -- this wasn't submitted as an ISA. It's a summary. So, I -- it's kind of preliminary right now. And we expect a lot of changes to that.

So I just wanted to clarify that this isn't a final ISA.

MEMBER BLEY: I know. But where you're going to hear me coming from when you get there is that if in your review, in the staff's review of the summary, and it's always a summary.

I mean, what you've asked, how you've pushed to make sure you think it's covering all the important items, is something I really want to have a good handle on.

MR. BALAZIK: Yes, sir. I understand. I just wanted to clarify that again.

MS. HAASS: So just to say one more thing. You know, from a safety perspective, you know, we went in and did a hazards analysis on the whole facility.

We did -- oh, I can't remember the exact number, eight or nine, ten, you know, qual -- you know, QRAs associated with, you know, the main --

MEMBER BLEY: You have at least some of that material to look at?

MS. HAASS: I believe so. I can't remember how many you requested. And then, you know, we also did the ISA, you know, an ISA summary.

And you know, we filled that, you know, we've covered a lot. But I completely agree with Mike, you know, when you go through this interim process and into your final design, yes, that will change.

And things are going to -- you know, some things will go up and become, you know, an IROF safety related. And some may come down based on that.

MEMBER BLEY: Things will change. But the real key for us, at least for me here, is that we haven't missed something --

MS. HAASS: Correct.

MEMBER BLEY: Up to this point for which you would have to do major surgery on these buildings after you're done with them.

MS. HAASS: Correct. All right, thank you.

MR. CORUM: Slide 44. So, the design basis for systems and components required for safe operation and shutdown are established in three categories, functions, value, and criteria. And as an example we've got the target fabrication system.

Which for the design basis functions. Those are listed, store, you know, fresh low-enriched uranium and LEU target material and new LEU target.

Produce LEU target material from fresh and recycled LEU material. It just talks about the functions for that design basis.

The safety-related functions are maintaining sub-criticality conditions within the system. Preventing flammable gas composition within the system. And limit the personnel exposure to hazardous chemicals and offgas.

And then some design basis values would

be for a 30-year design life with the exception of common replaceable parts, like pumps. And to maintain the primary fission product boundary during and after normal operations, shutdown conditions, and design basis events.

MEMBER STETKAR: Could you clarify that last bullet? I would hope you don't have any fission products in your target fabrication area.

MR. DUNFORD: Yes. I would agree with that.

MEMBER STETKAR: No. That's a --

MR. DUNFORD: Okay. Correct.

MEMBER KIRCHNER: You just want nice clean uranium going in.

MS. HAASS: That would be nice.

MR. DUNFORD: That's correct.

MEMBER KIRCHNER: Well, but you can't avoid it when they recycle the material.

MR. DUNFORD: And recycle is going to be traced.

MEMBER KIRCHNER: Yes.

CHAIR CHU: Any questions? If not, the staff will come up.

MR. BALAZIK: Good afternoon. This is Mike Balazik again. And Dave Tiktinsky will be presenting Chapter 3.

We also have two technical reviewers. And I just wanted to verify that Greg Hofer and Enver Odar are on the bridge line?

MEMBER BLEY: Please say your names and tell us if you're there.

MR. BALAZIK: Oh, okay. Before we get started, one thing I would like to say is that Rev 1 to the PSAR, Chapters 3, 6, 7 and 8, they were just received down at the document control center on Friday.

So I'd just like to add that the staff has not had time to review these revised PSARs to ensure that REI responses were captured accurately.

MEMBER BLEY: Yes. Thanks. And the SER is on Rev 0. Right?

MEMBER STETKAR: SER is kind of on Rev 0 and a half as best as I can tell.

MEMBER BLEY: Oh, yes. Because you had --

MEMBER STETKAR: Because they've incorporated --

MEMBER BLEY: Discussions and REIs. Yes.

MEMBER STETKAR: They've incorporated responses to REIs.

MEMBER BLEY: Yes. REIs.

MEMBER STETKAR: And presumptions about what Rev 1 will say in some cases.

MR. BALAZIK: And we will check for that accuracy on what it says. And revise as necessary.

MEMBER STETKAR: I'll try to let you guys off the hook on Rev 1 then.

MR. BALAZIK: Greg and Enver, are you on the line?

MR. HOFER: Yes. I am.

MR. ODAR: Yes. I am.

MR. BALAZIK: Oh, great. Great to hear from you guys. All right. So we'll go ahead and get started and I'll turn it over to Dave.

MR. TIKTINSKY: Thank you Mike. Slide 4 of the regulatory basis requirements and acceptance criteria. I won't go over this again since you've seen the same slide multiple times, the same requirements. Let's go next slide.

So, I wanted to go a little bit here of over what Northwest is doing. So, as per NUREG 1537 and the ISG, they are using the baseline design criteria that come out of 70.61(a) to justify their thing.

So even though the ISG states that the compliance with that is not specifically required for radioisotope production facility under Part 50, but a license application that addresses that would be found acceptable.

Just to also note here that in order to operate the actual facility, Northwest also proposes to fabricate low-enriched targets under Part 70, which is not subject to this application. As we discussed at the previous meeting that will be coming at some later date.

Just for your information of what's in 70.64, this includes quality standards and records, natural phenomena hazards, fire protection, environmental dynamic effects, chemical protection, emergency capability, utility services, inspection testing and maintenance, which is basically make things available and reliable, instrumentation control, and defense in depth principals.

Those are the things that they need to meet when they were trying to meet 70.64. Next slide.

Also, Northwest is chosen to meet the performance requirements stated in 70.61 as per the ISG. And development of using the ISA methodologies as described in Part 70 and NUREG 1520.

Also note as we'd mentioned earlier that in the Chapter 13 discussions at the next ACRS meeting, we'll go into more details about the staff's analysis, evaluation of the ISA methodology, and the ISA summary.

So the staff went and did a section by section evaluation of the information in Chapter 3 with the purpose of assessing the sufficiency of the design and the expected performance of SSCs in support of an issuance of a construction permit. Next slide.

So actual areas of staff review is the principal, the design criteria, to making sure they were sufficient of design basis.

And looking at types of equipment, functional requirements, the general arrangements of the equipment and the facility to determine whether it's sufficient to provide reasonable assurance that the final design will conform with the design basis.

So these are the sections in Chapter 3 that we'll go over. Design criteria, meteorological damage and external hazards, water damage, seismic damage, and systems and components, I'll be going through each of these individually. Next slide.

So the design criteria, they're listed in various PSAR sections. So 3.1.1, the facility's systems and IROFs. It has a summary of the IROFs that were identified in the accident analysis, which came from Chapter 13.

This section also provides cross

references of the list of systems and IROFs within the application. So sort of the roadmap to the application and where to find other things.

Section 3.1.3 is relevant to NRC guidance documents. So this lists the NRC guidance documents that Northwest used as design inputs.

Northwest medical isotope system design descriptions, which is the next level of detail. Also, identify specific requirements for each system.

Those were not specifically in the application. But they support the application.

In Section 3.1.7, the codes and standards. This section identifies codes and standards and other reference documents that maybe applicable to the RPF and are used as design inputs.

Northwest medical stated in the PSAR that commitments to code standards and reference documents needed to demonstrate compliance with regulatory requirements will be identified and committed to in the operating license application.

Section 3.5.1, general design basis information. Provides the definitions of safety related and quality level and seismic classifications. Which you've heard Northwest discuss. And I'll be discussing those a little bit more.

Section 3.5.2, design criteria. So this discusses the individual baseline design criteria that were derived from 70.64. And also the classifications of the systems in the RPF.

Which are both for quality assurance levels and seismic classification. The section also provides the design basis function and criteria for systems and components required for safe operation and shutdown of the RPF.

In this review, the staff had concluded that design --sorry. Tried to keep it off of there.

The staff concluded that the design criteria are based on navigable standards, guides and criteria to provide reasonable assurance of pubic and worker health and safety, and protection of the environment. And meets the applicable requirements for issuance of a construction permit.

So the next section -- and I know some of the questions you may have, we may need to refer to some of our reviewers that are on the phone.

Meteorological damage, the staff evaluate -- or the PSAR included how the facility was designed to withstand when tornados, snow, ice, and flood loadings postulated for the site location.

So for meteorological damage the staff

evaluated whether design criteria were compatible with local building codes. And whether the design specifications are compatible with functional requirements throughout the predicted meteorological conditions.

And the staff also reviewed the design loads and impacts. The staff had concluded for meteorological damage that the level of detail was adequate and supports a preliminary design of the RPF. And meets the acceptance criteria in NUREG 1537.

MEMBER STETKAR: Dave, you heard what I asked about the straight line winds before. And I guess I understand now that they have indicated that they will design a facility to the Reg Guide 1.7 -- I always forget the numbers. 1.76 is it?

MR. ADAMS: Yes, sir.

MEMBER STETKAR: Tornado winds and those associated missiles. And for this location that's probably going to be bounding. But, I don't know.

We know from -- where I'm headed is we know from experience along the gulf coast that straight line driven missiles can have higher energy then tornadic missiles.

So, despite the fact that I might have -- I'm balancing off a frequency of -- an accedence frequency event per year with a wind velocity and a missile energy that may determine my design.

So for example, new sites or facilities along the gulf coast and southeastern coast of the U.S., their missile design is actually driven by straight line hurricane winds, not tornado winds.

Despite the fact that the tornadic wind velocity might be higher than the hurricane wind velocity. It's just the energy of the missile.

And that's why I was bring up this concern about how are they justifying 5.88 times ten to the minus 4 accedence frequency for 120 mile an hour straight line wind when they've seen two examples -- two events in the last 60 years of 114 mile an hour winds.

And I'm not an -- I don't know anything about picking up automobiles or steel spheres or rods, and hurling them. It's not what I do. And I don't design buildings.

So Have no idea where those crossover points are between a wind -- straight line wind velocity of X and a tornadic wind velocity of, I think, it's 230 miles an hour.

MR. ADAMS: I think one thing we will go back and look at is, as was mentioned, we did do post-Fukushima evaluations for MURR. And one of those was determining what the bounding missile was.

MEMBER STETKAR: Okay.

MR. ADAMS: So, you know, what kind of energy that missile had. And how it acquired that energy.

MEMBER STETKAR: And I would hope that MURR given where it is, accounted for the fact that they've seen 114 mile an hour winds.

MR. ADAMS: No. Like I --

MEMBER STETKAR: Because I've seen 114 mile an hour winds, not picked a number out of some ASCE table.

MR. ADAMS: But you know, I know we did that evaluation. And, you know, the staff did it. And so, you know, it's something we can go back and look at to see, you know, how that fits into this question.

Mike, anything you can add?

MR. TIKTINSKY: I think you got it.

MEMBER STETKAR: I'm not necessarily -- I'm just raising a question about -- I'm raising the biggest question about how they justify that 5.88 times 10 to the minus 4. Which is a very, very precise, very small number for 120 miles an hour.

I quite honestly do not believe that number. I do not believe it can be justified given the meteorological history.

On the other hand, I don't know what straight line wind velocity at what accedence frequency is the cross over point for either just point wind loading. Which I suspect would have to be really high, but more importantly, wind driven missiles.

And that's where I think you need to take a look at.

MR. ADAMS: Yes. I'm -- you know, I'm going under the assumption --

MEMBER STETKAR: Assumption that you did that already at the MURR.

MR. ADAMS: Assumption that the staff considered those kind of things when they arrived at, you know, how fast the car was going --

MEMBER STETKAR: Yes.

MR. ADAMS: When it found the containment building, so.

MR. TIKTINSKY: The second part of this, external hazards. PSAR section 3.2.8 states a source of external hazards including fires and explosions were considered by Northwest and found not to be of concern.

The proposed facility is constructed of

robust non-combustible materials with adequate setbacks from transportation routes. What I would say here is as we had discussions at the last meeting and this morning that, you know, Northwest is providing some updates to their information related to these types of external hazards.

And the staff will evaluate those. And make any changes that might become appropriate based on that review. Next slide.

So, for water damage, section 3.3 of the PSAR just talks about how the facility's design for flood protection measures from both external flooding and postulated floods from failures of facility components containing liquids.

For the flood loads they've stated that they didn't consider it in the design based on the evaluation above the 100 year and 500 year flood plains. For those below grade, that's -- it will be in a hardened structure.

So, the staff reviewed the application for water damage based on both external flooding assumption and postulated flooding from facility components. The applicant stated that sensitive component -- sensitive systems are protected within the enclosure. And are designed for anticipated adverse environment condition.

The applicant also stated that critical components will be installed in accordance with relevant industry standards. The staff found that the RPF design features to cope with hydrological damage are sufficient. And meet the applicable requirements for issuance of a construction permit.

MEMBER STETKAR: David, are you satisfied that the grading at the site is sufficient to handle locally intense precipitation at the probable maximum precipitation rates?

MR. TIKTINSKY: I guess I'd like either Greg or Enver to answer that.

MEMBER STETKAR: I didn't see that particularly addressed. People kind of danced around it.

MR. TIKTINSKY: Greg or Enver, could you address that question, please?

MR. ODAR: Can you repeat the question? This is Enver Odar.

MEMBER STETKAR: Okay. I was asking, are you satisfied that the proposed grading at the site is going to be adequate to handle locally intense precipitation at the probable maximum precipitation rates for the site?

I didn't really see an analysis on the part of the applicant for a discussion of that issue in the SER. Unless I missed it someplace.

There's a discussion about the 500 year flood plain and flooding from the rivers and the location of the little drainage ponds and the heights of the dams on the drainage ponds that are -- they're across the road from the site.

I'm more concerned about things like ponding in the parking lots and water flows into truck bays and that sort of thing at very high precipitation rates. Which folks of get in Central Missouri.

MR. ODAR: Yes. Based on what we saw and report by telephone, it seems reasonable to accept the findings that are presented in the SAR.

We did not do any specific in depth evaluations in doing the evaluation ourselves.

MEMBER STETKAR: Well high precipitation rates --

MR. ODAR: Based in this --

MEMBER STETKAR: Go on. I'm sorry to cut you off.

MR. ODAR: No. I'm saying the SAR is quite conclusive in the fact that there would not be those kind of problems that you have just mentioned.

MEMBER STETKAR: But the highest precipitation --

MR. ODAR: Or anything else.

MEMBER STETKAR: NWNI may want to correct me if I'm wrong, but I think the highest precipitation rates that I saw that were something on the order of about three inches an hour. A little over three inches.

MR. ODAR: Three point 14 --

MEMBER STETKAR: Yes. Well, that's --

MR. BALAZIK: We'll follow up on them.

MEMBER STETKAR: That's -- yes, well they're this --

MR. BALAZIK: Member Stetkar, this morning we went over a couple of action items.

MEMBER STETKAR: Oh, you did? Okay.

MR. BALAZIK: And Northwest reported -- I think it was, correct me if I'm wrong, 3.5 inches an hour?

MS. HAASS: Three point 14.

MR. BALAZIK: Three point 14. I'm sorry. So yes, sir, you're correct. On that number.

MEMBER STETKAR: And Mike, let's take a look at that.

MR. BALAZIK: We'll take a look at that, sir.

MEMBER STETKAR: I live in southwestern Arkansas, and we get really heavy rainfall rates at times. So that doesn't -- I'm not saying that that is a normal occurrence, that a three inch an hour rainfall rate is a normal occurrence.

But if we're talking about 500 year accedence frequencies that's strange. And I get everything else.

I looked at the topography of the site. I looked at where the dams, you know, their little impoundment dams on those two catch basins.

And they're at a lower elevation. And everything slopes away.

I'm just worried about -- I was concerned whether anybody look at the actual footprint of the site? Because it's basically, to the best that I can tell, mostly a parking lot.

MR. BALAZIK: Yes, sir. And I've been to the site actually on a couple of occasions. And you're right, in front of the facility it all slopes down into a valley.

And even on the side or the back where those ponds are that you see, it doesn't slope as much I should say.

MEMBER STETKAR: Right.

MR. BALAZIK: The grading is a lot less.

MEMBER STETKAR: And I have no idea how they're -- how they're going to grade the site. Again, it's a little bit of a consideration before they start to move dirt around.

MR. BALAZIK: Yes, sir. How that change, what it looks like right now.

MEMBER STETKAR: Right.

MR. BALAZIK: Yes, sir. I understand.

MR. ADAMS: We'll take that as a take away and follow up on it and close the loop with you.

MEMBER STETKAR: Yes. Thanks Al.

MR. TIKTINSKY: Seismic. Seismic damage and safe shutdown earthquake. We've had a discussion about this a few different times today.

About what they use the .2 maximum ground acceleration as used at MURR. Using Reg Guide 1.60, the staff determined that the level of detail provided on the seismic damage is adequate.

It supports the preliminary design. And meets the acceptance criteria of NUREG 1537. Design criteria and design provide reasonable assurance that SSEs would continue to perform their safety function during and following a seismic event.

MEMBER RICCARDELLA: What -- I'm sure you heard the earlier discussion. What's the staff's position on using the NUREG 2115 CEUS GMRS?

MR. TIKTINSKY: Enver, would you like to answer that question?

MR. ODAR: Yes. I would like to answer that question. First of all, .2 G maximum ground acceleration and a conservative Reg Guide 160 spectra is a design basis condition.

The post-Fukushima near term task force recommended action are beyond the design basis evaluation. And generally they are evaluated for higher expected GMRS values as if it were. But using a different exception criteria then the one we apply for the loading associated with .2 G.

We, meaning the applicant is going to keep the stresses due to seismic load in combination with other loads at or below yield level. However, as we all know, the structure has a tremendous amount of residual capacity to resist loads without failures going well beyond the last minimums.

So, when we talk about Fukushima-based GMRS assessments, it's a different world. So, I reviewed that area.

And the reason I choose .2 Gs was conservative in combination with Reg Guide 166 as well as the soil-structure interaction model that they are going to be using for the ground development.

And one basis for that for simplistically assessing the adequacy is to look at the USGS and Boone County documents that estimate that a modified Mercalli intensity seven earthquake at the site if a 7.6 magnitude earthquake takes place at NWMI.

If you correlate intensity seven earthquake the range of expected acceleration are .07 to .16. With .16 being the highest possible established acceleration.

And this is based on fathers of seismology paper that was published. And that is Richter himself and Gutenberg.

So I looked at that and this drawing too. And we are dealing with .2, it is plenty of margin in terms of energy release into earthquake.

Now, in the -- in the -- I looked very briefly at the MURR university search reactor report and they show that at 0.3 acceleration, the GMRS is actually less then the SSE of .2.

And I think they concluded that they don't have to do anything further. Although I may be wrong.

MEMBER STETKAR: That's really interesting. You heard -- you have more?

MR. ODAR: Go ahead.

MEMBER STETKAR: Two questions. You mentioned USGS and papers and Richter and all that kind of stuff. And I will point you to the 2014 version of the USGS hazard map.

Pull up the coordinates of this site. You can find them. It's that level of specificity. And just look at the accedence frequencies in there. You will find that 1.0 E to the minus 5 is about .66 peak ground acceleration .66 G at this site. According to USGS.

That's not CEUS. That's not the evaluation according to the guidelines in the NUREG. It is just the USGS 2014 seismic hazard map.

Now, my question is, supposed --

MR. ODAR: Okay. I think has -- oh, I'm sorry.

MEMBER STETKAR: Suppose I want --

MR. ODAR: Seismic hazard is a different story then seismic design, very different. .66 is a tremendously high maximum ground acceleration for an earthquake.

MEMBER STETKAR: Right. And it occurs at -- excuse me. And it occurs, according to the USGS, at one times 10 to the minus 5 event per year.

It's not one times 10 to the minus 30 event per year. It's one times 10 to the minus 5 event per year.

MR. ODAR: As I said, I am sorry I am not familiar with that particular publication. But just --

MEMBER STETKAR: This is USGS. You're not familiar with the USGS seismic hazard map?

MR. ODAR: Of course. Of course I am.

MEMBER STETKAR: Oh, okay. Of course you are. So you are familiar with it.

MR. ODAR: Yes. Anyway, the --

MEMBER STETKAR: Now, my question to the staff is, suppose I today wanted to build a new commercial nuclear power plant at this site. What would be my design basis ground motion response spectrum for my new commercial nuclear power plant at this site?

MR. ADAMS: And my answer is going to be, I don't have any idea.

MEMBER STETKAR: Okay. Well --

MR. ADAMS: There is a dimension map we haven't talked about yet here. And that's the consequence of the failure.

MEMBER STETKAR: No, no. That's -- don't get into the consequence yet.

MR. ADAMS: Okay. Good. Okay.

MEMBER STETKAR: Because we reviewed several COL applications that use the new CEUS hazard as their design basis ground motion -- as the basis for their ground motion response spectra.

MR. ADAMS: And I think I -- I think we clearly -- we're clearly getting your message here.

MR. ODAR: May I ask which new nuclear power plant did that?

MEMBER STETKAR: It's --

MEMBER RICCARDELLA: North Anna, South Texas Project.

MEMBER STETKAR: North Anna, South Texas Project, it's ones that are in --

MEMBER RICCARDELLA: Lee -- Lee? No. It's the new --

MEMBER STETKAR: No. The new units three and four at ABWRs. There are two others in the mill that we shouldn't talk about because they're still being reviewed.

MR. ODAR: Is that Virginia Power?

MEMBER STETKAR: Yes. Virginia Power.

MEMBER RICCARDELLA: Yes. North Anna.

MEMBER STETKAR: North Anna -- that's North Anna.

MEMBER RICCARDELLA: That was North Anna.

MEMBER STETKAR: And actually one other.

MEMBER RICCARDELLA: And then what about the ones under construction? I think the AP1000s, I think uses this.

MEMBER STETKAR: I think that they went back and -- the problem is they were in a gray area. But I think they went back and used those.

MEMBER RICCARDELLA: My point is it's almost more of a matter of convenience. I mean, an operating nuclear plant, they can't go back and redefine their SSE. That's their design basis. It's already there.

So they're taking an alternative step of doing a seismic margins analysis or a seismic PRA. But if you're building a new plant, you know, why not use the most up to date information so you don't have to come back at some future date and do a seismic margins analysis.

MR. ADAMS: I don't disagree with you. And it's a lot easier to redesign paper then it is once the building is sitting there.

MEMBER RICCARDELLA: Yes.

MR. ADAMS: You know, I think we, you know, we've got your -- I think we got the message you're trying to give us very clearly.

But we need to go back and think about this very carefully. Because, you know, telling this applicant sorry, you're going to have to go back and redesign your facility for a different number is -- I have to make sure I have a clear regulatory basis for doing that.

Also considering the consequences of failure and how --

MEMBER RICCARDELLA: But I thought most of those detail designs weren't done yet?

MEMBER STETKAR: Yes, Al? Just look at this. Everybody's hanging their regulatory hat on .2 G. That to me is a completely arbitrary number.

It obviously doesn't apply to Calloway anymore. I have no idea why it applies to MURR. But you guys need to figure that out.

It's why don't I use .17 G? Why don't I use .263 G? You know, why .2 G now? In terms, you know, if you want to hang your hat on this regulatory basis.

MR. ADAMS: No. I got -- I mean, we got the message.

MEMBER STETKAR: That .2 G, you could kind of pick any number.

MR. ADAMS: We have your message. We need to go back and look at it, you know, and come back to you.

But also, we need to step back and look at the consequences of failure. Because, you know, there's a lot of research reactors, you know, that were built. And we went back and looked at them, you know, we saw they didn't meet the -- you know, they didn't meet today's code.

But when we look at the consequence of failure, you know, we were within Part 20. So, you know, I hate to say it, it sort of boils down to so what if the roof caves in?

MEMBER STETKAR: But what you're talking about doing is what the existing plants are having to do. And that's taking a look at the --

MR. ODAR: Or chose to do. Yes. They chose to do that.

MEMBER RICCARDELLA: No. No, no, no. they were required.

MEMBER STETKAR: They -- well, don't -- how they were chosen and how they were required and what sort of arm twisting was done is --

MR. ADAMS: You know, all I can tell you is we'll go back and look at it. You know, sitting here I don't know what the consequences are if we say to this applicant, sorry you've got to go to .4 or a different number.

Does that add a million dollars onto the building the facility? Does it add 20 -- I don't know.

MEMBER STETKAR: And I don't think that we're arguing with that notion about the fact that given a -- given a hazard at the site, and if you want to pick the CEUS hazard, which seems to be the current state of knowledge.

Given that hazard, one can do either a, you know, a more simplified seismic margin analysis given preliminary design of your facility. Or, you know, in the limit a full blown seismic probabilistic risk assessment, which is -- requires more effort obviously to provide confidence that the proposed design is adequate for the seismic -- the hazard at that site.

MR. ADAMS: Like I said, we --

MR. ODAR: That's what the basic plans are doing. Yes.

MR. ADAMS: So we've got the message. We'll go look at this and come back and talk to you some more.

MEMBER RICCARDELLA: As a minimum, I think you have to take out the words as was adapted by Calloway Nuclear Power Plant. Because that's not accurate anymore. I mean, they're using a higher --

MR. ODAR: It was as was adapted, I think is a better word.

MEMBER RICCARDELLA: Yes. But has -- and has been updated.

MR. ODAR: Yes. Since I am on the phone, can I mention one other thing, please?

MR. ADAMS: Sure.

MR. ODAR: Tornados. Tornados, we -- I reviewed the tornado situation. And my understanding of Northwest's commitment is that they will use a Reg Guide 176, Revision 1 as a basis.

That is the basis on which we accepted the response to the ROI. In other words, whatever is in that Reg Guide is applicable to the design of RPF.

And if anybody has questions on that, that's my basis for accepting the basis.

MR. TIKTINSKY: Okay.

MR. ODAR: But there was no case probability checking the numbers or anything. But this is my best writing in the guideline.

MR. TIKTINSKY: Okay. We're good. Now if no requests, we're going to move on.

Systems and components. The definitions of safety related as it was discussed by Northwest, there are safety-related IROFs and safety-related non-IROFs. The IROFs are designed to meet the performance requirements of 70.61.

I note that the application provided a preliminary list of IROFs to the RFP based on the accident analysis discussed in Chapter 13. And the quality assurance plan, it also is contained in Chapter 12.

Which both of those Chapters we'll talk about next meeting. So we've got a lot more detail about some of questions and the other concerns that you had related to accident analysis, ISA and quality assurance.

And just to give an example of that, what Northwest has used is safety-related non-IROFs include things like a fire protection system.

For seismic classifications, also they talked about this. So the seismic Classification I relates to IROFs. And it talks about functionality, integrity.

C II is integrity and non-seismic. The staff here determined that the level of details provided in the system and components is adequate and supports a preliminary design. And meets the ethical acceptance criteria of NUREG 1537.

I will note though that in -- if you read our SAR, we actually need to make a couple of changes on that. Because we refer to IROFs and non-IROFs as being C I. And that's not the case.

We just need to adjust the language. So that will be our take away to fix that. Went through the paragraph again wasn't exactly correct in matching the application.

So the final slide just evaluation findings. The staff found that Northwest has met the requirements of 50.53 for issuance of a construction permit with respect to the design of structure system components.

That they've been described, including the principal architectural and engineering criteria. Further technical design information that maybe reasonably left for later, the consideration of the FSAR, and reasonable assurance that the proposed facility can be constructed and operated without undue risk to health and safety of the public.

CHAIR CHU: Thank you. Any more questions?

(No audible response.)

CHAIR CHU: Okay. Now if you can go to Chapter 6.

MEMBER BROWN: Are we going to take a break?

CHAIR CHU: Do you want to take a break now or?

MEMBER BROWN: Some of are -- there are no breaks show in the rest of the meeting here. Oh, there we go. It's at 3:45. Okay.

CHAIR CHU: You can -- we can take a break. Yes. You want to take a break?

Okay. Let's take a ten minute break. Okay.

(Whereupon, the above-entitled matter went off the record at 2:55 p.m. and resumed at 3:05 p.m.)

CHAIR CHU: We are going to start again with NWMI presenting Chapter 6. Thank you.

MS. HAASS: So hi. I'm Carolyn Haass again, Northwest Medical Isotopes. And we're going to give an overview of Chapter 6, engineered safety features.

I do want to say that when you look at our validation documents for criticality and our CSEs, we have modified our USL, the upper subcritical limit. And that's been modified, but I do want you to know that the critical safety evaluations have not been modified since then. And we know with the modification of the USL that just like we said it's through an iterative process in design. We will know that certain additional items will become IROFS based on the lower USL. So we just want to keep that in mind. We do know that already.

And so we will move on to Chapter 6. I'm going to hand it over to Gary, who is going to do the first half which will be the introductions, as well as the confinement ESF features. And then Mike will come in and do the criticality and the conclusions.

MR. DUNFORD: Thank you. This is Gary Dunford again. So we're going to go through the engineering safety feature Chapter 6 information, but I'm actually going to lead off with a little bit of discussion about Chapter 13 and the major sets of accidents that we looked at.

So ESFs, engineering safety features, are both active and passive systems. The largest piece that we'll talk about and it's documented quite extensively in Chapter 6 and in follow on in Chapter 9, is the confinement system and what accidents it mitigates and we'll go through that.

So then after just kind of a brief

introduction of the accidents, there are four sets of tables that are just summary level tables of the IROFS from both radiological safety and criticality safety that came out of the QRA. And then we'll touch on those not real heavily, just kind of point to those because later on all those IROFS, both criticality and radiological, are talked about on a one-page slide, typically, or one or two per slide.

So we'll start with that. So I'm just going to move to the next slide which is three main types of accidents we looked at which were liquid sprays and spill accidents which is what this is covering that create both radiological and criticality hazards. We actually looked at three different types of solutions. One does not have a criticality aspect. It turns one doesn't really have a radiological aspect of it. So we looked at the range of solutions of that material that just came into the plant versus something that was going to go effectively to target fabrication.

And then we did a QRA in this area. So this would all be part of our ISA. So our ISA methodology which we'll talk about later really is the development of hazards, understanding your hazards. Then we would bin those against risks and eventually we would identify those that were in a higher risk category based on frequency or consequences or a combination thereof. We would then say we need to do a qualitative risk assessment against those.

So there's 75 accidents that came out of the ISA process that we have bound or binned in the families of accidents to be evaluated.

So in this particular case, what came out of this particular accident would have been shielding walls, liquid confinement, some criticality concerns. So we'll talk -- out of that family of accidents and then gaseous confinement, by the way. Those were the types of controls that we identified that would help mitigate an accident like this.

The next one is a dissolver accident, so we're doing dissolver offgas system and iodine release. This actually has a bullet that refers it back towards Chapter 19, but you guys haven't looked at 19 so don't worry about that. But there's an iodine release that could be very significant as part of that.

So the IROFS to reduce this were the primary offgas system and our gaseous confinement system including Zone 1 HEGA which would be an iodine absorption unit and some spare trains that we've identified also.

So at some level, when we looked at these first two accidents we talked about, all the hardware was already there. We just had to elevate what we had in our defense-in-depth boundaries up to and call this, hey we're going to call this one an IROFS because it mitigates that accident down to an accessible criteria. There's only, I think, when we went through the accident analysis we only ended up adding one or two feature that we had not had previously identified as there. One happened to be when we were loading in the cask material or the targets out of a cask. We did not have a seismic shielding. Now we have a seismic fence with a seismic qualification. We didn't have that initially. And there one other that dealt with the uranium system where we ended up with two monitors instead of a single monitor, i.e., the voting of 1, 2 because of to get the probability down where you need it.

MEMBER BLEY: Assuming the ISA is well done, that is a remarkable design job beforehand. I appreciate that.

MR. DUNFORD: We had some very stellar folks on the activity.

Okay, and then the last one is leaks in auxiliary systems. And actually that happens to be the other one that we didn't have in there which was double contained pipe as you left the hot cell and went to another hot cell. So this talks about those. So those big three families of accidents in reality.

Okay, so now I'm going to kind of move into the ISA. So the second column here that say IROFS, if it has a RS, that means it came out of the radiological. And if it has a CS it came out of criticality evaluation. And in lots of cases a family of accidents has both, so it will be an RS control and a CS control.

We're going to talk more about confinement in the confinement system, what that means as far as penetrations and shielding and doors and stuff like that. So we'll just pull that off until a little bit later. So this is just kind of a family of activities that we have.

Effectively, what this is trying to say is we define at the start of our hazard analysis that the confinement function was going to be an IROFS. We just took credit for it. We knew it had to be. You had to have biological shielding. So we just started with that, was always going to be an IROFS level of control and tech spec level of control.

So when we did our accident analysis if it was in the hot cell, effectively we said well, it's in the hot cell, so we already took credit at this point. This next little family are those then that came out of the accident analysis that eventually will end up as potential tech specs.

Offgas relief system, the process engineer already had that in his design and we needed to elevate it. In fact, I'll tell you, there's a lot of stuff that we had in the design that in control meetings and discussions, well, why is that an IROFS? Why isn't it an IROFS? And so there's a number of things I think on day about 10 of this were not IROFS and the day we finished the PSAR were elevated to IROFS. Steve had a lot to do with that. I'll just leave it at that.

MEMBER BLEY: So if I followed that discussion, it's interesting, a lot of the things you had already designed in you redesignated as IROFS because they were keyed to specific --

MR. DUNFORD: To either prevent or mitigate an accident or potential accident that had consequences above performance guides of 10 CFR 70.61 or VCE whatever.

I'm not going to go through these in detail. So this is the family, the exhaust stack was something that we use in our analysis and the height of that, so we just had to protect that as an assumption so it ended up being an IROFS. Double-wall piping I mentioned is a criticality one.

So this kind of goes through. You'll see now at the bottom of this page, I'm on Slide 52, there's dissolver offgas removal unit. There's the dissolver offgas primary absorber. These were ones that we felt we needed to elevate more so from a -- if it -- why wasn't it an accident, if you didn't have it, you would not be able to be 10 CFR 20 guidelines in any stretch of the imagination. So we needed to elevate these, we thought, to the level of potential tech specs. And that's where we are right now. So the primary absorber which is the Xenon absorber, the iodine removal units that are identified in the third from the bottom and then the dissolver offgas vacuum system which just happened to be part of the system. You have to have -- we felt those are areas that needed to have an appropriate pedigree and quality assurance.

This next family is two pages of criticality and some of them -- by the way, go back and forth, they're redundant. The double-wall piping comes out here as it's also in what we just looked at a moment ago.

Okay, confinement strategy. And if I'm going too slow, just tell me that I'm going too slow, please.

So the principal design states the objective, obviously, it's to protect the workers, the public, and the environment. And as I said, we started off with this theory that we needed adequate shielding, adequate ventilation to minimize the hazards. So that's where we started from.

So the enclosure for the facility is really the hot cells that's designed to limit the exchange of effluence between that enclosure, those hot cells and the rest of the facility, unless it's gone through some type of air cleaning system.

So we have internal pressure. We have negative pressure. Significant shielding, air movement, so all those things kind of go towards that and I think I'm going to skip to the next slide.

So in this particular case, this is the structures, and systems, and components that we've identified as part of the confinement safety function. So that's the inlet dampers, the ducting, isolation dampers, the exhaust stack, the filters, all these things and the third one is the process vent system is also identified as part of that, and ventilation controls.

Going back to Chapter 7, Charles isn't

here, so this is a case where we have identified in that large ventilation system, there is a physical that ducting has to be there. We take credit for it. There may be a lot of ancillary controls associated with the ventilation system, but turning the fan on and off, there are things that would be -- that are required or that we took credit for in this particular case. We took credit for the ventilation via passive systems. So the fact that the fan went off or the controls associated with that aren't really an issue per se as it relates to the ventilation controls, there are some attributes. Stack monitoring is part of the system and some of those things that are hard wired or have analog-based systems so that you don't have to go through the distributor process control system to actuate an alarm or an interlock.

MEMBER SKILLMAN: Gary, before you change slides, as we see the classification IROFS for those six items, as an example, secondary iodine removal bed, within that bed is material that needs to be purchased, correct?

MR. DUNFORD: Yes.

MEMBER SKILLMAN: Should we assume that there are controls on the procurement of that absorber material that has been submitted that has been subjected to the QA1 program that is your IROFS safety program?

MR. DUNFORD: Yes. If there is a -- whatever is the appropriate safety function of a piece of equipment or a piece of material, that should be identified in the spec. The quality level should be identified, the inspection levels, all that kind of activity.

So in this particular case, an iodine bed might be obviously certified vendor and we would buy that as a unit, but then we would have some testing, right? We want to make sure there's actually silver iodine or silver on that bed, right? So we'd have some spec, some requirement for verification that we received what we wanted to received. If it was replaced at media, the same type of thing, right? Some type of certs on that.

MEMBER SKILLMAN: Holding on to that same logic, would the construction details and the construction procedures and guidances also be classified safety quality 1 or quality 1, to ensure that the craft that constructs the device or whatever does so in a way that assures that the safety function is built into not just the device, but the entire system?

MR. DUNFORD: I would say with only a few minor instances and different examples where that's exactly what it has to be. Particularly that's real easy to talk about in our pencil tanks. Not only does it have the materials, the sizing, and the precise location, all has to be controlled because that's all part of the -- of our tech spec or all part of our criticality analysis. It says yeah, those are going to be 36 inches on center. That has to be measured and controlled to the specified tolerance and confirm that. So yes, the craftsmen doing that have to do that. If we have integrity, the vessel itself, the wells, all of those are going to end up being part of the quality assurance program and identified at the appropriate level. And in most cases, you'll find while we may not have a lot of IROFS, they repeat. Every vessel we have that's critically safe is an IROFS. Right? We only have it here once, but it turns out multiplying to 50 locations or 40 locations.

MEMBER SKILLMAN: So let's just stick with the Zone 1, your isolation dampers, ducting. Clearly if you have ducting, you have devices that hold the ducting into the structure of the building.

MR. DUNFORD: Yes.

MEMBER SKILLMAN: Should we then also assume that the ducting itself and the supports and restraints for the retainers for the ducting have that same quality level?

MR. DUNFORD: Yes, they have to be C1 because we take credit for those to function in seismic Category 1 because we take credit for those to not only be there, but to perform their safety function.

MEMBER SKILLMAN: Thank you.

MEMBER KIRCHNER: Gary, I know we were shown I think last month a picture where the confinement and the shielding to the first order converged. Without backing you into a containment argument, basically your design approach here is to put all these IROFS within the -- take advantage of the shielding to put as many of these systems within that concrete boundary to protect against things like the missile loads, seismic, and etcetera? To me, it's going to evolve.

MR. DUNFORD: That happens.

MEMBER KIRCHNER: With the exception maybe of the stack and a few other things.

MR. DUNFORD: That effectively happens because of the hazard of the radioactivity itself requires that it has to be shielded. In our case, we've used concrete in most cases as opposed to some other form. That's a true statement It ends up -- other than what you might end up with from a radiological, have as contamination on your filters by far -- or what's very, very small microcuries just sitting out with our Class A waste, everything else, that 99.999 percent of our inventory, yes, it's inside of one of three locations, the big hot cell, the small hot cell, or the waste management hot cell.

MEMBER KIRCHNER: Okay, thank you.

MR. DUNFORD: Am I on the right page here? So where we've ended up here is the Zone 1 system, we have not accredited the Zone 2 system or the Zone 3 and 4 system. Again, going back, not that I think we'll get there, but if we had had an accident where we said we needed the operating gallery, we needed a different set of controls we could potentially end up with the Zone 2 system getting elevated. Right now, it's a defense-in-depth area. It's not an IROFS area. But that would be an example of existing, hardware existing systems as we do further analysis, that we feel we need to pedigree to a different level.

MEMBER STETKAR: Gary, I have some question. I'm trying to think about the flow of this afternoon. I have a few questions about some of your safety systems and I suspect that they're treading on proprietary information because the whole PSAR is marked proprietary.

Are we going to have time later in a closed session to address those?

MR. DUNFORD: Yes, that's the idea.

MEMBER STETKAR: Okay, I'll hold -- I'm trained in CPR or the Heimlich maneuver, I can do it.

(Laughter.)

We will have time, good. Okay, I'll wait then.

MR. DUNFORD: So in that, that means other things like backflow preventers. So what we have is we have a master equipment list and every item that we've identified so far goes in the master equipment list and it's identified whether it's going to be an IROFS and what function or safety function it's performing in that case. Sometimes it's nothing but the pipe wall itself. You don't care what color it's painted. Sometimes you care what color it's painted, right? You all know that better than I do.

So I'm just going to kind of continue here so that we can get to answer those questions. And I really want to kind of get to where we end up at the back. But so uncontrolled releases into a confinement enclosure with offsite consequences is what we looked at, particularly the spray leak. And I apologize, there's also worker safety controls and limits in that, too. So bubble-tight dampers as an IROFS on the inlet ventilation is one of the ways that we keep that material from coming back into where the workers are.

And those dampers would be such that when they were not under power or not under air, depending on which kind they were, that they would go to their closed position or the open position in the exhaust system right now. So the inlets would be closed. So that's where we'd end up. So that then generates some requirements for some codes and standards for our ventilation system. The AG1 ASME standards, they have some requirements on leak rates and some different things like that. So that's where we are, the other side of the confinement.

And we talked about, I think, in a different aspect, talking about flooding and fire floods this morning or earlier this afternoon is the berming. We have a criticality issue, criticality concern, so you don't want to have a leak and then have that end up in something that's more than six inches in diameter and six inches tall. So there is requirements on all our skids, the floors, damming, sump areas. We're not planning on using any kinds of poisons in the sump, so it's all geometrically-based activity. So there's a set of controls on the berm. And from more of a passive side or another passive berm is because the waste management side doesn't have the criticality issues, and has larger tanks, so it's in its own berm. So if there is a leak there, it doesn't get to the rest of the system also.

MEMBER SKILLMAN: I was reviewing this and I read about the -- I guess I'm -- proprietary information. I'll wait for the next session.

MR. DUNFORD: All right. I'm going to just skip this slide and try to get to slide 60, talks about sealing of the floor, diking again.

We actually have a -- and we have to just make sure we're okay with the Moly purification areas, is a clean room and has a slightly different ventilation requirement. We have to marry that into the system, so we have to not only meet the normal air cleaning standards, that has a different FDA requirement. So there's a small nuance as it relates to the zone. It's part of the Zone 1 system, so there's a small nuance in that area, too.

Doors and entry ways have to be sealed against leaks, so pipe penetrations and ducting has to be located so that you -- again, you don't want anything coming back out of those areas.

So this is the credited confinement

components here on Slide 61. So it's the Zone 1 inlet filters. So in case there's any reversals, that's there. There's the Zone 1 ducting. That's there.

MEMBER SKILLMAN: Gary, what's the basis of 99.9 versus 99.999? Is 99.9 a flip answer or is that a number that becomes the basis for analysis?

Ivory soap was 99.9 percent pure, remember?

MR. DUNFORD: I do remember that one. I can't answer that question. I know there are other parameters where efficiency was based on the needs of the accident analysis. I think this is based on some standard value selected.

MEMBER POWERS: The standard qualification for something to be called a HEPA filter, the minimum.

MR. REESE: Yeah, but that's more nines than this. I think that's your point, correct? What's the right number of nines? What's the correct number? That's the question.

MEMBER POWERS: A standard HEPA would say 99.99. You've taking 99.95 because it degrades over time.

MR. REESE: I think we need to get back to them on that because I'm not sure if we use this number in the analysis.

MEMBER SKILLMAN: If that's what you did to be conservative -- if Dr. Powers said that's great, if you just picked a high result --

(Laughter.)

MEMBER POWERS: That's a very typical number to use in analyzing a HEPA filter.

MEMBER SKILLMAN: That's what we used on the Savannah.

MEMBER POWERS: And you would go ahead and do a test and you can -- they can be much better than that.

MEMBER SKILLMAN: That's correct.

MEMBER POWERS: The problem is your sampling time for finding it better is longer than the technician's lifetime and so they don't do it and they quote it out to a number that's feasible to do the testing. And there will be a particle size associated with that, typically .2 microns.

MR. DUNFORD: Okay, and the next bullet is the Zone 1 ducting, conveying of exhaust air into the HEPA filtration system. So this has bubble-tight dampers, the ductwork, the ductwork support structure to respond to someone else's question earlier. And again, those would have to be seismic qualified. So we have accredited the HEPA filter and now here we are at the 99.95.

And I believe in our accident analysis that's because we did use 99.95 in our accident analysis for going out to stack.

MEMBER POWERS: That would be very, very typical to do.

MR. DUNFORD: Yes. The HEGA filter is the one where I know we only used initially a 90 percent efficiency to get within the release guidelines as mitigated. It dropped it below the 10 CFR 70.61 requirements.

So we talked about the stack. We have accredited the stack. And then we have stack monitoring and interlocks. And this is an area where we have said okay, if the stack monitor alarm goes off, we are going to change to the spare train and then continue to monitor and trouble shoot as opposed to sometimes folks do that manually. Once they do some confirmation, we are working off of a monitor system, not off of sampling aspects of that.

And then the secondary, the offgas system, we had a primary -- so this is the process offgas system. We already had a primary bed for treating iodine. And this is actually a secondary bed that we have accredited as a safety device. The primary bed in this particular location is not some other primary beds where there is a lot more iodine or accredited as an IROFS level safety.

Okay, so there's now going to be ten of these slides or roughly.

MS. HAASS: Well, I want to interrupt real quick. I know that there is a little time issue, so we want to get to the NRC and then ask -- deal with any proprietary questions. There's about 17 pages here. And all of them are kind of -- they all have the same layout and so maybe we can go over some of the high-level ones, but you know, we have identified a lot of different IROFS here and we're just trying to describe them for you.

So I don't know if we need to step through every single one and all four aspects on each slide. I mean it's up to you guys what you want to do.

We can start with the first one which is a big one, the primary offgas release system and we can go from there.

MEMBER BLEY: I don't know about everybody else, but I'd suggest we walk through them for a while and then we decide. You've got them in priority order, I hope?

MEMBER BROWN: No, they're in numerical

order it looked like.

MS. HAASS: Yes, they're in numerical order based on like our --

MEMBER BROWN: Based on category.

CHAIR CHU: Can you go through at a high level of them, highlight a few points as you go through them?

MS. HAASS: Okay.

CHAIR CHU: Does that work?

MR. DUNFORD: Okay, so the first one is the dissolver offgas event and what we have sized is an offgas relief system that has the capability to hold the complete gas volume of the dissolution. If we would have an event loss of power or loss of vacuum at the start of a dissolution. So that's what the system is.

The IROFS things are the actual relief valves, the pressure relief tank itself, and what its function is is to capture the gas, right, so it doesn't get out and it will stay in that container and then we'll have to eventually evacuate it when the rest of the system is operational.

I'll try to go quickly and you'll need to slow me down.

MEMBER POWERS: If you get an over

pressurization of that in your dissolver, say, you just get a lot of gas coming off all at once. It relieves that gas.

MR. DUNFORD: Yes.

MEMBER POWERS: And vents it into a tank.

MR. DUNFORD: Yes.

MEMBER POWERS: And it carries along droplets of the fluid when it does that.

MR. DUNFORD: Droplets of what, I couldn't hear that.

MEMBER POWERS: Fluid.

MR. DUNFORD: Oh. So the location of this is after the caustic scrubber that we talked about and the NOx system. And I don't remember if it's before the first item or in between them, but it is right about that location. So it would capture all what's ever coming there.

Now if it was a pressure event in the dissolver itself, yeah, you might get some flooding, but you won't do two columns. I think what you're going to get out is what's ever might be carried over in the final NOx column which is not going to have a lot of radioactivity other than the gaseous components anyway.

So I understand what you're saying, but

the event is more likely that says I'm going to have to lost my vacuum for some other reason, loss of power, lost my motive forces. I have a filter that fails or starts plugging and I don't get the flow I want. When I have a normal flow, right, because it's more along those lines, I think.

Looking at a flooded -- a dissolver that has that much material coming off fast, I guess it can happen, but it's nothing that we --

MEMBER POWERS: I'm not sure that I'm worried about a catastrophic foam-up event.

MR. DUNFORD: Okay, but enough to change the pressure on the header.

MEMBER POWERS: But I mean if you are getting any kind of bubbling at all, you're going to carry droplets of liquid.

MR. DUNFORD: Yes.

MEMBER POWERS: And so the question is what does that liquid do? If it goes into your caustic bath, presumably it gets neutralized or captured there. Now if it goes anyplace else, it's an acidic medium.

MR. DUNFORD: Yes. Right. So the tank knows it has to handle NOx vapor anyway. So it's material constructions would also be an IROFS concern or feature because if it dissolves through, it obviously can't do its function. So I'm not quite sure where you're going. There could be a couple of -- in a lot of the accidents, there's multiple initiating events, the operator misvalved something, loss of power. Now and then you might have a wrong chemical and get chemical reaction.

So from a number of the accidents, there are multiple machining events. And if the answer is that we're trying to prevent it, that means you've got to go find what cuts the thread on all those initiating events and if it's you're trying to mitigate what this one does, then you end up with this is how I'm going to mitigate, so there's no release.

The active radiation monitoring isolation of a low dose waste, so most of our material that leaves the geometrically-favorable system, it's sampled back and then sampled before it's transferred over. But we have some condensate systems, two of them to be exact, that we have identified that we were going to monitor the condensate and use that as the basis for control for the low-dose material, for two of the low-dose concentrators.

We identified that. We came into the accident space of the ISA and the QRA and the analyst said no, you cannot -- you won't get enough prevention because now this is criticality event and we have to prevent criticality events, not mitigate them. So we ended up adding effectively a double system and a series of staging tanks to allow settling to allow that to happen. So that was one of the cases where we actually did add another secondary system and it happens to be the system where we have these kind of the two loading and it's really just either one creates an issue, you're going to dump the system.

Cask ventilation closure. So this is more of a worker safety issue. When we are bringing a cast in we have to sample that to make sure that before we open it up with the workers because the workers have to unseal it manually, that there has been no breach inside of the cask that would create a worker, a local worker safety issue. So that's what this control is.

Later on, there's as part of this docking, there's also a seismic qualification requirement for the system there, too, so the it doesn't tip over, once we take the shielding plug -- loosen the cap so that the internal small crane and hoist can remove the shielding plug and take the targets into the cell. And this is a control just to make sure that before we take the shielding plug off that the cask is appropriated mated.

Emergency purge gas system, hydrogen generation is the concern. Normally, we just use our facility air compressors to control that. We don't really have -- what we have identified is 12 tanks, 12 locations that have the bulk of the potential for radiolysis and those locations that do are identified and there's a rationale and then the system is sized for those systems. And I can't remember. I think it's a 24-hour length that the nitrogen purge would run before you'd have to go fill up the bottle there.

MEMBER SKILLMAN: Is the air purge process commonly used in handling this type of material?

MR. DUNFORD: For fission products coming off tanks, yes, at least I'm very familiar with it.

MEMBER SKILLMAN: Okay. I know one or two instances at TMI we were doing this and we got a flash. We got flames. I mean we learned the hard way. Be careful about how much gas you let out of a closed container and be very alert of where you're doing it. These were demineralizers or vessels that had remnant of the TMI-2 accident water in them and had either chabazite or had styrene beads. So we were getting hydrogen plus methane, ethane, propane, and butane.

MR. DUNFORD: In a closed container.

MEMBER SKILLMAN: When we opened it, and

then bam, there it was, and we learned there's got to be a better way to do this before we hurt somebody. So this is all piped and this is purging through closed piping to a destination that is also closed, so that the hydrogen concentration is highly controlled in that flow stream.

MR. DUNFORD: Yes, in most of the cases, it's CFH, cubic feet per hour.

MEMBER SKILLMAN: So it's a migration, not really a flow.

MR. DUNFORD: Well, that's all you need to stay below 25 percent of the LFL for base line generation. The first 10 or 12 tanks in the system, it's more than that and you're starting to be now a CFM. And they're vented. They're all vented. They're not closed systems, once you get it into the facility. Start it from the dissolver to all of the moly tanks and all of the uranium tanks. All those tanks are vented to the process vent system so they're not enclosed vessels for the kind of build up to happen. So while w\e just really set it on loss of power accident, we're going to lose the compressors, we still want to have a small air flow through that which then goes through the process vent system into the Zone 1 and out the stack in theory.

MEMBER SKILLMAN: Thank you.

MR. DUNFORD: This is the passive feature for the seismic event. It's not real complicated. The exhaust stack height, it's a fixed. We've used that in our analysis so we have to protect that as a control point. Double- wall piping, we have both from -- so this is criticality in this particular one, so we have between the target fabrication and the uranium hot cell, it goes through non-geometric, but favorable hallway effectively. So that would have to be double piped to go into a geometrically favorable location inside of target fabrication.

MEMBER SKILLMAN: This listing fixture, this IROFS SF04. This is the check before they vent it.

MR. DUNFORD: Yes. That's exactly right.

MEMBER SKILLMAN: Okay.

MR. DUNFORD: Okay, so one of the family of accidents was the auxiliary systems and backflows in the auxiliary systems, so there's a series of PECs and AECs dealing with that, that effectively are every input that's coming from a non-geometrically favorable system. It has to have either a backflow prevention or a day tank if it's like a chemical addition, something that will break any kind of backflow, and siphons back to a non-geometric favorable location. So that's CS 18 and 19. Effectively, it says you either have this or this is kind of what it tells you.

And there it is again with more functional requirements next to it which I've been ignoring, but I can pick up if somebody wants.

Now these didn't necessarily come out of accident analysis space, but they came out of controlled discussions and good judgment, so the primary iodine removal unit, this actually fails in an accident. But it's accredited at the IROFS level in terms of safety feature, I guess I should say. And there's three of those units. In our functional requirement, we're trying to comply with the 10 CFR 20 requirements.

Similarly here with the noble gas absorbers. Again, if we did not have those, we would not necessarily exceed a 10 CFR 70.61 requirement, but we would not meet a 10 CFR 20 normal release requirement.

Similarly, here this actually, it's just part of the dissolver offgas system. It provides our motive force. And again, if this isn't working that means part of the other system doesn't work including this is also where we would draw down the vacuum pressure relief tank. So we've identified this as an engineering safety feature.

Other things, effluent monitoring systems, stack monitoring the first one. I'm trying to see if there's anything else in here that's -- yes, let me just go on. That was a good one to kind of pass through quickly because it's Mike's turn. And Chris is in the room.

MR. CORUM: Before I get started on criticality, I'd just like to say a word about integrated safety. A lot of facilities and a lot of folks that I have worked with in the past, integrated safety, crit. safety, chem. safety, radiological safety, fire safety, industrial safety working together. And in those places with that perspective, if you've got a design project, you do -- design works in a vacuum and safety works in a vacuum. Design throws it over the wall and says okay, make it work. And that's usually what happens in those facilities.

With this particular project, from Day 1, I can say that even if the conceptual design phase integrated safety was built into the design and in most cases it drove the design, particularly for process equipment. It defined what the process equipment design was and the spacing of that equipment and the entire layout including the walls of the enclosure itself.

So when we first got started, we didn't really have a lot of information to build a safety analysis on. But we did use first principles and guides as the equipment design basis and for process area layout. And as that design went from conceptual to preliminary, then we got into the space where we're actually doing more of a design function in safety and building those things into the design.

So you'll see a lot of things that we've tried to do is passive design features. We really have taken the hierarchy of controls into account where passive engineer controls are, are the gold standard, followed by active engineer controls, followed by administrative controls with some kind of computer or alarm assist, and then finally administrative controls.

For a facility like this where you do have a lot of manual manipulation, you cannot get away from administrative controls. So in that case, you've got to rely on your operators and your training programs and your management measures and your oversight. So we're not going to say that this is a completely passive or active engineered design facility because it's just impossible to do that. What we can say is that we've got adequate protections in place to ensure safety to the workers and to the public.

So we've used a lot of geometry constraints and passive engineer features to limit the size of the vessels, the piping, the spacing between the vessels, to make sure that they remain in a critically safe configuration.

MEMBER BLEY: Michael, you're about to move into criticality.

MR. CORUM: Yes.

MEMBER BLEY: And I had a few questions that really belong to Gary and then one that belongs to you, I think.

MR. CORUM: Sure.

MEMBER BLEY: From one of our members who isn't here and I just wanted to offer up their questions and get them on the record.

The first one has to do with bubble tight. And is there some criteria on what bubble tight means, some associated leak rate or is that just --

MR. DUNFORD: There is.

MEMBER BLEY: What is it?

MR. DUNFORD: Yes, I don't know. I don't know which ASME or air cleaning guide. I don't know the answer so I was trying to be quiet. I'm not sure which ASME standard or the air clean guide define that, but it is a defined requirement for an enclosure or for a damper that has to have a leak rate qualified and obviously with a pressure.

MEMBER BLEY: Okay, so wherever that came from you use the same criteria for all the bubble-tight dampers?

MR. DUNFORD: Yes. Right now we have not --

MEMBER BLEY: Is that specified in the PSAR somewhere? I don't recall seeing it. But I haven't memorized everything that's in there.

MR. DUNFORD: I probably blew right through it in the confinement discussion because I thought it was there in the Chapter 6 confinement discussion.

MEMBER BLEY: Okay.

MR. DUNFORD: Bubble tight, here we go, Slide 61. So it's ASME AG-1 Section DA-5141, says our bubble-tight dampers will comply with that code or that requirement. Don't ask me what that is.

MEMBER BLEY: Okay. But you haven't bought them yet, so you're going to buy them such that they meet that criteria.

MR. DUNFORD: That's correct.

MEMBER BLEY: There was a follow on to that and I don't remember reading this, so I can't identify exactly where this comes up in the document. I'm curious why NWMI believes that penetrations or other aspects of a facility are leakier than the louvers. Does that ring a bell for you? There must be a statement somewhere like that that led to this comment and I didn't see it.

MR. DUNFORD: Well, we have identified that we need to seal penetrations.

MEMBER BLEY: Sure.

MR. DUNFORD: And the louvers are planned to be our design inlets and our design outlets, so calling those leakages is probably not the right set of words that I would use. That's where the design flows and where our design control to those cells would be adjusted.

MEMBER BLEY: So I can't clarify the question, but apparently someone got the impression that there are other penetrations or valves or something that are described as leakier than the louvers. But if that doesn't make any sense to you, we'll leave it until later, because I can't and that's fine. And our detail man hadn't spotted that either.

The next one is -- it wasn't -- someone couldn't find the concentration of hydrogen that you consider acceptable.

MR. DUNFORD: Our LFL we're controlling to is 25 percent of the NRC's action level or 5 percent. So we're at 1.25.

MEMBER BLEY: Okay.

MR. DUNFORD: And we have that -- it's in there in multiple locations.

MEMBER BLEY: Okay. I thought so.

MR. DUNFORD: Chapter 3.

MEMBER BLEY: Somebody didn't think it was there.

MR. DUNFORD: That's okay.

MEMBER BLEY: And the next one I think Carolyn already addressed this to some extent, but maybe you can answer it. Why do you believe that the selected value for USL is appropriate and I think you said you're still working on that.

MS. HAASS: I'm not sure which USL they were referring to.

MEMBER BLEY: I'm not either.

MR. CORUM: Yes, we'll cover that when we get to the MCNP validation. I'll touch on that.

MEMBER BLEY: You'll touch on that.

MR. CORUM: Yes.

MEMBER BLEY: Is that something you're

still working on?

MR. CORUM: No, we've completed it.

MEMBER BLEY: If I can simplify this -- well, let me just read it because I can't simplify it. This is a facility where we don't ever want to see anything go critical. It appears that it's believed that the calculations are so accurate that the uncertainty is only 25 percent at the sigma.

MR. CORUM: The administrative margin is .05. Okay, that's a .05 delta k is administrative margin. On top of that, we've got the --

MEMBER BLEY: So you have an uncertainty analysis.

MR. CORUM: We have a method bias and uncertainty analysis that brings the USL down to a .924 now. It used to be a .940, I believe. But now it's a .924.

MEMBER BLEY: Okay.

MEMBER KIRCHNER: Can I piggy back on that question?

MEMBER BLEY: Absolutely because don't want to ask the last one of these.

(Laughter.)

MEMBER KIRCHNER: So did you find in any of your kind of close analysis, Mike, when you're looking at this criticality set of issues, the need for fixed boron or other neutron absorbers or you've stated what -- you have the confidence in the calculations, as well as you've looked at a spectrum of things like a fire main break that just floods your entire hot cell or something and you still don't need any fixed boron or other kind of neutron absorber?

MR. CORUM: That's correct. We've looked at extreme conditions, fully flooded conditions for full hot cell and still remain below the USL. And we try to stay away from the fixed absorbers because of the maintenance measures that you have to maintain throughout the 30-year lifetime. So if you've got those inside of a hot cell, it could be pretty tricky to be changing out 15 years down the road. So we tried to minimize that as much as possible.

MEMBER BLEY: I had a follow on for myself from something Gary talked about that really fits in your area. You talked about berms to collect leakage from various places and that these are designed to be geometrically criticality safe. Are all of those cases where there are berms such that all of the fluid that could enter this is contained in the berm or what happens if the berms overflow? Is there a follow on geometrically-safe place?

MR. CORUM: So the berm itself is really not for criticality safety control. It's more for radiological control.

MEMBER BLEY: Okay, I misunderstood because I thought there was a consideration criticality.

MR. CORUM: But there is a criticality consideration because we have the height of the berm can only -- I think it's three inch. Somewhere around two inches is the safe slab. So the berm would have to be two inches. Now if it overflows that berm, we do have the criteria that the floor has to be flat, so --

MEMBER BLEY: So it spreads.

MR. CORUM: So it spreads out throughout the entire facility, so you never reach that two inch slab depth.

MEMBER BLEY: Okay. Thanks.

MR. CORUM: I think I'm on Slide 76. Yes. So the code that we used for the evaluation or for the calculations is widely used throughout the safety community is the MCMP code. With that code, we did six or seven calculations that supported the design in one aspect or another and then we also analyzed -- broke the systems up into 13 separate areas that they sensed from a system standpoint and evaluated those in criticality safety evaluations.

Of course, we started out with our process hazards analysis. Those led to scenarios that we had to consider and from those we built our safety evaluation based on satisfying those scenarios.

And then from the safety evaluations, we get the items relied on for safety which will then become a part of the tech specs in the future.

And primarily, I don't think we say it later, so I'll say it now, in any criticality safety evaluation, you use the double contingency principle. so you have to have at least two unlikely independent events or process subsets that occur before criticality can be feasible. And so if one of those process upsets happens to be unlikely just from a frequency standpoint, you don't really have to have controls on that. It's when the process upset is highly unlikely or greater than unlikely that you then need to establish controls. Most of the time with double contingency, we usually have two controls to make each leg a double contingency unlikely and then the combination of those would be highly unlikely.

MEMBER BLEY: I haven't had a chance to read the criticality analysis or the ISA, but I wonder if you've looked for places where although you need two mechanical failures to get into trouble, a single human with the wrong idea could wipe out your double contingency. Were those examined?

MR. CORUM: Yes, we do an evaluation of common mode failure on every scenario --

MEMBER BLEY: So people live in the common mode failure then?

MR. CORUM: Yes. People usually -- administrative controls usually fall in that common model failure. You'll have some with active engineer controls, you'll have common mode failure as well, but primarily the majority of common mode failures that we run into deal with humans and human interaction.

MEMBER BLEY: And if you find a case where a single wrong-headed or wrong-administrative procedure for the weird situation you're in causes trouble, is that -- do you somehow force another double contingency on the people as well as on the --

MR. CORUM: If you cannot engineer it and it absolutely has to be an administrative control, then you usually have two independent -- say an operator and a supervisor that have to independently perform the activity.

MEMBER BLEY: When we look through the ISA and the criticality analyses, we'll see those?

MR. CORUM: You'll see those, yes. And I can't recall how many of those there are. We try to minimize those as much as possible.

MEMBER BLEY: But you did find some. Okay.

MR. CORUM: But there are some situations where you can't avoid it.

MEMBER BLEY: Thank you.

MEMBER KIRCHNER: So Mike, in the set of calculations that you've conducted, which of these scenarios got you closest to your upper subcritical limits? And did you redesign as a result of having done the calculations anywhere along the line? I mean you're at a stage where you can actually still, without great expense, relay out piping configurations, etcetera, or operations.

MR. CORUM: Where we have the most concern is when we're going from a safe geometry to an unsafe geometry. So we definitely pay a lot of attention there. Ventilation is another area that we've paid particular attention to. So we try to put passive engineer controls in place. For the ventilation, we do have passive design features built into the system so that we don't get liquid backflowing up into the ventilation system.

MEMBER KIRCHNER: Member Powers mentioned earlier the offgas system, if that relief valve goes, it could carry over liquid into that tank. So is that receiver tank designed from a criticality standpoint?

MR. CORUM: That receiver tank would either be critically safe or we would have an overflow on that tank that would release to a favorable geometry or to the floor if it's flat.

MEMBER KIRCHNER: Since you brought that up, is the system designed to clean up after that happens? Relief valves are known to go even when they're not demanded.

MR. CORUM: Right, so this relief is the other way.

MEMBER KIRCHNER: And if the thing is the dissolvers is going at a high rate, etcetera, you could find a lot more liquid in that tank than you wished.

MR. DUNFORD: So the location we're talking about here is actually the opposite. It's a negative relief. So it's the lowest pressure in the system, so when you have a high pressure in the pipeline, so it won't go where you want it to go, it sucks everything into this tank. So it's not like it's a pressure relief. It's really a vacuum -- well, you can say -- it is a pressure relief, I guess. Depends on which way you want to look at it.

MEMBER KIRCHNER: But it could potentially collect liquid.

MR. DUNFORD: Well, so we have evaluated the system and the first four unit operations after the dissolver are all geometrically favorable. So with downdraft condensers, geometrically favorable, and it drains back liquid that goes in it, would drain back the tanks. So all you really end up with, the entrainment aspect, what's going to be entrained. And then you go to the caustic scrubber and it has the same thought process that it's liquid and that drains into -- it's a geometric favorable column and it's drained for liquid as to a geometrically favorable tank.

And then there's two other columns that are used for NOx absorption or conversion absorption before you get to what we've looked at and evaluated and said okay, from here on in, you do not have to be geometrically favorable. So that's where we are right now in our design. So once you get to the iodine removal unit and the absorbers and those tanks, they are not geometrically favorable in the systems.

Now going back to what you asked on the process vent system, that actually probably came out of the criticality analysis as well. You can have an overflow into the process vent system, but I said well, it's geometrically favorable. I mean it's relatively less than a six-inch pipe. Well, it is, but you don't have that as a control. Oh yeah, it is now. So it's a design requirement on the sizing of that system and it has to have drains.

And then after that, the system doesn't have to be geometrically favorable. So the guides helped us to find some points we maybe haven't documented exactly where the end point of the geometrically favorable boundaries were.

MEMBER KIRCHNER: Thank you.

MR. CORUM: I'm on Slide 77 now. So I'll just talk a little bit about the MCNP validation. We used MCNP 6.1, the Continuous Energy ENDF/B-VII.1 Cross-Sections. So first of all, when we're looking at the validation, we look at the operation in the process in the facility to identify a range of parameters that we want to be validated. Actually, with the RAIs we chose 96 criticality safety experiments that matched the uranium enrichment, geometry, moderator, reflector, and neutron energy conditions. And from the validation we defined the area of applicability for that validation so that any time you do an analysis or a calculation, the analyst has to go back to that area of applicability and make sure that everything that he's calculating is within that area of applicability or it needs to consider additional margin to what we already have in the validation. And our new USL turned out to be a .924 and that is with an MOS of .05 delta k.

This slide just shows the nine degrees of freedom that you work with when you're a safety engineer and I think we've already talked about some of the bullet points up at the top, so we can go to the next slide.

So this is getting into the actual IROFS that we have for criticality safety. This first one, you're going to see a lot of passive design features here, as well as some of the features that we couldn't design passively and we're protecting against movement from a safe geometry vessel into a non-safe geometry vessel from a criticality standpoint.

So this one deals strictly with interaction control spacing. So we have looked at all of the interactions that could occur within hot cells, as well as other areas of the plant where we have SNM. And we have defined spacing requirements for the location of that equipment that contains that SNM. So that's what this IROFS is about.

The next one shows the IROFS for the passive design features for the pencil tanks, the vessels, the piping, all the safe geometry diameters of tanks, vessels, and piping.

MEMBER POWERS: Can we go back to your solid uranium handling?

MR. CORUM: Yes.

MEMBER POWERS: The biggest hazard when you flag out, receive fresh uranium, your hazard there seems to me fire. And how is that controlled?

MR. CORUM: We will control it with combustible loading. We will also have fire suppression systems, this is the target fabrication area, right?

MR. DUNFORD: Yes, this is the receipt of the uranium --

MR. CORUM: Receipt, yes. Metal is pyrophoric, yeah. So we will have suppression in that area, fire suppression in that area.

MEMBER POWERS: How do you suppress it? What do you suppress it with?

MR. CORUM: That's for my fire guys to figure out.

MR. DUNFORD: A can? A lid?

MR. CORUM: Really.

MR. DUNFORD: I don't know. That's typically what you do if you have a metal fire in our industry is you put a lid over it until it self-reacts effectively. It self-limits itself if you can eliminate the oxygen supply.

In our case though, what we would be working with nominally, fairly small qualities, and fairly --

MEMBER POWERS: What is the size, the quantity that you're going to get?

MR. DUNFORD: There's a spec that particles are supposed to be no smaller than quarter-inch broken metal and they kind of range, I think it's from roughly that quarter inch to one to two inches in size. Pardon me?

MEMBER POWERS: They're not fine right?

MR. DUNFORD: So that's where we would be. We would bring those into what we would either -- what I think will end up being an inerted hood to do the cleaning on them and then from there, we'll either put them back in the slip lid can, but hopefully we will only clean them just before we're going to use them and dissolve them.

MEMBER POWERS: The problems I've had with uranium has always been with turnings.

MR. DUNFORD: Yes.

MEMBER POWERS: And the problem you run into is that hot uranium metal and goes into an intermetallic reaction with the metal container and that intermetallic reaction is exothermic and so you can put holes in stainless steel hoods really easy with the material. It will look like a little cookie cutter. It's kind of long and stamped holes in your stainless steel hood.

Suppressing it, the only suppressant that I know of is graphite powder. Anything else, CO2, halon, definitely not water, reacts just as well as the air does. So it's a challenge.

MR. CORUM: Let's see. I think I'm on Slide 81.

So these are --

MEMBER KIRCHNER: I know we're not reviewing that part of the application now, but is it typical for the DOE to send it to you in metal form, rather than in oxide?

MS. HAASS: No. We have a choice. We can get as uranium metal in an oil bath or we could go do it as a uranium oxide, but I'll tell you they are going charge an arm and a leg to get it to the oxide form. It's cheaper for us to put it into the oxide form than --

MEMBER KIRCHNER: And they convert it to oxide.

MS. HAASS: Correct. And by the way, if you have to go to an oxide form, they have to send it out of Y-12 and it goes somewhere else and then it goes back to Y-12 and then it comes to us. It's a logistical nightmare actually to do that.

MEMBER KIRCHNER: It's just a nicer way to handle uranium.

MS. HAASS: But I think we all agree with that, but yes, we agree.

MEMBER POWERS: Well, I mean the uranium metal is -- it's not like -- I mean they've specified basically chunks. They're trying to avoid the turning problems that I've had. And it typically comes to you well coated which is messy, but not impractical by any means at all.

MS. HAASS: Right, and if you remember what Gary said --

MEMBER POWERS: It's not the worst well that I've ever dealt with.

MS. HAASS: Right. We don't -- we plan on leaving it in the form we get it from Y-12 until we need it. We don't really want to go put it into a state that we could potentially be protected from it.

MEMBER POWERS: You're going to take it, you're going to clean it, and dump it into an acid bath about as quickly as you can.

MS. HAASS: It's quick.

MEMBER POWERS: And you're not going to clean it very much. Because you don't need to.

MS. HAASS: Right.

MEMBER POWERS: Your acid bath is going to cure a host of sins.

MS. HAASS: We'll just go real quick.

MR. CORUM: So on page 81, we've got a selection of passive design features that we've put into the design. And then on page 82, I'm trying to find one that might be kind of interesting.

MR. DUNFORD: That one is --

MR. CORUM: I wanted to get the active one though. There's one down the pike that's an active one.

On page 83, CS-14, we do have an active engineer control. And this is for discharges from safe-geometry systems to a non-favorable geometry system. And it's an active uranium detection system that will be used to close an isolation valve in the discharge line at a uranium concentration that exceeds the limit, concentration limit or the cumulative mass limit.

I don't think we fully developed that active engineer control. We do have some specifications out there for you.

MR. DUNFORD: On the next one right below is actually where the analyst said one wasn't good enough, so we had to a second one independent.

MR. CORUM: Correct.

MEMBER KIRCHNER: What's your uranium detection system based on? It's hard to measure uranium on the floor. Don't want to go there really and then have an active system that you have to quantify.

MR. CORUM: So on Slide 84, these are the two administrative controls where we just can't avoid having administrative controls. So this is one where we've got dual sampling and analysis with independent sampling, independent laboratory analysis and then an operator and supervisor over check before we send the fluid -- or send the solution to waste management.

Let's see, anything else? On Slide 85, these are -- well, we've got the evaporator concentrator condensate monitoring. That's an active engineer control. And then the others are passive engineer controls.

And now on page 86, that is our likelihood category and risk matrix that we have to meet, to meet the performance criteria in 7061. As a definition criticality is the high consequence of that, so it has to be treated as highly unlikely.

MEMBER KIRCHNER: May I ask a question about that? Conveniently your analyses, albeit it at a pretty high level come out like they did. Is there anything in between these results? There are no fives. What I'm getting at is there's something on the cusp of what you identify in red as unacceptable risk and something -- is there gray area in this chart?

MR. CORUM: There isn't in this chart.

MEMBER KIRCHNER: Yes, I know there's isn't. But is there a gray area in your own mind?

(Laughter.)

MR. CORUM: In my own mind --

MEMBER KIRCHNER: About how things so neatly fell out whereas sometimes you know it's like in interconnected systems, LOCAs, and so on that kind of creep along the edge of -- you know you don't want criticality, yes.

MR. CORUM: Right. In criticality safety space, we're not allowed to do PRA, so yes,

MEMBER KIRCHNER: God doesn't throw dice, right?

MR. CORUM: Exactly. Even though the Monte Carlo analysis that we do, that's all we're doing.

(Laughter.)

MEMBER KIRCHNER: Yes, that's why you're doing it repeatedly.

Maybe I should rephrase my question. So did you find any reason to go and just look a little bit to the left of the red line or a little bit below the red line to say well, did we miss something here? Or is it indeed such a nice, crisp result when you do this first order risk matrix?

MR. CORUM: You can probably answer that one because that's ISA space.

MR. DUNFORD: So the simple answer is we get to do it all again anyway. We'll go up through our hazard analysis which is where this kind of comes out of. And I know when we did this initial one, we had a number of events we classified as high consequence events. When we actually did the analysis they weren't high consequences.

So pretty much during the analysis, people failed in the conservative direction. I don't know what this is going to be, therefore we're moving it out. I don't know if it's going to be medium high.

It got evaluated as a high. Same thing with frequency. That doesn't mean when we get through there and we see a final design we're going to say wait a minute, this widget now, is that the boundary, and therefore we're going to elevate to an IROFS level because we need to do that, we need a second pressure device. We need something else.

But for right now, I would tell you that in most cases, in fact, I can't even think of a case the other way right now. We went to a much more conservative posture during the hazard analysis that then generated a family of accidents and then binned those to the 75 that we evaluated. Right now, it's still qualitative.

The other thing we haven't talked about in Chapter 6 is we didn't go over any of the family of criticality safety controls either. So these are the IROFS level. There's a whole other family of tables that are this lip can't be more than two inches. There's a whole bunch of other based on the double contingency controls that we haven't talked through today, but they are in Chapter 6.

MS. HAASS: Those are Chapter 6 slides.

CHAIR CHU: Any other questions before the staff comes up? Okay.

MEMBER POWERS: So this is the one that we ask all the questions to?

MR. BALAZIK: John Atchison, this is Mike Balazik on the bridge line.

MR. ATCHISON: Hi, Mike. This is John. I feel like I'm last, but not least.

MR. BALAZIK: That is a true statement. So this is the staff's presentation on Chapter 6. Just a quick couple additional introductions. Dr. Chris Tripp, who did the criticality review. And we also have on the line is John Atchison from ISL who looked at the ESFs. So I'll turn it over to John and John will start talking about the engineering safety features.

All right, John, go ahead.

MR. ATCHISON: Thank you, Mike. I'm going to briefly just go to Slide 3, regulatory basis and acceptance criteria. We've seen this several times today. There's nothing new here.

On Slide 4, acceptance criteria is NUREG-1537, Part 2 and Interim Staff Guidance, Part 2, also nothing new here.

Slide 5, I want to talk about engineered safety features just a little bit. The principal purpose of engineered safety features is to mitigate consequences of accidents and to minimize radiological exposures to the public, staff, and the environment within acceptable limits.

Northwest Medical Isotopes has proposed ESFs described in their PSAR which started with confinement and nuclear criticality safety as they just presented. And on top of that, we have a slew or an assembly of ESFs that have fallen out of the accident analysis in Chapter 13.

So the confinement system and nuclear criticality safety was initiated as part of design and the rest of the ESFs were derived from the accident analysis.

I want to note that Chapter 13 accident analysis in the PSAR has not identified the need for a containment system or emergency cooling system.

On Slide 6, the staff performed an evaluation of the technical information presented in Chapter 6 of the PSAR and as we've heard most of the presentations today, the information in Chapter 6 is a very high-level overview of emergency safety features design and functional requirements. Most of the details have been deferred to the construction permit and FSAR.

Staff considered the design criteria,

design bases, and design information provided in the PSAR to provide a reasonable assurance that the final design will conform to the design basis. Again, these are three high-level descriptions provided in the PSAR.

Areas of review for this chapter included a summary description of the ESFs, as well as a description of the confinement systems. Within these review areas, the staff assessed the confinement system and its components and the described functional requirements of confinement.

As an aside, we probably have been doing confinement systems in this country for 50 or 60 years. I'm thinking it's not new or novel. Northwest Medical Isotopes' confinement system follows general principles used in similar facilities around the country and in test reactors on the DOE side.

On Slide 7, PSAR Section 6.1 briefly describes the SSCs that constitute the confinement system and criticality safety ESFs and summarizes postulated accidents that are mitigated by these systems. As described in greater detail in Chapter 13 which will be the subject of the August meeting, specific postulated accident scenarios indicate the need for a confinement system, but not the need for a containment system.

PSAR Section 6.2 credits the hot cell confinement boundaries to confine the fissile and high rad dose solids, liquids, and gases, and to control gas releases to the environment during normal operations.

On Slide 8, PSAR Section 6.2 further describes the confinement ESF structures, systems, and components that will be incorporated into the design.

And in particular, the PSAR Section 6.2.1.4, documents the confinement system components as three principle areas. One is structural components consisting of sealed flooring, diked areas and sumps, catch basins, and sealed entryway doors as well as ceilings, floors, and walls. The ventilation system components are principally in the confinement system are the Zone 1 components. As mentioned in the Northwest Medical Isotopes presentation, the ventilation system also has Zones 2, 3, and 4 which are handled as vacuum or low pressure systems. Only Zone 1 is part of the confinement system.

And the secondary process offgas treatment iodine removal beds is the other ESF.

On Slide 9, the PSAR Section 6.2 provides confinement system ESF overview discussions of the accidents mitigated, system components, the functional requirements, the design basis, and the test requirements for each one of the IROFS that are identified with the confinement system.

I think the Northwest Medical Isotopes presentation on these areas covered about 20 slides just previously.

Information related to the exhaust system, the effluent monitoring system, the radioactive release monitoring system, and the confinement system mitigation effects is not provided in the current PSAR and has been deferred to the operating license application.

On Slide 10, the review of the ESFs incorporated the detailed descriptions of the safety features to mitigate the accidents that were identified in Chapter 13. The confinement ESF consists of the following IROFS: primary offgas relief system, active radiation monitoring and isolation of low-dose waste transfer; cask local ventilation during lid removal and docking preparations, cask docking port enabling sensor, process vessel emergency purge system, irradiated target cask lifting fixture, exhaust stack height, double wall piping, backflow prevention devices, and safe geometry day tanks.

Again all these IROFS were identified as necessary based on Chapter 13 of hazard analysis.

We're also aware that fortunately or unfortunately, I also performed a review of the Chapter 13 section, so I know that it's being substantially rewritten at this point and we may see some changes to the ESFs for a lot of that but I'll let Northwest Medical Isotopes address that one when it comes around.

MEMBER BLEY: Let me stop you there and ask a question. Since you reviewed Chapter 13 and perhaps the ISA and criticality analysis that are reflected there, did you from that point of view draw a conclusion about the completeness of the ESFs at the time you did this review?

MR. ATCHISON: I can only partially answer that. I evaluated the radiological consequences of the accidents analyzed in Chapter 13, but my responsibility was not to review the ISA itself.

MEMBER BLEY: Let me ask Al a question or Mike. Who on the staff review is responsible for gaining confidence that, in fact, those analyses have been reflected properly in the selection of ESFs and monitoring at the INC level as well? When will we hear about that correlation?

MR. BALAZIK: Just so I understand, the link between ISA and essentially the other systems and chapters?

MEMBER BLEY: Essentially, yes. What I'm saying is the only place one gains confidence that the ESFs are a complete set or a good enough set is by having reflected on the quality and content of the ISA and criticality analysis.

MR. BALAZIK: We do have a reviewer from NMSS that's looking at the ISAs, looking at the quality of those. That would inform other chapters, other reviewers on how deep into their review.

MEMBER BLEY: Will we hear about that at the Chapter 13 --

MR. BALAZIK: When we talk about the ISA, yes, sir, you will hear about that.

MEMBER BLEY: Perfect. Thank you. Go ahead, I'm done.

MR. ATCHISON: This is John again. I think I just want to restate that for the record. The real question is have we captured a significantly complete set of IROFS as it falls out of the ISA? That's your question?

MEMBER BLEY: I've lost track of who's who. You're with staff, right?

MR. ATCHISON: Yes. This is John Atchison with ISL.

MEMBER BLEY: With ISL.

MR. ATCHISON: I just want to make sure I captured your question. I believe you're asking --

MEMBER BLEY: I think Michael's got it, but what I'm saying is we want to be confident that the set of ESFs that the basis for the selection of the set of ESFs is sound, that nothing was left out of the ISA that should have been in it, that the IROFS that fell out of it are now covered by what's in the ESFs and likewise, as Michael said, the way these reflect into other systems as well, like INC.

MR. BALAZIK: And Dr. Bley, I think what John is trying to say and John correct me if I'm wrong, but the ISA summary is still kind of preliminary. In other words, we might see changes in that as the design matures.

MEMBER BLEY: What I'm interested in is as of right now --

MR. BALAZIK: Yes, sir.

MEMBER BLEY: How confident are we? And as things change, how confident are we picked the right process?

MR. BALAZIK: Yes, sir. John, this is Mike. I think you can go on with the presentation.

MR. ATCHISON: Thanks, Mike. This is John

Atchison again. I think we're on Slide 11. The staff has evaluated the sufficiency of the preliminary design of the confinement and related systems as described in PSAR Section 6.2.1, by reviewing confinement mitigation requirements, the defined confinement envelope, the structures, detailed descriptions of the ESFs associated with confinement. Additionally, we evaluated the passive and active ESF components under normal and abnormal operational conditions.

On the basis of its review, the staff determined that the summary description provided by Northwest Medical Isotopes demonstrates an adequate design basis for preliminary design.

On Slide 12, the confinement system ESFs' detailed functional requirements, design bases, probable subjects of technical specs, testing requirements, are not provided in the PSAR are currently being developed by Northwest Medical Isotopes in their final design and will be documented in the FSAR.

The staff's review of the ventilation system is described in further detail in SER Section 9.4.1.

I think that goes back to you, Mike, if you want to do questions on that now or wait until later?

MR. BALAZIK: I think we're going to

continue on with the presentation as long as I'm not hearing any questions. So now we're going into the nuclear criticality safety and I'll turn it over to Dr. Tripp.

MR. TIKTINSKY: Hi, this Dave Tiktinsky of the staff. I just wanted to add a little bit more to your answer, I think.

So we had a person responsible for reviewing the ISA, ISA methodology and what backs up the ISA methodology. The individual technical reviewers for each discipline were responsible for reviewing their technical area, so of course, people like Chris reviewing criticality to make sure he has reasonable assurance at what they're choosing, for instance, safety features, are reasonable. Chemical reviewers and each of the radiation reviewers. So all those people that were responsible for looking at their engineered safety features and the IROFS to make sure they're satisfied that everything is covered. So it's sort of a combination. So we go here on the next meeting is some of the reviewers, the rad safety and the chemical processing, as well as a discussion from the ISA reviewer that looked at the whole methodology of how it worked and whether it was going to meet the requirements or not.

MEMBER BLEY: Thanks.

DR. TRIPP: Okay, criticality safety. The primary goal, of course, is to prevent -- protection against consequences of criticality. Primarily it's for prevention. So the overall requirement in the industry is that nuclear processes be subcritical under normal and credible abnormal conditions. That's sort of a basic, most fundamental design principle.

The way that's normally done is to complying with double contingency principle which we heard about in the last presentation. It's mostly a deterministic analysis, so we don't have the PRA numbers. We have a consideration that at least two unlikely and independent events have to take place before criticality is possible.

The acceptability in other areas we looked at, the ISG implementing the NUREG-1537, this particular section was taken from Chapter 5 of NUREG-1520 which applies to fuel cycle facilities which have very similar types of processes and design criteria to what we have here. Those acceptance criteria are generally broad, programmatic design criteria, so it's that level of the review that we did in the criticality safety area.

In addition to prevention, we also had the criticality alarm systems as an added layer of defense in depth to ensure that in the highly unlikely event that criticality does occur, that there is some provision for reducing the dose to workers primarily to be as low as possible.

MEMBER STETKAR: Chris, I just have to say this to get on the record. You and NWMI always emphasize this is not PRA. This is not PRA. This is strictly deterministic. Highly unlikely is characterized as less than 10^{-5} per year. Unlikely is characterized as between 10^{-3} and 10^{-5} per year.

I submit that there are elements of risk assessment in the terms in the sense of frequency of occurrence here. So please don't try to paint this as something that does not have a sense of risk associated with it.

DR. TRIPP: Well, it's certainly a risk-informed determination.

MEMBER STETKAR: Okay, thank you.

DR. TRIPP: Next slide. So we looked at a few different things. We looked at the PSAR, Chapter 6.3, which contains the definition of the criticality safety program in terms of these broad programmatic criteria. We also did the criticality code validation report which undergirds the calculations that are used to demonstrate subcritical with a certain margin that's specified. And we did a sampling of preliminary Criticality Safety Evaluations. Specifically, it was one in particular that we looked at for the hot cell that we're going to talk about.

CHAIR CHU: Can I ask why you only do a sampling of the Criticality Safety Evaluation? I know you guys did an in-depth evaluation of the hot cell uranium purification process. But in there, there are several others that's seen in the view in my document file, the irradiated target dissolution and the moly extraction and liquid waste and all that.

I thought, you know, these are the key steps in the facility and I wonder why you didn't also --

DR. TRIPP: Well, there are basically two reasons. The first reason is that several of those in dividing the facility into nodes that's kind of an artificial division because there are a lot of interconnections and interactions between the different areas. And several of these analyses had aspects that applied to both the RPF and to the targeted fabrication area. So we're trying to look at one that only pertained to the RPF so that we could a complete review on it without having these hanging threads that went into other areas that we're not reviewing at the construction stage.

For the second area is because the guidance acceptance criteria are all in terms of programs and so at the acceptance review -- not the acceptance review, the construction stage, were not approving of the design of the facility. We are having reasonable assurance that they'll meet the criteria. We're looking a design basis and principal design criteria.

So we looked at this area not to approve the design for the hot cell, but to check the implementation of the program to make sure the program was being implemented, the design criteria was being implemented in a way that we thought was correct and would give us reasonable assurance, safety, in the final design.

So here we have basically a summary of the application. I'm not going to read through all this, but it's based a lot around the ANS programmatic standards that are used throughout the industry, the 8 series standards. Several of them are endorsed in Regulatory Guide 3.71 with various exceptions, primarily exceptions are because there are a few regulatory differences between the NRC and DOE regulations. And most of these working groups at ANS is more heavily dominated by the DOE side. So when the standards come out, there are certain times we have to take exceptions to them.

We have a requirement to have -- there's certain roles and responsibilities that apply to construction and some that apply to operations, so we tried to focus on those that were specific to construction. And we looked at the technical practices which are what I call the design criteria that apply to how you establish limits and controls on certain controlled parameters including how do you do the criticality modeling that leads you to conclude that you have subcritical under normal and credible abnormal conditions.

So several of these design criteria were compliance with double contingency principle, based on controlling parameters. And the controls we looked at what parameters were being controlled for their pipes and processes and whether there was adherence to this general preference for passive engineered over active over administrative controls. And in general, the design of the facility did rely primarily on passive engineered features.

Also, the use of the codes that are used to perform the calculation and a determination of an Upper Safety Limit or Upper Subcritical Limit as it's often called, along with defining an area of applicability which are basically the set of parameters within which the code has been considered validated. So those are our basic overall programmatic and technical design criteria.

So as I said, we looked at the CSE primarily to evaluate whether the programmatic commitments would be implemented acceptably. And the primary control in this area was favorable geometry which is passive engineered geometry with spacing between individual tanks and columns and so forth which always goes along with safe geometry.

They modeled an optimal uranyl nitrate solution in all of the vessels, so it's an optimal moderator to fuel ratio which means you don't have to consider things like precipitation, evaporation and so forth. Any change from optimal conditions are going to result in less reactive configuration; full water reflection including flooding the hot cell up to various levels of moderation.

And so if you only rely on passive geometry, the only things you have to consider are ways that you can deviate from that. And the primary way is consisting of leaks to in some cases drip tray and in some cases the floor and in this case the floor of the hot cell; a back flow from safe to unsafe geometry to various supplies like chemical agents, water, offgas and so forth. This is prevented with a series of passive overflows, air breaks, paddle blank, which is basically a hard flange in the pipe, a double block-and-bleed valves, vents, use of intermediate cooling loop which covers the second barrier of unsafe geometry and use of intermediate favorable geometry day tanks. So these were all a variety of things and we looked at the analysis to verify they did consider all possible backflow and leak-type scenarios.

So our conclusion was the overall approach was consistent with the hierarchy of preferring passive engineered controls and of preferring a favorable geometry over other parameters such as concentration or mass or so forth.

So the only scenarios of concern were those involving loss of geometry control and for all of those we looked at all the various pathways and concluded that they were protected against consistent with double contingency principle.

Now in terms of risk, this what I mean by deterministic analysis. There's a general presumption that if you have two independent engineered controls, passive engineered controls, and they are adequately independent and they are subjected to adequate management measures in the QA program, that that combination will result in something that's highly unlikely. So when I say deterministic, yes, there is an element of risk, but it's being evaluated against this preferred control hierarchy and against industry standard practices to say that you presumably come to that level.

Next slide.

Now moving on to the validation, we already talked a little bit about the validation and the basic issue here is that this is an area where we're dealing with 20 percent enriched material which is somewhat unusual. There are not a lot of good, high quality critical benchmarks in the industry that apply to that. They did use an upper subcritical limit with a minimum margin of subcriticality of .05 which is fairly standard for the nuclear industry. On the fuel side, we have a number of lower enriched facilities that have a smaller margin, sometimes as low as .02. The .05 is fairly normal.

There were a series of benchmarks that were around 20 weight percent that were somewhat anomalous, significantly under predicted k-effective by between 2 and 3 percent. And they were not included in the validation. Now we may not have noticed this except for the fact that they're in the SHINE review. They were included in the validation and affected the results and so those were brought up. So the question was raised as to why they weren't included. They seemed to be applicable although those particular benchmarks are for uranyl sulfate versus uranyl nitrate which is the type of process we have here. And rather than dispute the validity of these benchmarks, there is some question as to why they are under predicting. Northwest just decided to include them in its validation and this is what resulted in reduction in the upper subcritical limit of about .0166.

Now the reason that resulted in such a large condition and we had only four extra benchmarks being added to the 92 that were there is because the anomaly was large enough that it skewed the normality of the distribution, so they weren't able to use a lower tolerance limit method any more, but had to use something that was more conservative and not dependent on the distribution. It's a so-called nonparametric method. And that resulted in a larger increase.

Next slide.

So let me just say the effect of that was that initially we were told that -- or they didn't think that there was any effect on the criticality safety basis. Now we hear that there are some new IROFS that are going to have be put in place as a result. So it's good that you're looking to see if there's any impact.

We didn't see any impact in the hot cell CSE, but some of the bounding analyses that considered a full range of interspersed moderation to account for flooding, some of those would have exceeded the limit that was revised down. But we hadn't come to a resolution on whether that was going to affect the design or not. It sounds like it may affect the design somewhat. So I'll talk about that more when we get to the licensed conditions.

Now technical practices, as I said, were primarily the acceptance criteria are these programmatic commitments and these include commitments on how do you model and control all of the various parameters. That's a large part of this ISG guidance. The PSAR did not contain any commitments to those technical practices, nor did it contain a discussion of an acceptable alternative. And so when we reviewed the preliminary CSE, we found that the practices were generally consistent with industry practices, that they were what you would expect for that kind of a solution system, had it occurred in the facilities that we're used to regulating, consistent with industry practices and standards, adequate margin and so forth. But without those commitments, we don't know if the final design or the design of other areas that we haven't looked at yet would conform to that. And so that's the reason that we have a license condition that's proposing that they have to submit these design documents as they become due, as they complete them and prior to the completion of construction.

So commitment to technical practices is part of what provides conservative margin that's part of the subcritical margin, giving you assurance that urals will be subcritical under normal and credible abnormal conditions. We talked about the .05 minimum margin already.

I believe this is the last major technical issue. Yes.

The last major technical issue we want to talk was the criticality alarm system. Northwest did commit to install a criticality alarm system in accordance with 70.24. They're not taking any exception to that and they said there's going to be an alarm system that meets the dose threshold with dual coverage in all areas where SNM is handled, processed, or stored. It will be complied with ANS Standard 8.3

which is the basic industry gold standard for the criticality alarm system.

But with a few changes because the standard is not entirely consistent with 70.24, but those are outlined in the Reg. Guide and they'll comply with those exceptions in the Reg. Guide. This meets the acceptance criteria in the ISG. However, Northwest did make the statement that the evaluation of CAAS coverage will be done after the final design is complete, but prior to startup.

Now the RPF is a facility where we expect to have significant amounts of shielding so if the coverage is not designed into the facility up front, we didn't have reasonable assurance that we were convinced they would be able to meet the dose threshold in 70.24 at the end. And so that's why there's a condition pertaining to this.

They did describe their overall methodology, in general, using a reasonably conservative method, but if the evaluation is not going to be done until after the facility is built and the shielding is in place, that could be an issue.

Next slide, please.

So that gives the basis for the three license conditions that we're proposing. The first is related the lack of commitments to the technical practices. And for the ones we looked at, the hot cell analysis, we thought we didn't identify any issues seeing they had conservative margins. It's based on passive geometry control. Looks like they accounted for all the pathways, everything looks reasonable. But without those programmatic commitments, then we wanted to have some assurance upfront that the other areas would also be acceptable. And so we're proposing that Northwest periodically provide the criticality evaluations and any changes thereto as they proceed with the design. And this is similar conditions imposed on SHINE with almost parallel language.

Northwest -- the second one concerns this revision to the USL and assurance that they would go -- we wanted assurance that they would go back and relook at the criticality safety basis and any impact of this downward revision with the USL. And I'm gratified to hear it sounds like you started to do that because you identified a few areas where changes need to be made. So that was the reason for the second proposed condition.

And the third is really getting into what's the technical basis for the design of the CAAS, and particularly, the analysis of adequate detector coverage prior to the completion of construction, not at the completion of construction as was proposed in the application. So those were the major issues identified in the criticality safety review.

That was my last slide.

MR. BALAZIK: This is Mike Balazik. I'll just go over the evaluation findings and conclusions. Staff finds that the level of detail provided on the ESFs is suitable to determine that: the RFP is designed to operate with minimal heat load and fission product inventory during normal operation. Northwest's programmatic commitments for the Nuclear Criticality Safety program meets the applicable guidance in ISG Section 6.3 for the issuance of a construction permit with licensing subject to confirmatory information identified in the potential licensing conditions that Chris just went over.

Based on engineering judgment, the staff concludes that the level of detail on the ESFs provided in the PSAR, as confirmed by the potential licensing conditions is adequate for the issuance of a construction permit because it is commensurate with the minimal safety risk posed by the RPF.

And the evaluations made under 50.35, the ESF systems have been described included, but not limited to the principal architect and engineering criteria for the design, and Northwest has identified the major features and components of the systems. Also, that further technical and design information may be reasonably left for later consideration in the FSAR and that there is reasonable assurance that the proposed facility can be constructed and operated at the proposed location with undue risk to the health and safety of the public.

That would end the presentation on Chapter 6 from the staff. Any questions?

CHAIR CHU: Any questions? If not, this is the end of the open portion of the meeting and I would like to know if there are any members of the public on the phone who would like to make comments.

MR. THERON: Line's open.

CHAIR CHU: It's open?

MR. THERON: Yes.

CHAIR CHU: Nobody? Any member of the public in the audience? Okay.

I'm going to go around the room and see if each member has any comments. Pete?

MEMBER RICCARDELLA: No, I have no further comments.

CHAIR CHU: Dick?

MEMBER SKILLMAN: I have several questions for the next session. Thank you.

CHAIR CHU: Dana?

MEMBER POWERS: I've got some written comments that I'll send to you.

CHAIR CHU: Okay. Dennis?

MEMBER BLEY: I'll have the same thing as Dana.

CHAIR CHU: For the closed?

MEMBER BLEY: Well, no, for your letter. And I don't have anything further to add in the open session.

MEMBER STETKAR: Nothing more for the open session.

MEMBER KIRCHNER: No. Thank you.

CHAIR CHU: Charlie?

MEMBER BROWN: Nothing more from me.

CHAIR CHU: Well, thank you very much and now we will go into the closed session for a little bit. Thank you.

(Whereupon, the above-entitled matter went off the record at 5:02 p.m.)

U.S. Nuclear Regulatory Commission
ACRS Subcommittee Review

Chapter 7 – Instrumentation and Control Systems

July 11, 2017

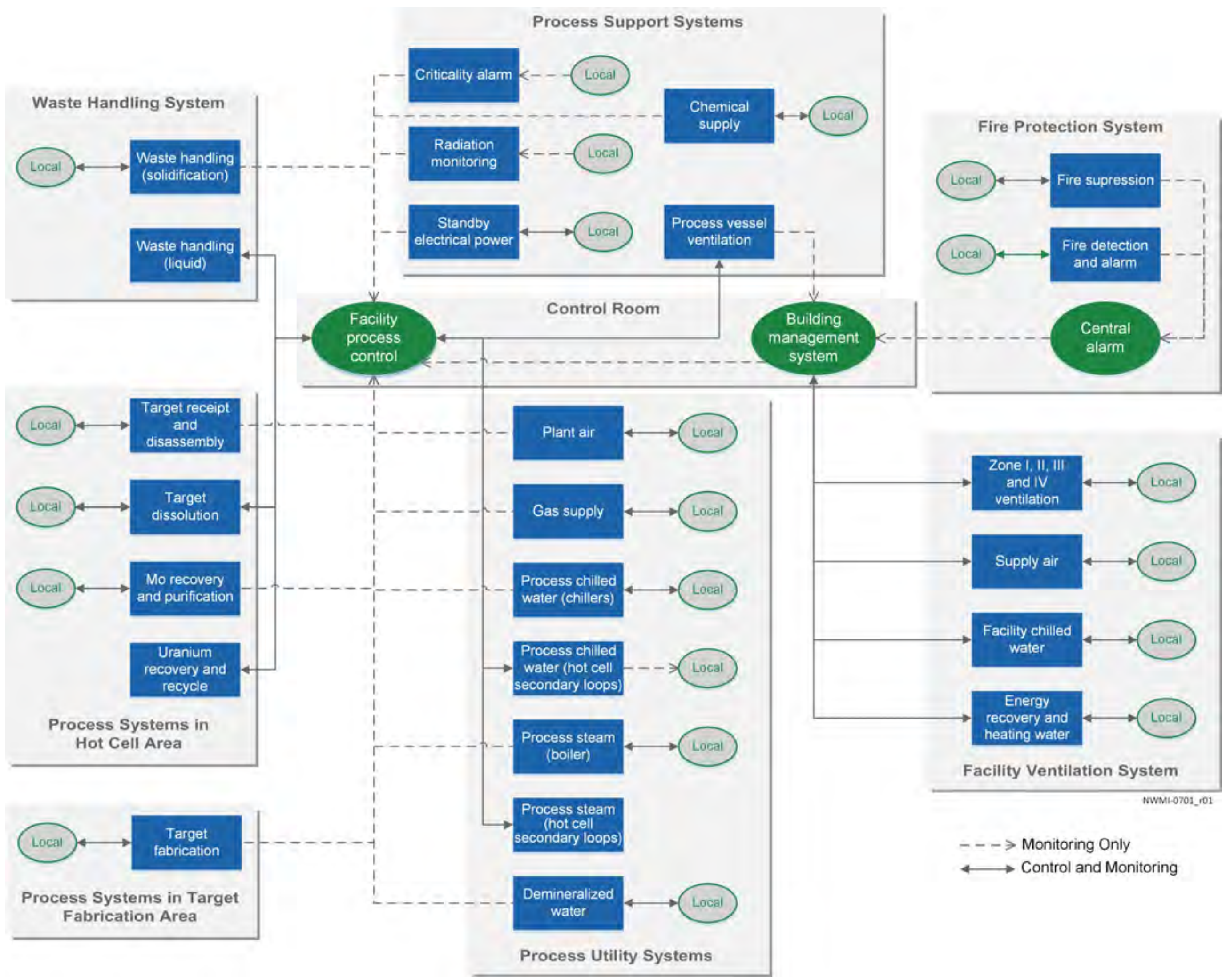
Technical Approach

- Radioisotope Production Facility (RPF) will have several instrumentation and control systems
  - Facility process control (FPC) system will provide monitoring or control
    - Process systems within the hot cells will be *controlled* by the FPC
    - Waste handling within the hot cells will be *controlled* by the FPC
    - Process utility systems *report* to the FPC
    - Criticality accident alarm system *reports* to the FPC
    - Radiation monitoring system *reports* to the FPC
  - Building management system (BMS) will control building mechanical utility systems
    - Ventilation system will be *controlled* by the BMS
    - Fire protection system *reports* to the BMS
- Information to be provided in Operating License Application
  - Details on manufacture (vendor), interlock/permissive programing and logic
  - Details on implementation of design criteria

Analog/Digital and Cyber

- Safety-related items relied on for safety (IROFS) will have hard-wired analog controls/ interlocks/permissives
- Some safety-related non-IROFS systems may be controlled by programmable logic controllers (PLC) (e.g., ventilation and fire)
- Most other processes (non-safety related) will have PLCs providing control, permissives, monitoring, and interlocks
  - Controls will be in place for PLC programming
- Dataloggers will also have digital components
- Control room will use PLCs and computers so cyber issues are recognized
  - Access controls
  - Air-gapped
  - Controls on media

Preliminary I&C System Configuration Concept



Notes:

- Green circles identify FPC and BMS distributed process control or PLC systems
- Solid lines and dashed lines show how special nuclear material (SNM) processes, support systems, utilities, radiation and criticality systems, and building functions relate to FPC and BMS and to local human-machine interface (HMI) stations
- Solid lines indicate control functions, and dashed lines indicate monitoring functions

Control Room

- Operators will have direct visualization of critical values and ability to input control functions into FPC system
- FPC system dedicated displays will perform the following functions:
  - **Static display** – Shows critical measurement values and performs the function of an annunciator panel → fixed display panel will not provide any interactive control functionality
  - **Alarm/event annunciator display panel** – Displays any event or alarm that is defined for a process
    - Enables the operator to acknowledge current events and alarms, and provides a historical record of events
  - **Dynamic interface display panel or HMI** – Enables operators to perform tasks, change modes, enable/disable overrides, and other tasks that require operator input to allow, perform, or modify a task or event
- All set of displays will be arranged in a workstation → a keyboard and mouse will be used to interface with system

RPF SNM Preparation and Handling Processes

- FPC system will control and/or monitor SNM preparation and handling processes
  - Target fabrication → Batch will be controlled by operators at local HMIs, with surveillance monitoring in the control room
  - Uranium recovery and recycle → Batch processes located inside hot cell area will be controlled by operators in the control room

RPF Extraction and Purification Processes

- FPC system will control and/or monitor RPF processes
  - Target receipt and disassembly
    - Hardware/target movement located in irradiated target basket receipt bay area, target cask preparation airlock, target receipt hot cell, and target disassembly hot cell will normally be controlled by operators at local HMIs
    - Surveillance monitoring in the control room
  - Target dissolution
    - Batch process located inside dissolution hot cell will occur at local HMIs in operating gallery, and offgas operations in tank hot cell will be controlled by operators in control room
    - Surveillance monitoring at both locations
  - Mo recovery and purification
    - Batch processes located inside ^{99}Mo hot cells will be controlled by operators at a local HMI in operating gallery
    - Surveillance monitoring in the control room
  - Waste handling (i.e., liquid waste handling and waste solidification, solid waste handling)
    - Operators in control room will control liquid waste handling
    - Operators at local HMIs in low-dose liquid solidification room will monitor and control liquid waste solidification and solid waste nondestructive examination and solidification

Other RFP Systems and Processes

- Criticality accident alarm system (CAAS)
  - Will be provided as an integrated vendor package
  - Detectors and alarm response are integral to individual units/locations
  - FPC system will monitor CAAS status in control room
- Radiation monitoring system
  - FPC system will monitor various radiation monitoring systems (e.g., continuous air monitors [CAM], air samplers, radiation area monitors [RAM], exhaust stack monitors)
  - CAMs and RAMs will be strategically placed throughout RPF to alert personnel of any potential radiation hazards
  - CAMs and RAMs will alarm in control room and locally at locations throughout RPF
- Facility ventilation system and mechanical utility systems
  - Control function for most of RPF ventilation system and mechanical utility systems will be BMS and hard-wired interlocks for engineered safety feature (ESF) functions
  - BMS will monitor systems and provide ventilation and mechanical utility system status as an input to FPC process controls
- Subsystems to be monitored by BMS
  - Facility ventilation Zones I, II, III, and IV
  - Supply air system
  - Facility chilled water system
  - Energy recovery and heating water

Anticipated Control and Monitoring Parameters

- Example of I&C control and monitoring parameters for target dissolution system
- Similar data for each system, including interlocks and permissive signals

Target Dissolution System Control and Monitoring Parameters

Subsystem name	Control parameters (automatic/manual)	Monitoring parameters		Primary control location
Target dissolution 1 and 2	• Dissolver agitator actuation (A/M) • Dissolver agitator speed (A) • Flowrate (A) • Pump actuation (A/M) • Pump motor speed (A) • Temperature (A) • Valve actuation (A/M)	• Dissolver agitator speed • Flowrate • Flowrate totalizer • Level	• Pressure • Radiation • Temperature • Valve position	Operating gallery
NO_x treatment 1 or 2	• Flowrate (A) • Pump actuation (A/M) • Pump motor speed (A) • Temperature (A) • Valve actuation (A/M)	• Differential pressure • Flowrate • Flowrate totalizer • Level	• Pressure • Radiation • Temperature • Valve position	Operating gallery
Pressure relief	• Pump actuation (A/M) • Pump motor speed (A) • Temperature (A) • Valve actuation (A/M)	• Flowrate • Level	• Pressure • Valve position	Operating gallery
Primary fission gas treatment	• Temperature (A) • Valve actuation (A/M)	• Differential pressure • Flowrate • Pressure	• Radiation • Temperature • Valve position	Operating gallery
Secondary fission gas treatment	• Valve actuation (A/M)	• Differential pressure • Flowrate • Pressure	• Radiation • Temperature • Valve position	Operating gallery
Waste collection	• Pump actuation (A/M) • Pump motor Speed (A) • Temperature (A) • Valve actuation (A/M)	• Differential pressure • Flowrate • Level • Temperature	• Pressure • Radiation • Valve position	Operating gallery

NO_x = nitrogen oxide.

Engineered Safety Feature and SSCs

- ESF systems will operate independently from FPC systems as hard-wired controls
- ESFs will integrate into FPC systems providing monitoring and alarming at control room and local HMI workstations

Engineered Safety Feature Actuation or Monitoring Systems

Engineered safety feature	IROFS	Accident(s) mitigated	I&C SSCs providing engineered safety feature
Primary offgas relief system	RS-09	Dissolver offgas failure during dissolution operation	Pressure relief device, pressure relief tank
Active radiation monitoring and isolation of low-dose waste transfer	RS-10	Transfer of high-dose process liquid outside the hot cell shielding boundary	Radiation monitoring and isolation system for low-dose liquid transfers
Cask local ventilation during closure lid removal and docking preparations	RS-13	Target cladding leakage during shipment	Local capture ventilation system over closure lid during lid removal
Cask docking port enabler	RS-15	Cask not engaged in the cask docking port prior to opening the docking port door	Sensor system controlling cask docking port door operation
Process vessel emergency purge system	FS-03	Hydrogen deflagration or detonation	Backup bottled nitrogen gas supply
Active discharge monitoring and isolation	CS-14	Accidental criticality	To be provided in the Operating License Application
Independent active discharge monitoring and isolation	CS-15	Accidental criticality	To be provided in the Operating License Application
Evaporator or concentrator condensate monitoring	CS-20	Prevent nuclear criticality from high-volume transfer to non-geometrically favorable vessels in solutions with normally low fissile component concentrations	Conductivity analyzer and control valve
Closed heating or cooling loop with monitoring and alarm	CS-27	Accidental criticality	Closed-loop, high-volume heat transfer fluid systems to prevent nuclear criticality or transfer of high-dose material across shielding boundary in the event of a leak into the heat transfer fluid with normally low fissile component concentrations
Dissolver offgas vacuum receiver or vacuum pump	TBD	Potential limiting control for operations; motive force for dissolver offgas	Dissolver offgas vacuum receiver tanks, dissolver offgas vacuum pumps

I&C = instrumentation and control.
IROFS = items relied on for safety.
SSC = structures, systems, and components.
TBD = to be determined.

Conclusions

- High-level approach to necessary interlocks and permissives has been developed for safety-related systems
- Monitoring parameters have been identified (both safety and non-safety-related)
- Safety-related systems will be analog to minimize issues related to digital verification and validation and cybersecurity concerns
- Systems within tank/waste hot cells will be controlled via the control room
- Systems other than tank/waste hot cells will be controlled locally and monitored by the control room
- Details and specifics on design basis and instrumentation will be provided in the Operating License Application

Chapter 7 Questions?

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Advisory Committee on Reactor Safeguards
Meeting on Northwest Medical Isotopes Construction Permit Application

Chapter 7
Instrumentation and Control Systems

July 11, 2017

Introductions

- **Michael Balazik** - Project Manager, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation

- **Alexander Adams, Jr.** - Chief, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation

- **James Servatius** - Technical Reviewer, Information Systems Laboratories, Inc.

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements:
  - 10 CFR 50.34, “Contents of applications; technical information,” paragraph (a), “Preliminary safety analysis report.”
  - 10 CFR 50.35, “Issuance of Construction Permits.”
  - 10 CFR 50.40, “Common standards.”
- Acceptance Criteria
  - NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria.”
  - Interim Staff Guidance Augmenting NUREG-1537, “Guidelines for Preparing and Reviewing Applications…for Licensing Radioisotope Production Facilities…,” Part 2.

Instrumentation and Control Systems

- Instrumentation and control (I&C) systems comprise the sensors, electronic circuitry, displays, and actuating devices that provide the information and means to safely control the radioisotope production facility (RPF), and to avoid or mitigate accidents.
- The RPF houses the special nuclear material (SNM) preparation and handling processes, radioisotope extraction and purification processes, process utility systems, criticality accident alarm system (CAAS), and radiation monitoring systems.
- The SNM processes are enclosed predominately by hot cells and glove boxes and criticality safety is controlled through the use of geometrically safe designs and control of process variables.

Instrumentation and Control Systems (continued)

- The Facility Process Control (FPC) system provides for monitoring of safety-related components within the RPF.

- The FPC system also provides for monitoring and control of the process systems within the RPF.

- The Building Management System (BMS) is a subset of the FPC system and provides for monitoring and control of ventilation and mechanical utility systems.

Staff Review

- The staff evaluated the technical information presented in Chapter 7 of the NWMI PSAR, as supplemented by responses to RAIs, to assess the sufficiency of the preliminary design and performance of NWMI's RPF I&C systems in support of the issuance of a construction permit.
- Staff considered design criteria, design bases, system 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 process control system descriptions, engineered safety features actuation and alarming systems, control console and display instruments, and radiation monitoring systems.

Summary of Application

- NWMI PSAR Chapter 7 describes the preliminary design of the RPF I&C systems, and includes physical descriptions and design criteria, together with tables describing the intent of the design to comply with requirements.
- I&C System functions within the RPF include:
  - Engineered Safety Features (ESF),
  - Process Controls,
  - Control Console and Display, and
  - Radiation Monitoring

Production Facility Summary Description

- PSAR Section 7.1 states that the FPC system and BMS provide monitoring and control functions as illustrated in a schematic of the preliminary I&C system configuration.
- PSAR Section 7.1 identifies that staff at local human-machine interfaces (HMIs) stations will control facility systems and that several different terms (i.e., operator interface displays, operator interface terminals, and HMIs) describe these interfaces.
- In response to a request for additional information (RAI), the applicant stated that, for consistency, terms like “operator interface displays” and “operator interface terminals” will be replaced with a single term “HMI” in the FSAR.
- The staff finds this response and the summary description acceptable.

Production Facility I&C System Design

- PSAR Section 7.2 discusses the ability of the facility's instrumentation to manage, monitor, and actuate ESFs and identifies that ESF systems will operate independently from the FPC system or BMS.

- In response to an RAI, the applicant stated that the PSAR will be amended to state that ESF systems will operate upon actuation of an alarm setpoint reached for a specific monitoring instrument/device and that, in addition, the FPC system or BMS will have the ability to actuate ESF as needed.

- The staff finds this response and level of detail in the preliminary design acceptable.

Production Facility Process Control Systems

- PSAR Section 7.3 discusses the facility's process control systems including SNM preparation and handling processes and radioisotope production processes.

- The facility's process control is administered by the FPC system.
  - Monitor valve positions that control inter-process fluid transfers
  - Control pumps that move fluid during inter-process transfers

- The staff finds the level of detail in the process control system description acceptable.

Production Facility ESF Actuation Systems

- PSAR Section 7.4 discusses the facility's ESF actuation and monitoring systems.
- The facility's ESF systems are hard-wired controls that operate independently from the FPC systems and are actuated when parameters monitored by the I&C system reach setpoints.
- In addition, the FPC system or BMS will have the ability to actuate ESF as needed.
- The staff finds the level of detail in the description of the ESF actuation system acceptable.

Production Facility Control Console

- PSAR Section 7.5 discusses the design criteria, design basis, and system description of the facility's control room and HMI interfaces.
- The facility's control room contains a control console, several HMIs, master distributed controller, and necessary cabinetry and subcomponents.
- The BMS will be controlled and monitored from the control room.
- The staff finds the level of detail in the facility control room design acceptable.

Production Facility Radiation Monitoring

- PSAR Section 7.6 discusses the design criteria, design basis, and system description of the facility's radiation monitoring systems.

- The facility's radiation monitoring systems include continuous air monitors, radiation area monitoring, exhaust stack monitoring, process control instruments, and personnel monitoring and dosimetry.

- Provides control room personnel with a continuous record and indication of radiation levels at selected locations.

- The staff finds the level of detail in description of the facility radiation monitoring systems acceptable.

Evaluation Findings and Conclusions

- The preliminary RPF I&C system described in the NWMI PSAR meets the regulatory requirements and acceptance criteria for the issuance of a construction permit.

- Based on engineering judgment, the staff concludes that the level of detail on the RPF I&C system in the PSAR is adequate for the issuance of a construction permit because any required modifications to the system design and operating procedures can be readily implemented after major facility construction activities have been completed.

Evaluation Findings and Conclusions (continued)

- Accordingly, NWMI has met the following requirements of 10 CFR 50.35 for issuance of a construction permit, with respect to the RPF I&C systems:

  1) RPF I&C systems have been described, including, but not limited to, the principal architectural and engineering criteria for the design, and has identified the major features or components.

  2) Further technical or design information may be reasonably left for later consideration in the FSAR.

  3) There is reasonable assurance that the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

U.S. Nuclear Regulatory Commission
ACRS Subcommittee Review

Chapter 8 – Electrical Power Systems

July 11, 2017

Electrical Power Systems Strategy

- Normal electrical power (NEP) system design basis is to provide sufficient and reliable electrical power to RPF systems and components requiring electrical power for normal operations
  - Electrical requirements of the system
  - Equipment
  - Instrumentation
  - Controls
  - Communications
  - Devices related to safety functions and devices
- Combination of uninterruptable power supplies (UPS) and standby electrical power (SEP) system will provide emergency electrical power to RPF → Only selected UPS systems will have a safety function
- NEP will be 480 volt (V), 3-phase, 120 amp, 60 hertz (Hz) → Total power required will be approximately 2,998 kilowatt (kW) (4,020 horsepower [hp])

Electrical Loads

Summary of Radioisotope Production Facility and Ancillary Facilities Electrical Loads

Demand		Normal electrical peak power load kW	Normal electrical peak power load hp	Uninterruptable power	Standby electrical peak power load kW	Standby electrical peak power load hp
Target fabrication system		125	168	No	0	0
Target receipt and disassembly system		30	40	No	0	0
Target dissolution system		40	54	No	40	54
Molybdenum recovery and purification system		30	40	No	25	34
Uranium recovery and recycle system		10	13	No	10	13
Waste handling system		25	34	No	5	7
Radiation monitoring and CAAS systems		5	7	Yes[a]	5	7
Standby electrical power system		N/A		No	N/A	N/A
General facility electrical power		173	232	Yes[a]	101	135
Process vessel ventilation system		40	54	No	40	54
Facility ventilation system:	Ventilation Zone I	67	90	No	67	90
	Ventilation Zone II/III	215	288	No	215	288
	Ventilation Zone IV	295	396	No	295	396
	Laboratory ventilation	38	51	No	10	13
	Supply air	49	66	No	49	66
Fire protection system		0.8	1	Yes[a]	0[b]	0[b]
Plant and instrument air system		60	83	No	60	83
Gas supply system		0.8	1	No	0.8	1
Process chilled water system		280	375	No	140	188
Facility chilled water system		1,300	1,743	No	0	0
Facility heated water system		47	63	No	0	0
Process stream system		0.8	1	No	0.8	1
Demineralized water system		0.8	1	No	0	0
Supply air system						
Chemical supply system		49	66	No	49	66
Facility process control and communications systems		5	7	Yes	5	7
Energy recovery		5	7	No	0	0
Safeguards and security		40	54	Yes	40	54
Administrative building		90	121	No	18	24
Waste management building		11	15	No	3	4

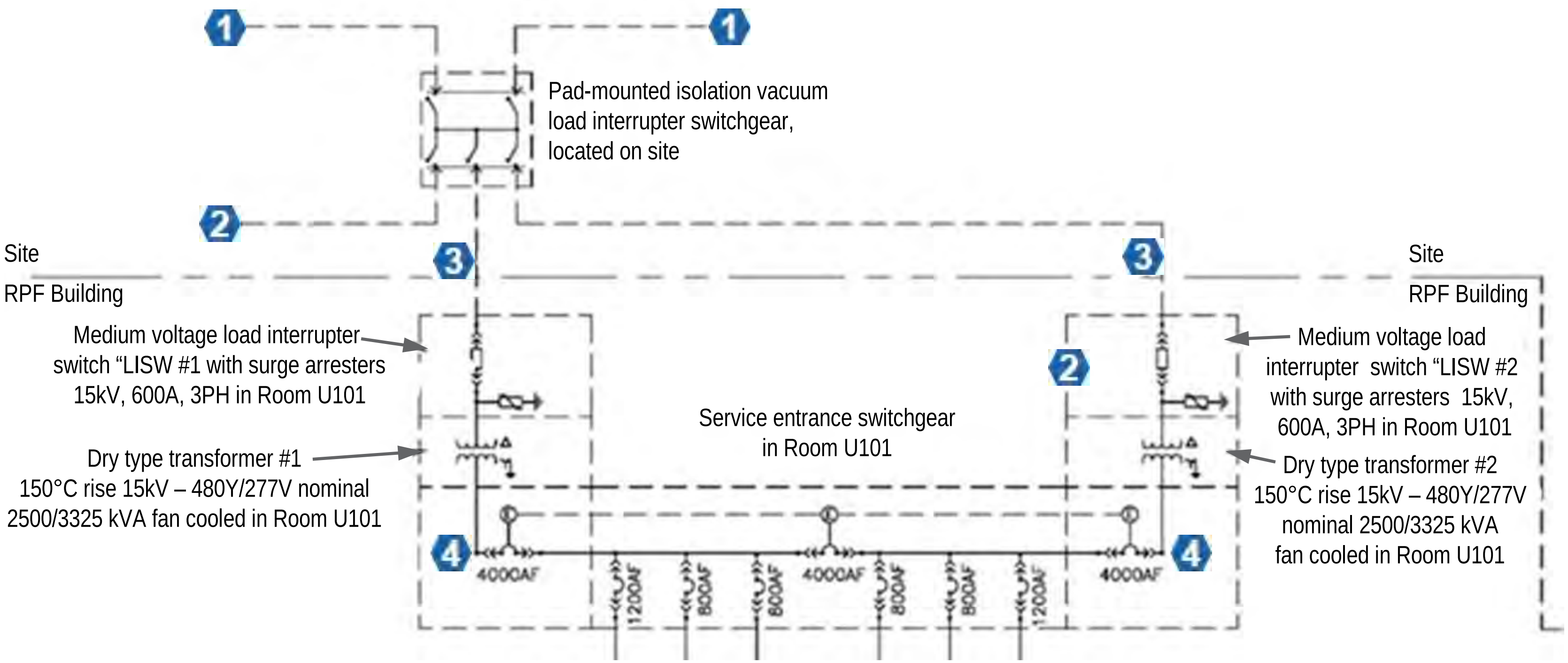
[a] Only parts of the system are provided with uninterruptable power supplies.

[b] The fire detection and fire alarm subsystems will be provided by an uninterruptable power supply with a 24-hr capacity. Chapter 9 provides additional detail.

Normal Electrical Power Systems

- Power will be provided to RPF from an underground utility feed
- Pad-mounted switchgear will be located outside of RPF
- Power will then be routed underground from switchgear to RPF and Admin Building
- Underground feeders to the RPF will comprise two redundant full-capacity service laterals to the RPF
  - Each service lateral will support redundant full-capacity service transformers that will normally carry half of RPF load
  - Either of RPF feeders can be opened and tie breaker closed, as needed → allowing other feeder to carry entire RPF load
- Any RPF loads requiring SEP will be provided power from diesel generator when required

Electrical One-Line Diagrams



General Notes:
The number of branch circuit breakers, distribution and lighting panelboards, and electrical systems and equipment, such as UPS systems and controllers is subject to change during detailed design.

Keyed Notes:

1. Underground utility feeds. To be determined if two feeds can be provided to the site from sources that have redundancy.
2. Underground feeder to Administration Building.
3. Redundant full-capacity underground feeders to the RPF.
4. Main-tie-main 480V electrical distribution capability, breakers are rated to carry to full building load. System normally operates with the tie breaker open in a fully redundant topology. Each of the two feeders and transformers normally carries approximately half the full building load. As required, either main can be opened and the tie breaker closed, thus one or the other feed will carry the full building load.

Safe Shutdown Design

- In event of loss of NEP → UPSs will automatically provide power to RPF systems and components that support safety functions and safe shutdown and protecting workers and public
- Systems and components supported with UPSs include:
  - Process and facility monitoring and control systems
  - Facility communication and security systems
  - Emergency lighting
  - Fire alarms
  - Radiation protection and CAAS
- UPSs will be provided for selected systems in RPF, and will:
  - Include unit device, rack-mounted, and/or larger capacity cabinet units
  - Service loads requiring uninterruptable power on a short-term basis
  - Be backed up by an on-site diesel generator to extend duration of power available to connected loads

Operations

- UPSs will be designed to operate for a period of up to 120 minutes
- FPA (fire panel) will have a UPS that provides 24 hours of uninterrupted power
  - If NEP service is reestablished within a determined timeframe, normal operations will resume
- On loss of normal power
  - Inlet bubble-tight isolation dampers within Zone I ventilation system will close → HVAC system will automatically be placed into passive ventilation mode of operation
  - Process vessel vent system will automatically be placed into passive ventilation mode of operation → All electrical heaters will cease operation as part of passive operation mode
  - Pressure-relief confinement system for target dissolver offgas system will be activated on reaching system relief setpoint, and dissolver offgas will be confined in offgas piping, vessels, and pressure-relief tank
  - Process vessel emergency purge system will be activated for hydrogen concentration control in tank vapor spaces
  - Uranium concentrator condensate transfer line valves will be automatically configured to return condensate to feed tank due to residual heating or cooling potential for transfer of process fluids to waste tanks
  - Equipment providing a motive force for process activities will cease
    - Pumps performing liquid transfers of process solutions
    - Pumps supporting operation of the steam and cooling utility heat transfer fluids
    - Equipment supporting physical transfer of items (primarily cranes)

Emergency Electrical Power

- Emergency electrical power system design basis
  - Provides uninterrupted power to instrumentation, control, communication systems, and devices required for safety functions protecting workers and the public
  - Provides sufficient electrical power to ensure safe shutdown in event of loss of NEP
  - Provides SEP to operate select process-related equipment to limit impacts of loss of NEP on RPF production operations
- RPF has a standby 1,000 kW (1,341 hp) diesel generator for economical reasons and defense-in-depth
- SEP will be 480 V, 3-phase, 42 amp, 60 Hz → Total peak SEP is 1,178 kW
- UPSs will be provided for selected systems in RPF
  - Safety-related instrumentation
  - Effluent, process, and area radiation monitors
  - Physical security control, information, and communication systems
  - Emergency lighting
- Emergency cooling water system will not be required

Conclusions

- Loss of power with radiological and criticality consequences
- Multiple initiating conditions identified, including loss of site power, a “not unlikely” frequency
- The ESFs requiring power will activate (emergency purge system) or go to a fail-safe configuration (ventilation dampers and offgas relief tank)
- No additional IROFS have been identified specific to this event
- Loss of NEP will not result in unsafe conditions for either workers or the public in uncontrolled areas

Chapter 8 Questions?

Advisory Committee on Reactor Safeguards
Meeting on Northwest Medical Isotopes Construction Permit Application

Chapter 8
Electrical Systems

July 11, 2017

Introductions

- **Michael Balazik** - Project Manager, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation

- **Alexander Adams, Jr.** - Chief, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation

- **Stephen Alexander** - Technical Reviewer, Information Systems Laboratories, Inc.

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements
  - 10 CFR 50.34, “Contents of applications; technical information,” paragraph (a), “Preliminary safety analysis report.”
  - 10 CFR 50.35, “Issuance of construction permits.”
  - 10 CFR 50.40, “Common standards.”
- Acceptance Criteria
  - NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria.”
  - Interim Staff Guidance Augmenting NUREG-1537, “Guidelines for Preparing and Reviewing Applications…for Licensing Radioisotope Production Facilities…,” Part 2

NWMI RPF Electrical Systems

- Electrical systems provide electrical power (1) for electrical and I&C equipment during normal operation and (2) to support safe shutdown of the RPF, maintaining it in a safe shutdown condition, and preventing offsite release of radioactivity in excess of regulatory guidelines upon loss of normal power and/or in any other postulated design-basis event.
- Electrical systems are designed for high reliability and durability through redundancy and diversity, using quality assurance in design, manufacturing, procurement, and installation, and regulatory oversight during the design and construction phase.

NWMI RPF Electrical Systems (continued)

- Normal electrical power comes from the local utility, Columbia Water and Light, via the Grindstone Substation. Standby/backup electrical power is provided by an onsite diesel generator with emergency power to critical electrical and I&C equipment provided by uninterruptable power supplies (UPSs).

Staff Review

- The staff evaluated of the technical information presented in Chapter 8 of the NWMI PSAR, as supplemented by responses to RAIs, to assess the sufficiency of the preliminary design and performance of RPF electrical systems for the issuance of a construction permit.
- The staff considered design criteria, design bases, and relevant design information to provide reasonable assurance that the final design will conform to the design basis.
- The staff review included the normal electrical power (NEP), standby electrical power (SEP) system and UPSs and their loads, seismic and environmental qualification, independence, single-failure criterion, safe shutdown, and probable subjects for technical specifications.

Summary of Application

PSAR Section 8.1 provides a high-level description of the preliminary design of the NWMI RPF NEP system. The NEP system is to receive 480-volt, 3 phase, 60-hertz (Hz), alternating current (AC) from the local utility, Columbia Water and Light, via the Grindstone Substation. The NEP system is to be used for normal operation and normal shutdown of the RPF. The total power requirement of the RPF will be approximately 2,998 kilowatts (kW).

PSAR Section 8.1 states the design basis of the NEP system is to provide sufficient and reliable power to all systems and components requiring electrical power for normal operations and normal shutdown, including the electrical requirements of the system, equipment, I&C, communication, and devices related to the safety functions.

Summary of Application (continued)

PSAR Section 8.2 describes the RPF SEP and emergency electrical power systems. In the event of loss of normal power, several safety-related UPSs provide power to certain safety-related systems and components, considered IROFS, for protection of workers and the public, until the standby diesel generator (SDG) automatically comes on line and the automatic transfer switch (ATS) shifts the SEP loads to the SDG bus. The SDG powers the SEP system, which supplies certain SEP loads to allow the RPF to continue to operate on a limited basis, and also extends the supply of power to the UPS loads.

Emergency electrical power is the temporary substitute for NEP in the event of a loss-of-offsite power (LOOP). Emergency electrical systems are designed to support systems that prevent damage to the RPF and releases of radioactivity to the environment.

Summary of Application (continued)

PSAR Table 8-1 lists the electrical loads of the systems and equipment served by the NEP, the SEP, and the UPSs. The UPSs supply power to facility process control and communication, fire protection, radiation monitoring and the criticality accident alarm system (CAAS), safeguards and security, and certain parts of the general facility electrical system, such as emergency lighting. UPSs are typically comprised of direct current storage batteries, battery chargers and inverters, with supply distribution panels for safety-related loads. PSAR Figure 8-1 is a one-line schematic diagram of the RPF electrical systems.

All other systems are designed to fail safe in the event of an LOOP. RPF operation on a limited basis can continue once the SDG comes on line because many of the NEP loads can be powered by the SEP, which then also takes over to provide power to the UPSs and their loads.

Technical Safety Review and Evaluation

The staff found certain inconsistencies between PSAR Chapters 8 and 3 in the information presented on the emergency electrical power systems. The staff issued RAIs to address these, including the mission time of the UPSs (other than fire protection), the capacity of the SDG, and the reserve fuel and design mission time for the SDG under more design load than originally designed for.

In November 2016 RAI responses, NWMI explained how it intended to resolve the discrepancies in the revised PSAR. The staff found the proposed resolutions acceptable.

Technical Safety Review and Evaluation (continued)

The staff determined that the information in PSAR Chapter 8 demonstrates an adequate design basis for the electrical systems and is sufficient for satisfying the standards for issuance of a construction permit.

Evaluation Findings and Conclusions

The staff evaluated descriptions and discussions of the NWMI RPF electrical power systems, including probable subjects of technical specifications, as described in PSAR Chapter 8 and supplemented by the applicant's responses to RAIs, and finds that the preliminary design of the electrical power systems, including the principal design criteria; design bases; and information relating to general arrangement, major structures, systems, and components, and a high-level functional description:

- Provides reasonable assurance that the final design will conform to the design basis, and
- Meets applicable regulatory requirements and acceptance criteria in or referenced in NUREG-1537.

Evaluation Findings and Conclusions (cont.)

- The design of the electrical systems as documented in the PSAR is sufficient for satisfying the standards for issuance of a construction permit.

- Certain parts of the electrical system provide electrical power for IROFS and the preliminary design provides reasonable assurance that the electrical system IROFS should remain functional for the protection of the health and safety of facility personnel and the public.

- Based on engineering judgment, the staff concludes that the level of detail on the electrical systems in the PSAR is adequate for the issuance of a construction permit.

Evaluation Findings and Conclusions (continued)

- Accordingly, NWMI has met the following requirements of 10 CFR 50.35 for issuance of a construction permit, with respect to the electrical power systems:

    1) RPF electrical power systems, including, but not limited to, the principal architectural and engineering criteria for the design, and has identified the major features or components.

    2) Further technical or design information may be reasonably left for later consideration in the FSAR.

    3) There is reasonable assurance that the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public.

U.S. Nuclear Regulatory Commission
ACRS Subcommittee Review

Public Session – Chapters 3, 6, 7, and 8

July 11, 2017

U.S. Nuclear Regulatory Commission
ACRS Subcommittee Review

Chapter 3 – Design of SSCs

July 11, 2017

Facility Design Strategy

- Identifies and describes principal architectural and engineering design criteria for facility structures, systems, and components (SSC)
- Emphasizes safety and protective functions and related design features that help provide defense-in-depth against uncontrolled release of radioactive material to the environment
- Applies defense-in-depth (a design philosophy) from the outset and through completion of final design that is based on providing successive levels of protection such that health and safety are not wholly dependent on any RPF single element of design, construction, maintenance, or operation
  - Net effect of incorporating defense-in-depth practices is a conservatively designed facility and systems that exhibit higher tolerances to failures and external challenges
  - Risk insights obtained through performance of accident analysis can then be used to supplement final design by focusing attention on prevention and mitigation of higher risk potential accidents

Facility Design Strategy (continued)

- NWMI's design is based on applicable standards, guides, codes, and criteria and provides reasonable assurance that the RPF SSCs (including electromechanical systems)
  - Are built and will function as designed and required by analyses in Chapter 13, "Accident Analysis"
  - Ensure acceptable protection of workers, public and environment from radiological risks (e.g., radioactive materials, exposure) resulting from operations
  - Protect against potential hydrological (water) damage
  - Protect against seismic damage
  - Provide surveillance activities and technical specifications required to respond to or mitigate consequences of seismic damage
  - Have technical specifications developed to ensure that safety-related functions of electromechanical systems and components will be operable and protect workers, public, and environment
- Actual design codes and standards (and any exception) will be explicitly documented in final safety analysis report (FSAR) for safety-related SSCs

Design Criteria

- Principal design criteria for a production facility establish necessary design, fabrication, construction, testing, and performance requirements for SSCs important to safety
  - Example: SSCs that provide reasonable assurance that the facility can be operated without undue risk to workers and public
- Chapter 6 presentation reviews the list of IROFS
- Design criteria sources:
  - Code of Federal Regulations
  - U.S. Nuclear Regulatory Commission
  - Other Federal regulations, guidelines, and standards
  - Local and State government regulations and standards
  - University of Missouri/Discovery Ridge Research Park
  - Codes and standards (various codes and standards are used as guidance for design of the facility SSCs)

Natural Phenomena

- RPF meteorological accidents with radiological consequences have been evaluated
  - NWMI-2015-SAFETY-011, *Evaluation of Natural Phenomenon and Man-Made Events on Safety Features and Items Relied on for Safety*
- Structural design basis of RPF will be to withstand a highly unlikely event (> 10^{-5})
- Demands on structural elements due to applied loads were evaluated
- Effect of each load case is determined separately and total demand is determined by combining load effects using load combinations for evaluating strength and evaluating serviceability criteria
- Four categories of load were evaluated
  - **Normal loads** – Loads expected to be encountered during normal plant operations/shutdown and loads due to natural hazard phenomena likely to be encountered during service life
  - **Severe environmental loads** – Loads that may be encountered infrequently during service life
  - **Extreme environmental loads** – Loads that are credible but are highly improbable to occur during service life
  - **Abnormal loads** – Loads generated by a postulated high-energy pipe break accident used as a design basis

Natural Phenomena (continued)

- Normal wind load criteria are based on ASCE 7, *Minimum Design Loads for Buildings and Other Structures*
- Tornado load requirements
  - Design based Regulatory Guide 1.76, *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants* → annual exceedance probability of 10^{-7}, which is lower than in NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*
- High Straight-Line Winds
  - RPF is designed as a Risk Category IV structure, in accordance with ASCE 7 → Return frequency of basic design wind speed is 5.88×10^{-4}/year
  - Maximum probability of failure targeted for Risk Category IV is 5.0×10^{-6}

Normal Wind Load Criteria

Element	Value
Basic wind speed, V	193.1 km/hr (120 mi/hr)
Exposure category	C
Enclosure classification	Enclosed
Risk category	IV

Source: ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, American Society of Civil Engineers, Reston, Virginia, 2013.

Tornado Wind Field Characteristics

Description	Value
Tornado region	Region I
Maximum wind speed	370.1 km/hr (230 mi/hr)
Translational speed	74.0 km/hr (46 mi/hr)
Radius of maximum rotational speed	45.7 m (150 ft)
Pressure drop, ΔP	(1.2 lb/in.^{2})

Source: NRC Regulatory Guide 1.76, *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants*, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, D.C., March 2007.

Natural Phenomena (continued)

- Tornado-Generated Missile Impact Effects
  - Based on Regulatory Guide 1.76 (standard design missile spectrum)

Tornado Wind-Driven Missile Criteria

Description	Weight	Velocity coefficient	Horizontal velocity	Vertical velocity
Automobile	4,000 lb	16.4 ft × 6.6 ft × 4.3 ft	92 mi/hr	62 mi/hr
Pipe	287 lb	6.625 in. diameter × 15 ft long	92 mi/hr	62 mi/hr
Steel Sphere	0.147 lb	1.0 in. diameter	18 mi/hr	12 mi/hr

NWMI NORTHWEST MEDICAL ISOTOPES

Rain, Snow, and Ice Loading

- Rain
  - Rain loads will be based on the estimate of weight of the 48-hour probable maximum precipitation
  - Rain load estimate will be compared with the local building code rain load and the greater value will be used for roof design
- Normal Snow Load
  - Based on 100-year ground snow (per NUREG-1537 and DC/COL-ISG-007, modified using the procedures of ASCE 7 to determine roof snow load, including snow drifting)
  - 100-year ground snow load is calculated by factoring ground snow load stipulated in City of Columbia Code of Ordinances amendments and 2012 International Building Code, and is equivalent to mapped ground snow load

Rain Load Criteria

Element	Value
Static head	5 cm (2-in)
Hydraulic head	TBD
Rainfall intensity	3.14 in./hr[a]

[A] NOAA Atlas 14, *Precipitation-Frequency Atlas of the United States*, Volume 8, Version 2.0: Midwestern States, National Oceanic and Atmospheric Administration, Silver Spring, Maryland, 2013.

TBD = to be determined.

Normal Snow Load Criteria

Element	Value
Mapped ground snow load (50-year)	[a]20 lb/ft^2
Conversion factor, 100-year to 50-year	[b]0.82
Design ground snow load, pg (100-year)	24.4 lb/ft^2
Exposure factor (Ce)	[b]1.0
Thermal factor (Ct)	[b]1.0
Importance factor	[b]1.0

[a] City of Columbia, "City of Columbia Code of Ordinances," www.gocolumbiamo.com/Council/Code_of_Ordinances_PDF/, accessed September 8, 2014.
[b] ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, American Society of Civil Engineers, Reston, Virginia, 2013.

Rain, Snow, and Ice Loading (continued)

- Extreme winter precipitation load is normal snow load plus the liquid weight of the 48-hr probable maximum winter precipitation (PMWP)
- For SSCs to be considered sensitive to ice, ice thickness and concurrent wind loads are determined using procedures in ASCE 7

Extreme Winter Precipitation Load Criteria

Element	Value
24-hr, 10-mi^2 PMWP	46.7 cm (18.2 in.)[a]
72-hr, 10-mi^2 PMWP	56.9 cm (22.5 in.)[a]
48-hr, 10-mi^2 PMWP (interpolated)	22.2 cm (8.73 in.)
Weight of 48-hr PMWP	106 lb/ft^2

[a] NWS/NOAA HR 53, *Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates*, United States East of the 105th Meridian, National Oceanic and Atmospheric Administration, Silver Spring, Maryland, 1980.

PMWP = probable maximum winter precipitation.

Atmospheric Ice Load Criteria

Element	Value[a]
Ice thickness (50-year)	2.54 cm (1 in.)
Concurrent wind speed	64.4 km/hr (40 mi/hr)
Ice thickness MRI multiplier	1.25
Wind speed MRI multiplier	1.00
Importance factor	1.00

[a] ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, American Society of Civil Engineers, Reston, Virginia, 2013.

MRI = mean recurrence interval.

Water Damage

- Flooding from Precipitation Events
  - Flood loads will be based on water level of the 100-year flood (one percent probability of exceedance per year)
    - RPF site has been determined to be above both the 100-year and the 500-year flood plain
  - Site will be graded to direct stormwater from localized downpours with a rainfall intensity for 100-year storm for a 1-hr duration around and away from RPF
    - No flooding from local downpours is expected based on standard industrial design
- Compartment Flooding from Fire Protection Discharge
  - Design of fire suppression systems using water (e.g., automatic sprinklers, hose stations) includes elements such as grading and channeling of floors, raising of equipment mounts above floors, shelving and floor drains, and other passive means
  - These features will ensure sufficient capacity for gravity-driven collection and drainage of maximum water discharge rate and duration to avoid localized flooding and resulting water damage to equipment or surrounding area
  - Safety-related systems and components will be protected from external water damage by being enclosed in a reinforced-concrete safety-related structure

Water Damage (continued)

- Compartment Flooding from Fire Protection Discharge (continued)
  - Any water-sensitive, safety-related equipment will be installed above floor slab at-grade to ensure that equipment remains above flooded floor during sprinkler discharge
  - Total discharge from failure of fire protection piping consists of the combined volume from any sprinkler and hose systems
  - In accordance with NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials* (Section 5.10), credible volume of discharge is sized for suppression system operating for a duration of 30 min
  - Design of water-sensitive, safety-related equipment will ensure that potential flooding from sprinkler discharge will not adversely affect safety features
    - Example: Equipment may be raised from the floor sufficiently such that potential flooding due to sprinkler discharge will not impact criticality analyses
- Outside of radiologically controlled area, there will be limited water discharge from fire protection systems

Seismic Damage

- Seismic analysis criteria will conform to IAEA-TECDOC-1347, *Consideration of External Events in the Design of Nuclear Facilities Other Than Nuclear Power Plants, with Emphasis on Earthquakes*
- NUREG-0800 and other NRC Regulatory Guides provide additional detailed guidance for seismic analysis and design
- Safe-Shutdown Earthquake
  - Will use a spectrum anchored to 0.20 g peak ground acceleration design basis per Regulatory Guide 1.60, *Design Response Spectra for Seismic Design of Nuclear Power Plants*
  - Soil type will not be a parameter used to determine design response spectra
  - Composition of soil surrounding will be included in the soil-structure-interaction analysis as part of building response analysis
  - Peak ground acceleration matches that of University of Missouri Research Reactor (MURR) and Calloway Nuclear Generating Station, both within 80.5 km (50 mi) of RPF site
  - Structural damping will follow recommendations of Regulatory Guide 1.61, *Damping Values for Seismic Design of Nuclear Power Plants*, which range from about 3 to 7 percent
  - Response spectra corresponding to recommended damping values of Regulatory Guide 1.61 will be used to derive seismic loads → Damping varies depending on type of SSC

Seismic Damage (continued)

- Soil-Structure Interaction and Dynamic Soil Pressures
  - Structure is supported on a shallow foundation system on stiff competent soils
  - Phase 1 Assessment (Terracon, 2011a/b) stated site is classified as Site Class C
  - Prescribed in ASCE 7, Table 20.3-1, typical shear wave velocities for soils present at site are 1,200 to 2,500 ft/sec
  - Typical practice is to define competent soil as having a shear wave velocity > 1,000 ft/sec
  - Analysis of RPF building structure to safe-shutdown earthquake will include the effects of a soil-structure interaction
  - Dynamic soil pressures will be determined using ASCE 4, *Seismic Analysis of Safety-Related Nuclear Structures and Commentary*, Section 3.5.3.2, and applied to earth retaining walls in hot cell area
- Operating Basis Earthquake
  - Operating basis earthquake was selected to be one-third safe-shutdown earthquake defined previously (based on Regulatory Guide 1.61)
  - Since this option was selected, explicit design and analysis of RPF structure for operating basis earthquake ground-motion is not required

Seismic Damage (continued)

- **Direction of Seismic Loading**
  - Design of IROFS will consider seismic loads in all three directions using a combination of square-root-of-the-sum-of-squared or 10/40/40 methodologies per Regulatory Guide 1.92, *Combining Modal Responses and Spatial Components in Seismic Response Analysis*
  - 10/40/40 methodology will be used in the development of RPF final design
- **Dynamic and Static Analysis**
  - Dynamic analyses will only be used for the evaluation of RPF structural components
  - Static analysis will be completed during final design by using a combination of static load computations to ensure SSCs remain in place and intact, and a combination of existing shake table test data and earthquake experience to ensure that equipment functions following an earthquake
- **Seismic Qualification of Subsystems and Equipment**
  - Based on characteristics and complexities of the subsystem or equipment, seismic qualification will be done by a combination of static load computations to ensure that SSCs remain in place and intact, and a combination of existing shake table test data and earthquake experience to ensure that equipment functions following an earthquake

Seismic Damage (continued)

- Seismic Instrumentation
  - Seismic recording instrumentation will be triaxial digital systems that record accelerations versus time accurately for periods between 0 and 10 sec
  - Recorders will have rechargeable batteries such that if there is a loss of power, recording will still occur
  - All instrumentation will be housed in appropriate weather and creature-proofed enclosures
  - Systems will have the capability to produce motion time histories
  - Response spectra will be computed separately
  - Purpose of the instrumentation is to:
    - Permit a comparison of measured responses of C-I structures and selected components with predetermined results of analyses that predict when damage might occur
    - Permit facility operators to understand the possible extent of damage within RPF immediately following an earthquake
    - Be able to determine when an safe-shutdown earthquake event has occurred that would require the emptying of tank(s) for inspection
  - Seismic instrumentation will not be considered an IROFS; will be treated as safety-related QL-2

Systems and Components

- Certain RPF systems and components are considered important-to-safety because they perform safety functions during normal operations or are required to prevent or mitigate consequences of abnormal operational transients or accidents
- Safety-related is a classification applied to items relied on to remain functional during or following a design basis event (DBE) to ensure the items provide a safety-related function
- Safety-related also applies to documentation and services affecting a safety-related item
- SSC functionality is relied on during or following a DBE to provide:
  - Integrity of facility infrastructure
  - Capability to shut down facility and maintain in a safe-shutdown condition
  - Capability to prevent or mitigate the consequences of postulated accidents identified through accident analyses that could result in potential off-site and worker exposures comparable to applicable guideline exposures set forth in of 10 CFR 50.270.61(b), 10 CFR 70.61(c), and 10 CFR 70.61(d), “Performance Requirements”
  - RPF operations without undue risk to workers, public, and environment to meet 10 CFR 20, “Standards for Protection Against Radiation,” normal release or exposure limits for radiation doses and applicable limits for chemical exposures

Systems and Components (continued)

- SSCs in the RPF are classified as safety-related and non-safety-related:
  - **Safety-related** is a classification applied to items relied on to remain functional during or following a postulated DBE to ensure the:
    - Integrity of the facility infrastructure
    - Capability to shut down the facility and maintain it in a safe shutdown condition
    - Capability to prevent or mitigate the consequences of postulated accidents identified through accident analyses that could result in potential offsite and worker exposures comparable to the applicable guideline exposures set forth in 10 CFR 70.61(b), 10 CFR 70.61(c), and 10 CFR 70.61 (d)
    - Operation of the facility without undue risk to the health and safety of workers, the public, and the environment to meet 10 CFR 20 normal release or exposure limits for radiation doses and applicable limits for chemical exposures
  - **Safety-related IROFS** – SSCs identified through accident analyses that are required to meet the performance requirements of 10 CFR 70.61(b), 10 CFR 70.61(c), and 10 CFR 70.61(d) (Table 3-2).
  - **Safety-related Non-IROFS** – SSCs that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of workers, the public, and environment, and includes SSCs to meet 10 CFR 20 normal release or exposure limits.
  - **Non-safety-related** – SSCs related to the production and delivery of products or services that are not in the above safety classifications

Quality Levels

- **Quality Level (QL) 1** will implement the full measure of Quality Assurance Program Plan and will be applied to safety-related SSC IROFS, including items in which failure or malfunction could directly or indirectly result in a condition that adversely affects workers, the public, and/or environment, as described in 10 CFR 70.61
  - Items to prevent nuclear criticality accidents (e.g., preventive controls and measures to ensure that under normal and credible abnormal conditions, all nuclear processes are subcritical)
  - Items credited to withstand credible design-bases external events (e.g., seismic, wind)
  - Items to prevent degradation of structural integrity (e.g., failure or malfunction of facility)
- **QL 2** will be applied to non-QL 1 safety SSCs
  - QA program is important to acceptability and suitability of item or service to perform as specified
    - SSCs to meet 10 CFR 20 normal release or exposure limits
    - Fire protection systems
    - Safeguards and security systems
    - Material control and accountability systems
- **QL 3** will include non-safety-related quality activities that are deemed necessary to ensure manufacture and delivery of highly reliable products and services to meet or exceed customer expectations and requirements
  - QL 3 items are controlled in accordance with standard commercial practices

Seismic Classification for SSCs

- SSCs identified as IROFS will be designed to satisfy the general seismic criteria to withstand the effects of natural phenomena (e.g., earthquakes, tornados, hurricanes, floods) without loss of capability to perform their safety functions
- ASCE 7, Chapter 11, sets forth criteria to which plant design bases demonstrate capability to function during and after vibratory ground-motion associated with safe-shutdown earthquake conditions
- Seismic classification methodology used complies with preceding criteria and with recommendations stated in Regulatory Guide 1.29, *Seismic Design Classification*
- Methodology classifies SSCs into three categories
  1. **Seismic Category I (C-I)**: Applies to IROFS and those SSCs required to support shutdown of RPF and maintain in safe shutdown condition both from functionality and integrity perspective
  2. **Seismic Category II (C-II)**:
     - Applies to SSCs designed to prevent collapse under the safe-shutdown earthquake from an integrity perspective
     - SSCs are classified as C-II to preclude structural failure during a safe-shutdown earthquake, or where interaction with C-I items could degrade the functioning of a safety-related SSC to an unacceptable level or could result in an incapacitating injury to occupants of main control room
  3. **Non-seismic (NS)**: NS SSCs are those that are not classified seismic C-I or C-II

System Safety/Seismic Classification and Quality Level Summary

System Safety and Seismic Classification and Associated Quality Level Group

System name (code)	Highest safety classification	Seismic classification	Quality level group
Facility structure (RPF)	IROFS	C-I	QL-1
Target fabrication (TF)	IROFS	C-I	QL-1
Target receipt and disassembly (TD)	IROFS	C-I	QL-1
Target dissolution (DS)	IROFS	C-I	QL-1
Mo recovery and purification (MR)	IROFS	C-I	QL-1
Uranium recovery and recycle (UR)	IROFS	C-I	QL-1
Waste handling (WH)	IROFS	C-I	QL-1
Criticality accident alarm (CA)	IROFS	C-I	QL-1
Radiation monitoring (RM)	IROFS	C-I	QL-1
Standby electrical power (SEP)	IROFS	C-I	QL-1
Normal electrical power (NEP)	SR	C-I	QL-1
Process vessel ventilation (PVV)	IROFS	C-I	QL-1
Facility ventilation (FV)[c]	IROFS	C-I/II	QL-1/2
Fire protection (FP)	SR	C-II	QL-2
Plant and instrument air (PA)	NSR	C-II	QL-2
Emergency Purge gas (PG)	IROFS	C-II	QL-1
Gas supply (GS)	NSR	C-II	QL-2
Process chilled water (PCW)	IROFS	C-I	QL-1
Facility chilled water (FCW)	NSR	C-II	QL-2
Facility heated water (HW)	NSR	C-II	QL-2
Process steam	IROFS	C-I	QL-1
Demineralized water (DW)	NSR	C-II	QL-2
Chemical supply (CS)	IROFS	C-I	QL-1
Biological shield (BS)	IROFS	C-I	QL-1
Facility process control (FPC)	SR	C-II	QL-2

IROFS = items relied on for safety.
NSR = non-safety related.
RPF = Radioisotope Production Facility.
SR = safety-related (not IROFS).

Design Basis Functions, Values, and Criteria

- Design basis for systems and components required for safe operation and shutdown are established in three categories:
  1. Functions
  2. Value
  3. Criteria

- Target Fabrication System (example)
  - Design basis functions
    - Store fresh low-enriched uranium (LEU), LEU target material, and new LEU target
    - Produce LEU target material from fresh and recycled LEU material
    - Assemble, load, and fabricate LEU targets
    - Reduce or eliminate the buildup of static electricity
    - Minimize uranium losses through system
  - Safety-related functions
    - Maintain subcriticality conditions within system
    - Prevent flammable gas composition within system
    - Limit personnel exposure to hazardous chemicals and offgases
  - Design basis values
    - 30-year design life with the exception of common replaceable parts (e.g., pumps)
    - Maintain primary fission product boundary during and after normal operations, shutdown conditions, and DBEs

Chapter 3 Questions?

Advisory Committee on Reactor Safeguards
Meeting on Northwest Medical Isotopes Construction Permit Application

Chapter 3
Design of Structures, Systems, and Components

July 11, 2017

Introductions

- **Michael Balazik** - Project Manager, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation

- **David Tiktinsky** - Senior Project Manager, Fuel Manufacturing Branch, Division of Fuel Cycle Safety, Safeguards, and Environmental Review, Office of Nuclear Material Safety and Safeguards

- **Alexander Adams, Jr.** - Chief, Research and Test Reactors Licensing Branch, Division of Policy and Rulemaking, Office of Nuclear Reactor Regulation

Introductions (continued)

- **Greg Hofer**- Technical Reviewer, Information Systems Laboratories, Inc.
- **Enver Odar** - Technical Reviewer, SC&A Inc.

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements:
  - 10 CFR 50.34, “Contents of applications; technical information,” paragraph (a), “Preliminary safety analysis report.”
  - 10 CFR 50.35, “Issuance of construction permits.”
  - 10 CFR 50.40, “Common standards.”
- Acceptance Criteria
  - NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors~~,~~: Standard Review Plan and Acceptance Criteria.”
  - Interim Staff Guidance Augmenting NUREG-1537, “Guidelines for Preparing and Reviewing Applications…for Licensing Radioisotope Production Facilities…,” Part 2.

Regulatory Basis and Acceptance Criteria (continued)

- Per NUREG-1537 and ISG Augmenting NUREG-1537, the design is evaluated against both the criteria of 10 CFR Part 50 and the 10 CFR 70.64(a), "Baseline Design Criteria
  - As required by 10 CFR 50.34(a)(3)(i), NWMI must describe the principal design criteria for its facility in the PSAR
  - ISG states that compliance with 10 CFR 70.64 is not specifically required for a radioisotope production facility licensed under 10 CFR 50, but a license application that adequately addresses the baseline design criteria listed in 10 CFR 70.64 would be found acceptable.

* Note that in order to operate and produce radioisotopes in the proposed NWMI facility, NWMI proposes to fabricate low-enriched targets under 10 CFR Part 70

Regulatory Basis and Acceptance Criteria (continued)

- NWMI has chosen to demonstrate that the facility will meet the performance requirements of 10 CFR 70.61 as per the ISG to NUREG-1537
- ISG states that use of Integrated Safety Analysis methodologies as described in 10 CFR 70 and NUREG-1520, application of the radiological and chemical consequence and likelihood criteria contained in the performance requirements of 10 CFR 70.61, designation of items relied on for safety, and establishment of management measures are an acceptable way to demonstrate adequate safety for the radioisotope production facility.

Review Procedures and Technical Evaluation

- Section-by-section evaluation of the technical information presented in Chapter 3 of the NWMI PSAR following NUREG-1537 (including ISG)

- Assessed sufficiency of preliminary design and expected performance of these SSCs in support of construction permit issuance

Areas of Staff Review

- Sufficiency of principle design criteria
- Design bases for the facility
- Information on types of equipment, functional requirements, and general arrangement, sufficient to provide reasonable assurance that final design will conform with design basis

Chapter 3 Sections

- Design Criteria
- Meteorological Damage and External Hazards
- Water Damage
- Seismic Damage
- Systems and Components

Design Criteria

- PSAR Section 3.1.1 provides a list of facility systems and IROFS
- PSAR Section 3.1.3 discusses the relevant NRC documents used to guide the design of the NWMI facility
- PSAR Section 3.1.7 provides the codes and standards used to guide the design of the NWMI facility
- PSAR Section 3.5.1 provides the general design basis information and classification definitions for the NWMI facility
- PSAR Section 3.5.2 discusses design criteria requirements and design basis

Meteorological Damage and External Hazards

- Meteorological Damage:
  - PSAR Section 3.2 describes how the facility is designed to withstand wind, tornado, snow, ice, and flood loadings postulated for the site location.

- External Hazards:
  - PSAR section 3.2.8 states that sources of external hazards including fires and explosions were considered by NWMI and were found not to be of concern. The proposed facility is constructed with robust, non-combustible materials with adequate setbacks from transportation routes

Water Damage

- PSAR Section 3.3 describes how the facility is designed to include flood protection measures for both external flooding and postulated flooding from failures of facility components containing liquid.
- NWMI states that flood loads on the SSCs are not considered in the design because of the elevation of the site.
  - For Safety Related SSCs below grade, the SSCs will be protected using a hardened approach (enclosed in robust reinforced concrete structure).
- The proposed site is above the 100- and 500-year flood plain.

Seismic Damage

- Safe Shutdown Earthquake (SSE):
  - PSAR Section 3.4.1 states that Safety Related SSCs of the proposed NWMI facility are designed to withstand the SSE response loads postulated for the site location, using RG 1.60 ground response spectrum anchored at 0.2 g maximum ground acceleration as was adapted by University of Missouri-Columbia research reactor and Calloway Nuclear Power Plant, which are in the proximity of the RPF site

Systems and Components

Definition of Safety Related Structures, Systems, and Components

- Safety-Related: Classification applied to items relied on to remain functional during or following a postulated design basis event
  - Safety-Related IROFS: Meet performance requirements of 10 CFR 70.61 (PSAR Table 3-2) (Quality Level 1)
  - Safety-Related non-IROFS: Meet 10 CFR Part 20 dose standards or chemical exposure limits (Quality Level 2)
- Non-Safety Related: SSCs related to production and delivery of products or services that are not in above safety classifications (Quality Level 3)

Systems and Components (continued)

Seismic Classifications

- Seismic C-I: Applies to all IROFS and SSCs required to support safe shutdown of the RPF (functionality and integrity)

- Seismic C-II: Applies to SSCs designed to prevent collapse during the SSE (integrity) or interaction with C-I that results in degradation of functionality

- Non-Seismic: Applies to SSCs that are not classified as either C-I or CI-II

Evaluation Findings and Conclusions

- Accordingly, NWMI has met the following requirements of 10 CFR 50.35 for issuance of a construction permit, with respect to the design of structures, systems and components:

  1) Design of systems and structures have been described, including the principal architectural and engineering criteria for the design

  2) Further technical or design information may be reasonably left for later consideration in the FSAR

  3) Reasonable assurance that the proposed facility can be constructed and operated without undue risk to the health and safety of the public

U.S. Nuclear Regulatory Commission
ACRS Subcommittee Review

Chapter 6 – Engineered Safety Features

July 11, 2017

Engineering Safety Features Strategy

- Engineered safety features (ESF) are active or passive features designed to mitigate consequences of accidents and to keep radiological exposures to workers, public, and environment within acceptable values
- ESF associated with confinement of the process radionuclides and hazardous chemicals for the RPF are summarized in Table 6-1
  - Accidents mitigated
  - Structures, systems, and components (SSC) used to provide ESFs
- Additional IROFS associated with the confinement system were derived from accident analyses developed in Chapter 13 and listed in Table 6-1
- Current design approach does not anticipate requiring containment or an emergency cooling system as ESFs

Liquid Sprays and Spills Accident (Chapter 13)

- Liquid solution spills and spray events causing a radiological and criticality hazard
- Three solutions evaluated to bound the range of process streams
- Multiple initiating conditions, a "not unlikely" frequency
- Parameter definitions derived from NUREG/CR-6410, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*
- Mitigation of radioactive consequence required
- Prevention of criticality accident required

- Shielding
  - Hot cell walls
  - Cover block
  - Leaded windows
- Liquid confinement
  - Hot cell liners
  - Overflow drain/seal pots
  - Hot cell penetration requirements
- Criticality
  - Pencil tanks and vessel spacing
  - Floor and sump geometry control
  - Double wall piping our geometry areas
- Gaseous confinement
  - Zone I exhaust system (e.g., HEPA filters, ducting/flow path, dampers, and stack)
  - Process ventilation iodine removal unit and Zone I high-efficiency gas adsorption (HEGA) filtration system

Dissolver Offgas Accident (Chapter 13)

- Reduced efficiency of the dissolver offgas iodine removal unit (IRU) due to process upset or equipment failure
- Operator error or equipment failure initiating conditions (including loss of power), a "not unlikely" frequency
- Conservatively, all the iodine from a dissolver batch is not captured; about 70% less iodine than the maximum hypothetical accident (MHA)
- Mitigation of release consequence required
- IROFS reduce consequences
- Primary offgas relief system
  - Relief tank with capacity to hold the gases from a complete dissolution on loss of vacuum (or power)
- Gaseous confinement
  - Process ventilation has an IRU
  - Zone I HEGA
  - Spare dissolver IRU trains

Leaks into Auxiliary Services and Systems (Chapter 13)

- Liquid solutions leak into secondary containment with radiological and criticality consequences
- Operator error or equipment failure (e.g., tank cooling jacket) initiating conditions, a "not unlikely" frequency
- Secondary cooling and heating loops
- Prevention of criticality accident required
- Hot cell shielding boundary protects worker for high-dose solutions
- Six different criticality IROFS
  - Pencil tanks and vessel spacing
  - Closed safe-geometry loops with monitoring and alarms
  - Evaporator condensers have monitoring and alarms
  - Uranium evaporators condensate monitoring
  - Backflow prevention
  - Safe-geometry day tanks

Engineering Safety Features (Chapter 6)

Summary of Confinement Engineered Safety Features (2 pages)

Engineered safety feature	IROFS	Accident(s) mitigated	SSCs providing engineered safety features	Detailed description section
Confinement includes: • Hot cell liquid confinement boundary • Hot cell secondary confinement boundary • Hot cell shielding boundary	RS-01 RS-03 RS-04	• Equipment malfunction and/or maintenance • Hazardous chemical spills	• Confinement enclosures, including penetration seals • Zone I exhaust ventilation system, including ducting, filters, and exhaust stack • Zone I inlet ventilation system, including ducting, filters, bubble-tight isolation dampers • Ventilation control system • Secondary iodine removal bed • Berms	6.2.1.1 through 6.2.1.6
Confinement IROFS Derived from Accident Analyses and Potential Technical Specifications				
Primary offgas relief system	RS-09	Dissolver offgas failure during dissolution operation	• Pressure relief device • Pressure relief tank	6.2.1.7.1
Active radiation monitoring and isolation of low-dose waste transfer	RS-10	Transfer of high-dose process liquid outside the hot cell shielding boundary	Radiation monitoring and isolation system for low-dose liquid transfers	6.2.1.7.2
Cask local ventilation during closure lid removal and docking preparations	RS-13	Target cladding leakage during shipment	Local capture ventilation system over closure lid during lid removal	6.2.1.7.3
Cask docking port enabler	RS-15	Cask not engaged in cask docking port prior to opening docking port door	Sensor system controlling cask docking port door operation	6.2.1.7.4
Process vessel emergency purge system	FS-03	SSC damage due to hydrogen deflagration or detonation	Backup bottled nitrogen gas supply	6.2.1.7.5
Irradiated target cask lifting fixture	FS-04	Dislodging the target cask shield plug while workers present during target unloading activities	• Cask lifting fixture design that prevents cask tipping • Cask lifting fixture design that prevents lift from toppling during a seismic event	6.2.1.7.6

Engineering Safety Features – Chapter 6 (continued)

Summary of Confinement Engineered Safety Features (2 pages)

Engineered safety feature	IROFS	Accident(s) mitigated	SSCs providing engineered safety features	Detailed description section
Exhaust stack height	FS-05	• Equipment malfunction resulting in liquid spill or spray • Carbon bed fire	• Zone I exhaust stack	6.2.1.7.7
Double-wall piping	CS-09	Solution spill in facility area where spill containment berm is neither practical nor desirable for personnel chemical protection purposes	Double-wall piping for selected transfer lines	6.2.1.7.7
Backflow prevention devices Safe geometry day tanks	CS-18 CS-19	High worker exposure from backflow of high-dose solution	Backflow prevention devices located on process lines crossing the hot cell shielding boundary	6.2.1.7.9
Dissolver offgas iodine removal unit	–	• Potential limiting control for operation • Primary iodine control system during normal operation	Dissolver offgas iodine removal units (DS-SB-600A/B/C)	6.2.1.8
Dissolver offgas primary adsorber	–	• Potential limiting control for operation • Primary noble gas control system during normal operation	Dissolver offgas primary adsorber units (DS-SB-620A/B/C)	6.2.1.8.2
Dissolver offgas vacuum receiver or vacuum pump	–	• Potential limiting control for operation • Motive force for dissolver offgas	• Dissolver offgas vacuum receiver tanks (DS-TK-700A/B) • Dissolver offgas vacuum pumps (DS-P-710A/B)	6.2.1.8.3

IROFS = items relied on for safety.

SSC = systems, structures, and components.

Criticality IROFS (Chapter 6)

Summary of Criticality Engineered Safety Features (2 pages)

Engineered safety feature	IROFS	SSC features providing engineered safety features	Detailed description section
Interaction control spacing provided by passively designed fixtures and workstation placement	CS-04	Defines spacing between SSC components using geometry to prevent nuclear criticality	6.3.1.2.1
Pencil tank, vessel, or piping safe geometry confinement using the diameter of tanks, vessels, or piping	CS-06	Defines dimensions of SSCs using geometry to prevent nuclear criticality	6.3.1.2.2
Pencil tank geometry control on fixed interaction spacing of individual tanks	CS-07	Defines spacing between different SSCs using geometry to prevent nuclear criticality	6.3.1.2.3
Floor and sump geometry control on slab depth, and sump diameter or depth for floor dikes	CS-08	Defines sump geometry and dimensions for SSCs using geometry to prevent nuclear criticality	6.3.1.2.4
Double-wall piping	CS-09	Defines transfer line leak confinement in locations where sumps under piping are neither feasible nor desirable	6.3.1.2.5
Closed safe-geometry heating or cooling loop with monitoring and alarm	CS-10	Closed-loop heat transfer fluid systems to prevent nuclear criticality or transfer of high-dose material across shielding boundary in the event of a leak into the heat transfer fluid	6.3.1.2.6
Simple overflow to normally empty safe-geometry tank with level alarm	CS-11	Overflow to prevent nuclear criticality from fissile solution entering non-geometrically favorable ventilation equipment	6.3.1.2.7
Condensing pot or seal pot in ventilation vent line	CS-12	Seal pots to prevent nuclear criticality from fissile solution entering non-geometrically favorable ventilation equipment	6.3.1.2.8
Simple overflow to normally empty safe geometry floor with level alarm in the hot cell containment boundary	CS-13	Overflow to prevent nuclear criticality from fissile solution entering non-geometrically favorable ventilation equipment	6.3.1.2.9

Criticality IROFS (Chapter 6) (continued)

Summary of Criticality Engineered Safety Features (2 pages)

Engineered safety feature	IROFS	SSC features providing engineered safety features	Detailed description section
Condensing pot or seal pot in ventilation vent line	CS-12	Seal pots to prevent nuclear criticality from fissile solution entering non-geometrically favorable ventilation equipment	6.3.1.2.8
Simple overflow to normally empty safe geometry floor with level alarm in the hot cell containment boundary	CS-13	Overflow to prevent nuclear criticality from fissile solution entering non-geometrically favorable ventilation equipment	6.3.1.2.9
Active discharge monitoring and isolation	CS-14	Information to be provided in the Operating License Application	6.3.1.2.10
Independent active discharge monitoring and isolation	CS-15	Information will be provided in the Operating License Application	6.3.1.2.11
Backflow prevention device	CS-18	Backflow prevention to preclude fissile or high dose solution from crossing shielding boundary to non-geometrically favorable chemical supply tanks and prevent nuclear criticality	6.3.1.2.12
Safe geometry day tanks	CS-19	Alternate backflow prevention device	6.3.1.2.13
Evaporator or concentrator condensate monitoring	CS-20	Prevent nuclear criticality from high-volume transfer to non-geometrically favorable vessels in solutions with normally low fissile component concentrations	6.3.1.2.14
Processing component safe volume confinement	CS-26	Defines volume of SSCs to prevent nuclear criticality	6.3.1.2.15
Closed heating or cooling loop with monitoring and alarm	CS-27	Closed-loop, high-volume heat transfer fluid systems to prevent nuclear criticality or transfer of high-dose material across shielding boundary in the event of a leak into the heat transfer fluid with normally low fissile component concentrations	6.3.1.2.16

IROFS = items relied on for safety. SSC = systems, structures, and components.

Confinement Strategy

- Principal design and safety objectives to protect workers, public, and environment → Personnel protection control features (e.g., adequate shielding and ventilation control) will minimize hazards normally associated with radioactive or chemical materials
- An enclosure of the facility (e.g., RPF hot cell area) that is designed to limit exchange of effluents between the enclosure and its external environment to controlled or defined pathways
  - Should include capability to maintain sufficient internal negative pressure to ensure in-leakage (i.e., prevent uncontrolled leakage outside of the confined area)
  - Does not need to be capable of supporting positive internal pressure or significantly shielding the external environment from internal sources of direct radiation
  - Air movement in a confinement area can be integrated into HVAC systems (e.g., exhaust stacks or vents to the external environment, filters, blowers, and dampers)
- Describes low-leakage boundary surrounding radioactive or hazardous chemical materials released during an accident to facility regions surrounding the physical process equipment containing process materials
- Localize releases of radioactive or hazardous materials to controlled areas and mitigate consequences of accidents

Confinement System Safety Functions

Confinement System Safety Functions

System, structure, component	Description	Classification
Zone I enclosure inlet isolation dampers and ducting leading from isolation dampers to enclosures	Provide confinement isolation at Zone I/Zone II enclosure boundaries	IROFS
Zone I enclosure exhaust ducting leading from enclosures to the exhaust stack, filters, and exhaust stack	Provides confinement to the confinement exhaust boundary	IROFS
Process vessel vent exhaust ducting leading from process vessels to Zone I exhaust plenum	Provides confinement to the confinement exhaust boundary	IROFS
Ventilation control system	Provides stack monitoring and interlocks to monitor discharge and signal changing on service filter trains during normal and abnormal operation	IROFS
Secondary iodine removal bed	Mitigates a release of the iodine inventory in the dissolver offgas treatment system	IROFS
Hot cells, tank vaults, and glovebox enclosure structures	Provide solid, liquid, gas confinement	IROFS

IROFS = item relied on for safety.

Operations – Confinement

- During normal operation, passive confinement will be provided by contiguous boundary (passive) between hazardous materials and surrounding environment and is credited with confining hazards generated as a result of accident scenarios
- Passive boundary includes enclosure structures and extension of structures through Zone I ventilation components
  - Intent of passive boundary is to confine hazardous materials while also preventing disturbance of hazardous material inventory by external energy sources.
  - Passive confinement boundary extends from the isolation valve downstream of intake high-efficiency particulate air (HEPA) filter to exhaust stack
- In event of process material release to a confinement enclosure will be confined by enclosure structural components
  - Each process line that connects with vessels located outside of a confinement boundary with vessels located inside a confinement boundary will be provided with backflow prevention devices to prevent releases of gaseous or liquid material
  - Backflow prevention devices on piping penetrating the confinement boundary will be:
    - Designed as passive devices
    - Located as near as practical to the confinement boundary or take a position that provides greater safety on loss of actuating power

Consequences – Confinement

- Uncontrolled releases within a confinement enclosure or off-site consequences of releasing fission products through ventilation systems will be mitigated by use of active components → e.g., bubble-tight isolation dampers as IROFS on inlet ventilation ducting to each enclosure
  - ESF ducting to confinement volume needs to remain intact to achieve enclosure confinement
  - Dampers will close automatically (fail-closed) on loss of power and ventilation system will automatically be placed into passive ventilation operating mode
- Performance assurance of active confinement components will be achieved through factory testing and in-place testing
  - Duct and housing leak tests will be performed in accordance with minimum acceptance criteria (ASME AG-1, *Code on Nuclear Air and Gas Treatment*)
  - Specific requirements with respect to acceptable leak rates will be based on safety analysis
- Berms will employ a passive confinement methodology
  - Passive confinement will be achieved through a continuous boundary between hazardous materials and surrounding area
  - In the event of an accidental release, hazardous liquid will be confined to limit exposed surface area

Functional Requirements – Confinement

- Structural components
  - Capture and contain liquid or solid releases to prevent material from exiting boundary and causing high dose to a worker or public or producing significant environment contamination
  - Prevent spills or sprays of radioactive solution that are acidic or caustic from causing adverse exposure to personnel through direct contact with skin, eyes, and mucus membranes (e.g., where combination of chemical exposure and radiological contamination would lead to serious injury and long-lasting effects)
- Ventilation components
  - Provide negative air pressure in hot cell (Zone I) relative to lower zones outside of hot cell using exhaust fans equipped with HEPA filters and HEGA to reduce the release of radionuclides (both particulate and gaseous) outside primary confinement boundary
    - Mitigate high-dose radionuclide releases to maintain exposure to acceptable levels to workers and public in a highly reliable and available manner (10 CFR 20 release limits during normal and abnormal operations)
  - Hot cell secondary confinement boundary will perform this function using a system of passive and active engineered features to ensure a high level of reliability and availability
  - Removing iodine isotopes present in process vessel vent under accident conditions → Comply with 10 CFR 70.61 for an intermediate consequence release

Structural Components – Confinement

- Sealed flooring will provide multiple layers of protection from release to environment
- Diked areas will contain specific releases
  - Sumps of appropriate design will be provided with remote-operated pumps to mitigate liquid spills by capturing liquids in appropriate safe-geometry tanks
- ^{99}Mo purification clean room, smaller confinement catch basins will be provided under points of credible spill potential in addition to sealed floors
- Entryway doors into a designated liquid confinement area will be sealed against credible liquid leaks to outside boundary
- Piping penetrations and air ducts will be located to minimize the potential for liquid leaks across the confinement boundary

Credited Components – Confinement

- Ventilation System
  - Zone I inlet HEPA filters will provide an efficiency of greater than 99.9% for removal of radiological particulates from air that may reverse flow from Zone I to Zone II
  - Zone I ducting will ensure that negative air pressure can be maintained by conveying exhaust air to the stack
    - Bubble-tight dampers will comply with the requirements of ASME AG-1, Section DA-5141
    - Ventilation ductwork and ductwork support materials will meet the requirements of ASME AG-1
    - Supports will be designed and fabricated in accordance with the requirements of ASME AG-1
  - Zone I exhaust train HEPA filters will provide an efficiency of >99.95% for removal of radiological particulates from air that flow to the stack
  - Zone I exhaust train HEGA filters will provide an efficiency of >90% for iodine removal
  - Zone I exhaust stack will provide dispersion of radionuclides in normal and abnormal releases at a discharge point of 75 feet above building ground level
  - Stack monitoring and interlocks will monitor discharge and signal changing of service filter trains during normal and abnormal operations
- Offgas Systems
  - Secondary process offgas treatment iodine removal beds will mitigate an iodine release

IROFS RS-09, Primary Offgas Relief System

Overview

- As an active engineered control (AEC), primary offgas relief system will be a component for both target dissolvers
- Dissolver offgas system is intended to operate at a pressure that is less than confinement enclosures to maintain gaseous components generated during dissolution within vessels and route gaseous components through offgas treatment unit operations
- Primary offgas relief system, or pressure relief tank, will be used to confine gases to dissolver and a portion of dissolver offgas equipment, if offgas motive force (vacuum pumps) ceases operation during target batch dissolution

Accident Mitigated

- Dissolver offgas system malfunctions (e.g., loss of power during target dissolution operations)

System Components

- Pressure relief valves
- Pressure relief tank

Functional Requirements

- Use relief device to relieve pressure from system to an on-service receiver tank maintained at vacuum with capacity to hold the gases generated by dissolution of one target batch
- Prevent failure of primary confinement system by capturing gaseous effluents in a vacuum receiver tank

IROFS RS-10, Active Radiation Monitoring and Isolation of Low-Dose Waste Transfer

- Overview
  - As an AEC, recirculating stream and discharge stream of low-dose waste tank will be simultaneously monitored in a background shielded trunk outside of hot cell shielded cavity
  - Continuous gamma instrument will monitor the transfer lines to provide an open permissive signal to dedicated isolation valves
- Accident Mitigated
  - Transfer of high-dose process liquid solutions outside hot cell shielding boundary
- System Components
  - Additional detailed information of the radiation monitor and isolation of low-dose waste transfers will be developed for Operating License Application
- Functional Requirement
  - Maintain worker and public exposure rates within approved limits

IROFS RS-13, Cask Local Ventilation During Closure Lid Removal and Docking Preparations

- **Overview**
  - As an AEC, a local capture ventilation system will be used over irradiated target cask closure lid to remove any escaped gases from worker breathing zone during removal of the closure lid, removal of the shielding block bolts, and installation of lifting lugs
- **Accident Mitigated**
  - Irradiated target cladding fails during transportation, releasing gaseous radionuclides within the cask containment boundary
- **System Components**
  - Use a dedicated evacuation hood over top of cask during containment closure lid removal
  - Remove gases to the Zone I secondary confinement system for processing
- **Functional Requirement**
  - Prevent exposure to workers by evacuating any high-dose gaseous radionuclides from worker breathing zone and preventing immersion of worker in a high-dose environment

IROFS RS-15, Cask Docking Port Enabling Sensor

- Overview
  - As an AEC, cask docking port will be equipped with sensors that detect when a cask is mated with cask docking port door
- Accident Mitigated
  - Cask lift failure occurs after shield plug removal (but before target basket removal) with targets inside the cask
- System Components
  - Enabling contact signal and positive closure signal when sensor does not sense a cask mated to cask docking port, causing cask docking port door to close
- Functional Requirement
  - Prevent cask docking port door from being opened and allowing a streaming radiation path to areas accessible by workers

IROFS FS-03, Process Vessel Emergency Purge System

- **Overview**
  - Hydrogen gas will be evolved from process solutions through radiolytic decomposition of water in high radiation fields
  - An air purge to vapor space of selected tanks will be provided by facility air compressors to control the hydrogen concentration from radiolysis in vessel vapor space to below flammability limit for hydrogen
  - As an AEC, emergency backup set of bottled nitrogen gas will be provided for all tanks that have potential to evolve significant volumes of hydrogen gas through radiolytic decomposition of water (both a short- and long-term storage condition)
- **Accident Mitigated**
  - Hydrogen deflagration or detonation in a process vessel
- **System Components**
  - Information will be provided for Operating License Application
- **Functional Requirement**
  - Prevent development of an explosive hydrogen-air mixture in tank vapor spaces to prevent deflagration or detonation hazard

IROFS FS-04, Irradiated Target Cask Lifting Fixture

- **Overview**
  - As a passive engineered control (PEC), irradiated target cask lifting fixture will be designed to prevent cask from tipping within fixture and fixture itself from toppling during a seismic event
- **Accident Mitigated**
  - Dislodged irradiated target shipping cask shield plug in the presence of workers during target unloading activities
- **System Components**
  - Detailed information on system components will be developed for Operating License Application
- **Functional Requirement**
  - Detailed information on system functional requirements will be developed for Operating License Application

IROFS FS-05, Exhaust Stack Height

- Overview
  - As a PEC, the exhaust stack is designed and fabricated with a fixed height for safe release of the gaseous effluents during a seismic, fire, or explosion event
- Accidents Mitigated
  - Process solution spills and sprays
  - Carbon bed fire
- System Component
  - Zone I exhaust stack
- Functional Requirement
  - Provide an offgas release height for ventilation gases consistent with stack height used as input to mitigated dose consequence evaluations

IROFS CS-09, Double-Wall Piping

- **Overview**
  - Has both confinement and nuclear criticality prevention function
  - As a PEC, piping system conveying fissile solution between credited confinement locations will be provided with a double-wall barrier to contain any spills that may occur from primary confinement piping
  - Used at those locations that pass through facility, where creating a spill containment berm under piping is neither practical nor desirable for personnel chemical protection purposes
- **Accident Mitigated**
  - Leak in piping that passes between confinement enclosures
- **System Components**
  - Transfer piping containing fissile solutions traversing between hot cell walls
  - Transfer piping connecting uranium product transfer send tank and uranyl nitrate storage tank
  - Other locations to be identified in Operating License application
- **Functional Requirements**
  - Double-wall piping prevents personnel injury from exposure to acidic or caustic licensed material solutions conveyed in piping that runs outside a confinement enclosure
  - Double-wall piping routes pipe leaks to a critically safe leak collection tank or berm as a nuclear criticality control feature

IROFS CS-18/19, Backflow Prevention Devices/Safe-Geometry Day Tanks

- Overview
  - As a PEC or AEC, chemical and gas addition ports to fissile process solution systems will enter a confinement enclosure through a backflow prevention device
  - Backflow prevention devices and safe-geometry day tanks will provide alternatives for preventing process addition backflow across confinement boundaries
  - Device may be an anti-siphon break, an overloop seal, or other active engineering feature that addresses conditions of backflow and prevents fissile solution from entering non-safe geometry systems or high-dose solutions from exiting hot cell shielding boundary in an uncontrolled manner
- Accident Mitigated
  - Backflow of process material located inside a confinement boundary to vessel located outside confinement via connected piping due to process upset
- System Components
  - System component information will be provided in Operating License Application

- Functional Requirements
  - Prevent fissile solutions and/or high-dose solutions from backflowing from tank into systems outside confinement boundaries that may lead to accidental criticality or high exposures to workers
  - Provide each hazardous location with an engineered backflow prevention device that provides high reliability and availability for that location
  - Locate the backflow prevention device features for high-dose product solutions inside confinement boundaries
  - Support backflow prevention devices with safe-geometry day tanks located inside confinement boundary
  - Direct spills from backflow prevention device to a safe-geometry confinement berm

ESF – Dissolver Offgas Iodine Removal Unit

- **Overview**
  - Significant fraction of iodine entering RPF will be released to dissolver offgas during dissolution
  - Dissolver offgas IRUs will be included in RPF as the primary SSCs for controlling release of iodine isotopes to the environment or facility areas occupied by workers
  - Components of dissolver offgas system (beginning with IRU) will also be used to treat vent gas from target disassembly system
    - Target disassembly vent gas is treated by dissolver offgas components as a measure to mitigate unverified potential for a release of fission gas radionuclides during target transportation
- **Accidents Mitigated**
  - Projected limiting control/condition for operation
  - Required for normal operation and not for accident mitigation
- **System Components**
  - Iodine removal units A, B, and C
- **Functional Requirement**
  - Remove iodine isotopes from the dissolver offgas during normal operations
    - Dose to workers complies with 10 CFR 20.1201, "Occupational Dose Limits for Adults"
    - Dose to the public complies with 10 CFR 20.1301, "Dose Limits for Individual Members of the Public"

ESF – Dissolver Offgas Primary Adsorber

- **Overview**
  - Noble gases (e.g., Kr, Xe) entering RPF in targets are projected to be released to dissolver offgas during target dissolution
  - Dissolver offgas primary adsorber units will be included in RPF as primary SSCs for controlling release of noble gas isotopes to environment or facility areas occupied by workers
  - Components of dissolver offgas system will also be used to treat vent gas from target disassembly system
    - Target disassembly vent gas is treated by dissolver offgas components configuration as a measure to mitigate unverified potential for release of fission gas radionuclides during target transportation
- **Accidents Mitigated**
  - Projected limiting control for operation
  - Required for normal operation and not for accident mitigation
- **System Components**
  - Primary adsorber A, B, and C
- **Functional Requirement**
  - Delay release of noble gas isotopes via the dissolver offgas during normal operations
    - Dose to workers complies with 10 CFR 20.1201
    - Dose to the public complies with 10 CFR 20.1301

ESF – Dissolver Offgas Vacuum Receiver/Vacuum Pump

- **Oversight**
  - Offgas vacuum pump will provide motive force for transferring offgas, generated in dissolvers and disassembly equipment during operation, through the dissolver offgas equipment train while maintaining dissolver vessels at a pressure greater than equipment enclosure pressure
  - Vacuum receiver tanks will be provided as part of motive force system to allow vacuum pumps to cycle on and off less frequently and accommodate wide variations in gas flow rate associated with a target dissolution cycle
- **Accidents Mitigated**
  - Projected limiting control for operation
  - Required for normal operation and not for accident mitigation
- **System Components**
  - Vacuum receiver tank A and B
  - Vacuum pump A and B
- **Functional Requirements**
  - Maintain dissolver vessel gas space at a pressure less than dissolver vessel enclosure pressure throughout target dissolution cycle
  - Accommodate pressure drops associated with dissolver offgas unit operations over range of gas flow rates generated in both dissolvers and target disassembly equipment vent throughout a target dissolution cycle

Other ESFs

- **Effluent Monitoring System**
  - Each RPF exhaust stack will include an effluent monitoring system
  - Monitoring system sample lines will comply with ANSI N13.1, *Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities*
  - Additional detailed information will be provided in the Operating License Application
- **Radioactive Release Monitoring**
  - Effluent monitoring system will provide flow rate, temperature, and composition inputs for dispersion modeling of releases from exhaust stacks
  - Inputs will provide the capability for calculating potential exposures as a basis for actions to ensure that the public is protected during both normal operation and accident conditions
  - Additional detailed information will be provided in the Operating License Application
- **Confinement System Mitigation Effects**
  - Information will compare radiological exposures to RPF staff and public with and without confinement system ESF
  - Comparison will be based on analyses showing airflow rates, reduction in quantities of airborne radioactive material by filter systems, system isolation, and other parameters that demonstrate the effectiveness of system
  - Additional detailed information will be provided in the Operating License Application

Criticality Overview

- Used "first principles" and guides as bases for equipment design and process area layouts
  - Geometry constraints (e.g., pencil tank diameters)
  - Tank array spacing (conservative)
  - Consideration of transition from "safe-geometry" process equipment to less-restricted waste staging and processing equipment
- Evaluations and Analysis
  - Monte Carlo N-Particle (MCNP) code validation and upper subcritical limits (USL) for all areas of applicability
  - Develop project-specific single-parameter criticality limits for uranium enrichment, forms, and basic geometries
- Organization of CSEs
  - Normal operating conditions described
  - Criticality hazard evaluation
  - Contingency analysis
  - Double contingency controls

Criticality Safety Evaluation (CSE) Documents
Irradiated Target Handling and Disassembly
Irradiated Low-Enriched Uranium Target Dissolution
Molybdenum-99 Recovery
Low-Enriched Uranium Target Material Production
Target Fabrication Uranium Solution Processes
Target Finishing
Target and Can Storage and Carts
Hot Cell Uranium Purification
Liquid Waste Processing
Solid Waste Collection, Encapsulation, and Staging
Offgas and Ventilation
Target Transport Cask and Drum Handling
Analytical Laboratory

Calculations

- *Single Parameter Subcritical Limits for 20 wt% ^{235}U - Uranium Metal, Uranium Oxide, and Homogenous Water Mixtures*
- *Irradiated Target Low-Enriched Uranium Material Dissolution*
- *55-Gallon Drum Arrays*
- *Single Parameter Subcritical Limits for 20 wt% ^{235}U - Low-Enriched Uranium Target Material*
- *Target Fabrication Tanks, Wet Processes, and Storage*
- *Tank Hot Cell*

MCNP Validation (ANSI/ANS 8.24 Requirement)

- MCNP 6.1, Continuous Energy ENDF/B- VII.1 Cross-Section
- Define operation/process to identify range of parameters to be validated
- 92 criticality safety experiments were selected that adequately match uranium enrichment, geometry, moderator, reflector, and neutron energy
- Define area of applicability (AOA) of the validation
- Analyzed data
  - Determined bias and bias uncertainty
  - Identified trends in data → No trends were identified
  - Test for normal or other distribution and select statistical method for data treatment
  - Identify and support subcritical margin – margin of subcriticality (MoS) of 0.05 Δk
  - Calculate USL – 0.9240

Criticality Parameters

- RPF divided into 13 activity groups for development of preliminary CSEs of activities and associated equipment
- Controlled nuclear criticality safety parameters vary with activity group
- A minimum of two nuclear criticality safety parameters are controlled to satisfy double-contingency principle

Controlled Nuclear Criticality Safety Parameters

Nuclear parameter	NWMI criticality safety evaluation (NWMI-2015-CSE[a])												
	001	002	003	004	005	006	007	008	009	010	011	012	013
Mass	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y[b]	Y	Y
Geometry	Y	Y	Y	Y	Y	Y[c]	Y[c]	Y	N	Y	Y	Y	Y
Moderation	Y	N	N	N	N	N	N	N	N	N	N	N	N
Interaction	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
Volume	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	Y
Concentration/ density	N	Y[d]	Y[d]	Y[d]	Y[d]	N	N	N	Y[e]	Y[e]	Y[e]	N	N
Reflection	N	N	N	N	N	N	N	N	N	N	N	N	N
Absorbers	N	N	N	N	N	N	N	N	N	N	N	N	N
Enrichment[f]	N	N	N	N	N	N	N	N	N	N	N	N	N

[a] Derived from the indicated CSE reference document.
[b] Limited by nature of process in the air filtration.
[c] Limited by target design.
[d] Controlled through input fissile mass.
[e] Limited by total uranium mass allowed in the system.
[f] Facility license limited to ≤20 wt% ^{235}U.

IROFS CS-04, Interaction Control Spacing via Passively Designed Fixtures and Workstation Placement

- During handling of uranium solids and solutions outside of processing systems under normal conditions, material will be handled in safe masses controlled by either physical measurement or batch limits on well-characterized devices
- Solid uranium will be handled outside of processing systems during:
  - Receipt and processing of fresh uranium (and presumably shipment of spent uranium back to the supplier)
  - Fabrication of targets using sintered LEU target material (including movement of LEU target material to and from the fabrication workstation and handling of the completed targets)
  - Disassembly of targets following irradiation
  - Laboratory sampling and analysis activities (in smaller quantities)
- Each activity is assigned a mass or batch limit for safe handling

- Chapter 13 (preliminary hazards analysis) identified a number of individual potential initiating events that could lead to a spill of fissile solution from geometrically safe confinement tanks, vessels, or piping that provide primary safety functions of the processes
- Four processing systems will handle fissile solutions:
  - Target fabrication (from the uranium dissolution tanks to the gelation column)
  - Target dissolution system
  - First stage of molybdenum recovery and purification
  - Entire uranium recovery and recycle system
- Three systems partially located within hot cell wall boundary due to high-dose of fission products
- Initiating events include general categories of tank, vessel, or piping failure due to operator error (valves out of position), valves leaking, equipment leaking (e.g., pumps, piping, vessels), high-pressure events from various causes, including high-temperature solutions (locked in boundary valves), hydrogen detonation, and exothermic reactions with the wrong resins or reagents used in respective systems
- Some initiators result in small leaks that are identified and mitigated (e.g., pump seal and small valve leaks)
- Over the life of facility, these types of leaks are to be expected, but do not challenge overall safety of operations

Other IROFS

All criticality IROFS are identified by preliminary safety analysis report (PSAR) accident analyses (Chapter 13)

- IROFS CS–07, Pencil Tank Geometry Control on Fixed Interaction Spacing of Individual Tanks
  - As a PEC, pencil tank and vessel spacing control using fixed interaction spacing of individual tanks or vessels
- IROFS CS–08, Floor and Sump Geometry Control on Slab Depth, Sump Diameter or Depth for Floor Dikes
  - As a PEC, floor and sump geometry control of slab depth, sump diameter or depth for floor spill containment berms will be provided
- IROFS CS–09, Double-Wall Piping
  - As a PEC, a piping system for conveying fissile solution between confinement structures will be provided with a double-wall barrier to contain any spills that may occur from primary piping
- IROFS CS–10, Closed Safe Geometry Heating or Cooling Loop with Monitoring and Alarm
  - As a PEC, a closed-loop, safe-geometry heating or cooling loop with monitoring for uranium process solution or high-dose process solution will be provided to safely contain fissile process solution that leaks across heat transfer fluid boundary if primary boundary fails

Other IROFS (continued)

- IROFS CS–11, Simple Overflow to Normally Empty Safe Geometry Tank with Level Alarm
  - As a PEC, a simple overflow line will be installed below level of process vessel ventilation port and any chemical addition ports (where an anti-siphon safety feature will be installed) for each vented tank containing fissile or potentially fissile process solution for which this IROFS is assigned
- IROFS CS–12, Condensing Pot or Seal Pot in Ventilation Vent Line
  - As a PEC, a safe-geometry condensing pot or seal pot will be installed downstream of each tank for which this IROFS is assigned to capture and redirect liquids to a safe-geometry tank or flooring area with safe-geometry sumps
  - One such condensing or seal pot may service several related tanks within the safe-geometry boundary of the ventilation system
  - Condensing or seal pot will prevent fissile solution from flowing into respective non-geometrically favorable process ventilation system by directing solution to a safe-geometry tank or flooring area with safe-geometry sumps

Other IROFS (continued)

- IROFS CS–13, Simple Overflow to Normally Empty Safe Geometry Floor with Level Alarm in the Hot Cell Containment Boundary
  - As a PEC, simple overflow line will be installed above high alarm setpoint for each vented tank containing fissile or potentially fissile process solution for which this IROFS is assigned
  - Overflow will be directed to one or more safe-geometry flooring configurations with safe-geometry sumps
- IROFS CS–14, Active Discharge Monitoring and Isolation
  - As an AEC for discharges from safe-geometry systems to non-favorable geometry systems, an active uranium detection system will be used to close an isolation valve in discharge line at a uranium concentration limit and/or cumulative mass limit
  - System will prevent a high-concentration uranium solution from being discharged to a non-favorable geometry system
- IROFS CS–15, Independent Active Discharge Monitoring and Isolation
  - As an AEC for discharges from safe-geometry systems to non-favorable geometry systems, an independent active uranium detection system will be used to close an independent isolation valve in discharge line at a uranium concentration limit and/or cumulative mass limit
  - System will prevent a high concentration uranium solution from being discharged to a non-favorable geometry system

Other IROFS (continued)

- **IROFS CS-16**, Sampling and Analysis of U Mass/Concentration Prior to Discharge/Disposal
  - As an augmented administrative control (AAC), prior to initiating discharge from the safe-geometry container, tanks, or vessels assigned IROFS CS-16 to non-favorable geometry systems, the container, tank, or vessel will be isolated and placed under administrative control, recirculated or otherwise uniformly mixed, sampled, and sample analyzed for uranium content
  - Discharge or disposal will only be approved following independent review of sample results to confirm that uranium content is below a concentration or a mass limit (to be determined for each individual application based on expected volumes and follow-on processing needs)
  - Disposal container or vessel uranium mass will be tracked to ensure that the mass or concentration limit for container is not exceeded
- **IROFS CS-17**, Independent Sampling and Analysis of U Concentration Prior to Discharge/Disposal
  - As an AAC, prior to initiating discharge from safe-geometry tanks or vessels assigned IROFS CS-17 to non-favorable geometry systems, the tank or vessel will be isolated and placed under administrative control, recirculated, sampled, and sample analyzed for uranium content
  - Recirculation or uniformly mixing, sampling, and analysis activities will be independent (performed at a different time, using different operators or laboratory technicians, and different analysis equipment, checked with independent standards) of that performed in IROFS CS-16

Other IROFS (continued)

- IROFS CS–20, Evaporator/Concentrator Condensate Monitoring
  - As an AEC, the condensate tanks will use a continuous active uranium detection system to detect high carryover of uranium that shuts down the evaporator feeding tank
  - System purpose:
    1. Detect an anomaly in evaporator or concentrator indicating high uranium content in condenser
    2. Prevent high concentration uranium solution from being available in condensate tank for discharged to a non-favorable geometry system or in condenser for leaking to non-safe geometry cooling loop
- IROFS CS–26, Processing Component Safe Volume Confinement
  - As a PEC, some processing components (e.g., pumps, filter housings, and ion exchange columns) will be controlled to a safe volume for safe storage and processing of fissile solutions
  - Safe volume confinement of fissile solutions will prevent accidental nuclear criticality, a high consequence event
- IROFS CS–27, Closed Heating or Cooling Loop with Monitoring and Alarm
  - As a PEC, closed cooling water loops with monitoring for breakthrough of process solution will be provided on evaporator or concentrator condensers to contain process solution that leaks across this boundary, if boundary fails
  - Will be applied to the high-heat capacity cooling jackets (requiring large loop heat exchangers) servicing condensers where leakage is always from cooling loop to condenser
  - Inherent characteristics of leak path will reduce back-leakage into closed loop system

Likelihood Categories and Risk Matrix

"Likelihood of an Occurrence" for each accident scenario will be based on:

- Frequency of initiating events
- Historic record of occurrence within similar systems
- Expert engineering judgment
- Assessment of number, type, independence, and observed failure history of designated IROFS

	Likelihood category	Event frequency limit
Not unlikely	3	More than 10^{-3} events/year
Unlikely	2	Between 10^{-3} and 10^{-5} events/year
Highly unlikely	1	Less than 10^{-5} per events/year

Risk Matrix

Severity of Consequences	Likelihood of Occurrence: Highly Unlikely (Likelihood Category 1)	Likelihood of Occurrence: Unlikely (Likelihood Category 2)	Likelihood of Occurrence: Not Unlikely (Likelihood Category 3)
High Consequence (Consequence Category 3)	Risk Index = 3 Acceptable Risk	Risk Index = 6 Unacceptable Risk	Risk Index = 9 Unacceptable Risk
Intermediate Consequence (Consequence Category 2)	Risk Index = 2 Acceptable Risk	Risk Index = 4 Acceptable Risk	Risk Index = 6 Unacceptable Risk
Low Consequence (Consequence Category 1)	Risk Index = 1 Acceptable Risk	Risk Index = 2 Acceptable Risk	Risk Index = 3 Acceptable Risk

Chapter 6 Questions?

NWMI
NORTHWEST MEDICAL ISOTOPES

Advisory Committee on Reactor Safeguards
Meeting on Northwest Medical Isotopes Construction Permit Application

Chapter 6
Engineered Safety Features

July 11, 2017

Introductions

- **Michael Balazik** - Project Manager, Research and Test Reactors Licensing Branch (PRLB), Division of Policy and Rulemaking (DPR), Office of Nuclear Reactor Regulation (NRR)
- **Chris Tripp** - Senior Nuclear Process Engineer, Programmatic Oversight and Regional Support Branch Division of Fuel Cycle Safety, Safeguards, and Environmental Review, Office of Nuclear Material Safety and Safeguards
- **Alexander Adams, Jr.** - Chief, PRLB, DPR, NRR
- **John Atchison** - Technical Reviewer, Information Systems Laboratories (ISL), Inc.

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements:
  - 10 CFR 50.34, “Contents of applications; technical information,” paragraph (a), “Preliminary safety analysis report.”
  - 10 CFR 50.35, “Issuance of construction permits.”
  - 10 CFR 50.40, “Common standards.”

Regulatory Basis and Acceptance Criteria (continued)

- Acceptance Criteria:
  - NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria.”
  - Interim Staff Guidance Augmenting NUREG-1537, “Guidelines for Preparing and Reviewing Applications…for Licensing Radioisotope Production Facilities…,” Part 2.

RPF Engineered Safety Features

- The principal purpose of the Engineered Safety Features (ESFs) is to mitigate the consequences of accidents and to keep radiological exposures to the public, the facility staff, and the environment within acceptable values at the Northwest Medical Isotopes (NWMI) proposed radioisotope production facility (RPF).
- NWMI's proposed ESFs described in the preliminary safety analysis report (PSAR) include confinement and nuclear criticality safety.
- The need for ESFs is determined by NWMI's accident analysis documented in Chapter 13 of the PSAR.
- The current accident analysis in Chapter 13 has not identified a need for a containment system or an emergency cooling system.

Staff Review

- The staff performed an evaluation of the technical information presented in Chapter 6 of the NWMI PSAR, as supplemented by responses to requests for information (RAI), to assess the sufficiency of the preliminary design and the performance of NWMI's ESFs for the issuance of a construction permit.
- Staff considered the design criteria, design bases, and relevant design information to provide reasonable assurance that the final design will conform to the design basis.
- Areas of review for this chapter included a summary description of the RPF ESFs, as well as a description of the RPF confinement. Within these review areas, the staff assessed the confinement system and components, and functional requirements of confinement.

Summary of Application

- NWMI PSAR Section 6.1 briefly describes the SSCs that constitute the confinement and criticality safety ESFs in the RPF design and summarizes the postulated accidents that are mitigated. As described in greater detail in PSAR Chapter 13, specific postulated accident scenarios indicate the need for a confinement system ESF, but not the need for a containment system ESF.

- NWMI PSAR Section 6.2 credits the hot cell confinement boundaries to confine the fissile and high radiological dose solids, liquids, and gases; and to control gaseous releases to the environment during normal operations.

Summary of Application (continued)

- NWMI PSAR Section 6.2, describes the confinement ESF structures, systems, and components (SSCs) that will be incorporated into the RPF design.
- NWMI PSAR Section 6.2.1.4, documents the confinement system components as:
  - Structural components: sealed flooring, diked areas and sumps, catch basins, and sealed entryway doors.
  - Ventilation system components: Zone I inlet HEPA filters, Zone I ducting, bubble tight dampers, Zone I exhaust train HEPA filters, Zone I exhaust train HEGA filters (iodine removal), Zone I exhaust stack, stack monitoring and filter train interlocks.
  - Secondary process offgas treatment iodine removal beds.

Summary of Application (continued)

- NWMI PSAR Section 6.2 provides confinement system ESF overview discussions of: Accidents Mitigated, System Components, Functional Requirements, Design Basis, and Test Requirements.

- Information related to the Exhaust System, the Effluent Monitoring System, the Radioactive Release Monitoring System and the Confinement System Mitigation Effects is not provided in the NWMI PSAR and is deferred to the operating license application.

Review of ESFs

- PSAR Section 6.2 provides detailed descriptions of the safety features to mitigate the accidents identified in Chapter 13, Section 13.1.3, "Preliminary Hazards Analysis Results." The confinement ESF consists of the following Items Relied on for Safety (IROFS):
  - Primary Offgas Relief System,
  - Active Radiation Monitoring and Isolation of Low-Dose Waste Transfer,
  - Cask Local Ventilation During Closure Lid Removal and Docking Preparations,
  - Cask Docking Port Enabling Sensor,
  - Process Vessel Emergency Purge System,
  - Irradiated Target Cask Lifting Fixture,
  - Exhaust Stack Height,
  - Double Wall Piping,
  - Backflow Prevention Devices, and
  - Safe Geometry Day Tanks.

Review ESFs (continued)

- The staff evaluated the sufficiency of the preliminary design of the NWMI confinement and related systems as described in NWMI PSAR 6.2.1, “Confinement,” in part, by reviewing confinement mitigation requirements, the defined confinement envelope, and detailed descriptions of the ESFs associated with confinement. Additionally, the staff evaluated the passive and active ESF components, under normal and abnormal operational conditions.

- On the basis of its review, the staff determined that the summary description of the NWMI RPF ESFs demonstrates an adequate design basis for a preliminary design.

Review ESFs (continued)

- The confinement system ESFs' detailed functional requirements, design bases, probable subjects of technical specifications, and testing requirements are not provided in the PSAR and will be developed by NWMI during final design and documented in the final safety analysis report.
- The staff's review of the RPF ventilation system is described in further detail in SER Section 9.4.1.

Nuclear Criticality Safety (NCS)

- Protection against consequences of nuclear criticality in the RPF; prevention of inadvertent criticality
- Acceptability based on ISG Augmenting NUREG-1537, Part 2
  - Commitment to elements of an NCS Program applicable to design and construction
  - Commitment to principal design criteria and design bases (referred to as “technical practices” in ISG)
- Subcriticality under normal and credible abnormal conditions
  - Compliance with double contingency principle (DCP)
  - Criticality accident alarm system (CAAS) and associated emergency planning

Staff Review

- Section 6.3 of NWMI PSAR
- Criticality code validation report and sampling of preliminary Criticality Safety Evaluations (CSEs)
- Staff considered principal design criteria and design bases to provide reasonable assurance that the final design will ensure subcriticality under normal and credible abnormal conditions

Summary of Application

- Commitments to NCS Program (NCSP) applicable to design and construction
  - Based on ANSI/ANS-8 programmatic standards per RG 3.71
  - Roles and responsibilities of qualified staff implementing NCSP
  - Development of CSEs for limits and controls
  - Management measures applicable to design and construction (most pertinent to construction, configuration control)
- Commitments to design criteria for NCS
  - Compliance with DCP based on controlled parameters
  - Determination of Upper Safety Limit (USL) for k_{eff}
  - Ensuring “credible” criticality events are “highly unlikely”
- List of parameters and controls by individual process area (CSE)

NWMI-2015-CSE-08, Hot Cell Uranium Purification

- Chosen as review sample to verify adequate implementation of the NCS technical practices (CSE unique to the RPF)
- Reliance on favorable geometry as primary NCS control
- Optimum uranyl nitrate concentration and full reflection assumed
- Scenarios of concern those involving loss of geometry control:
  - Solution leaks from favorable geometry tanks, columns, piping; worst-case leak would be safely subcritical on hot cell floor
  - Backflow to unfavorable geometry offgas treatment, steam condensate, cooling water return, water or chemical reagent supply, fresh resin supply, process gas; prevented by passive overflows, air breaks, paddle blanks, double block-and-bleed, tank venting, intermediate cooling loops or favorable geometry day tanks.

NWMI-2015-CSE-08, Hot Cell Uranium Purification (continued)

- Overall approach consistent with preference for passive engineered control, and preferred reliance on favorable geometry
- Only scenarios of concern involved loss of geometry control; found to be protected against consistent with the DCP
- Adequate safety margin consistent with standard industry practices and standards (e.g., ANSI/ANS-8.1)
- No concerns identified with implementation of controls for this process

Validation & Subcritical Margin

- Safety limits on controlled parameters based on computer code methods (MCNP6.1) validated using critical benchmark data*
- Few benchmarks exist for 20wt% ^{235}U uranyl nitrate solutions
- Upper Subcritical Limit (USL) determined based on minimum margin of subcriticality of 0.05.
- NWMI Validation did not include all IHECSBE benchmarks around 20wt%; IEU-SOL-THERM-001 uranyl sulfate experiments known to underpredict k-effective by ~2.9%.
- NWMI revised its Validation Report in response to staff RAIs:
  - Narrowed definition of its validated area of applicability (AOA) as design work progressed; much of range covered by very broad initial validation determined not needed to support the design
  - Inclusion of 4 IEU-SOL-THERM-001 benchmarks resulted in a reduction in the USL of 0.0166
  - Conservative nonparametric method used for USL due to the 4 added benchmarks skewing data normality

*International Handbook of Evaluated Criticality Safety Benchmark Experiments (IHECSBE)

Technical Practices for NCS

- ISG Augmenting NUREG-1537, Part 2, indicates applicant should commit to acceptance criteria for use and modeling of controlled parameters (e.g., mass, geometry, moderation…)
- PSAR did not contain those commitments
- Initial review of preliminary CSEs showed the applicant generally modeling parameters consistent with industry practice (as specified in ANSI/ANS-8.1 and related standards)
- Commitments to technical practices for modeling provide conservative margin that is part of subcritical margin to provide assurance of subcriticality under normal and credible abnormal conditions
- Minimum subcritical margin of 0.05 deemed acceptable based on conservative modeling practices and conservative inclusion of new benchmarks in validation, resulting in a lower USL

Criticality Accident Alarm System (CAAS)

- NWMI commits to the following in the construction permit application:
  - Install CAAS, consistent with 10 CFR 70.24, in all areas where SNM is handled, processed, or stored
  - Comply with ANSI/ANS-8.3 (modified by exceptions in RG-3.71)
- Follows acceptance criteria in ISG Augmenting NUREG-1537, Part 2
- NWMI stated that evaluation of CAAS coverage will be done after final design is complete, but prior to startup
- In response to an RAI, NWMI will use conservative point-kernel method wherever practical, 3D Monte Carlo modeling otherwise
- Staff identified that permanently-installed shielding in the RPF could challenge ability of CAAS to detect criticality; evaluating detector coverage after construction could result in not meeting 10 CFR 70.24 dose detection criteria

Possible Construction Permit Conditions

1) NWMI will periodically provide CSEs and any changes to CSEs; alternately, applicant may commit to technical practices described in ISG to NUREG-1537, Part 2

2) NWMI will ensure processes are subcritical under both normal and credible abnormal conditions prior to the completion of construction, consistent with revised USL

3) NWMI will periodically provide technical basis for the design of the CAAS, including demonstrating adequate detector coverage, prior to completion of construction

Evaluation Findings and Conclusions

- The staff finds that the level of detail provided on the ESFs program is suitable to determine that:
  1) The RPF is designed to operate with a minimal heat load and fission product inventory during normal operation.
  2) NWMI's programmatic commitments for the NCS program meets the applicable guidance in ISG Section 6.3 for the issuance of a construction permit with licensing subject to confirmatory information identified in potential license conditions.
  3) Based on engineering judgment, the staff concludes that the level of detail on the ESFs provided in the PSAR, as confirmed by potential license conditions, is adequate for the issuance of a construction permit because it is commensurate with the minimal safety risk posed by the RPF.

Evaluation Findings and Conclusions (continued)

- Accordingly, NWMI has met the following requirements of 10 CFR 50.35 for issuance of a construction permit, with respect to the ESFs:

  1) ESF systems have been described, including, but not limited to, the principal architectural and engineering criteria for the design, and has identified the major features or components

  2) Further technical or design information may be reasonably left for later consideration in the FSAR.

  3) There is reasonable assurance that the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public.