Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Radiation Protection and Nuclear Materials
Subcommittee Meeting - Open Session

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Wednesday, August 19, 2015

Work Order No.: NRC-1831 Pages 1-504

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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RADIATION PROTECTION & NUCLEAR MATERIALS

SUBCOMMITTEE - OPEN SESSION

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WEDNESDAY

AUGUST 19, 2015

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ROCKVILLE, MARYLAND

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Dennis C. Bley, Acting Chairman, presiding.

COMMITTEE MEMBERS:

DENNIS C. BLEY, Acting Meeting Chairman

RONALD G. BALLINGER, Member

DANA A. POWERS, Member

JOY L. REMPE, Member

STEPHEN P. SCHULTZ, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

ACRS CONSULTANT:

KORD SMITH*

DESIGNATED FEDERAL OFFICIAL:

MAITRI BANERJEE

ALSO PRESENT:

ALEXANDER ADAMS, JR., NRR

MARY ADAMS, NMSS

JOSEPH ALDIERI, Sargent & Lundy

DAN BARSS, NSIR

VANN BYNUM, SHINE

JIM COSTEDIO, SHINE

MIRELA GAVRILAS, NRR

BILL HENNESSY, SHINE

GREGORY HOFER, SC&A*

CATHERINE KOLB, SHINE

STEVEN T. LYNCH, NRR

STEPHEN MARSCHKE, SC&A

JOHN MCLEAN, Sargent & Lundy

DIANE MLYNARCZYK, ISL

EUSEBIO RICOHERMOSO, Sargent & Lundy

JOSEPH STAUDENMEIER, RES

ERIC VAN ABEL, SHINE

*Present via telephone

C O N T E N T S

P R O C E E D I N G S

8:32 a.m.

ACTING CHAIRMAN BLEY: The meeting will now come to order. This is a meeting of the ACRS Subcommittee on Radiation Protection and Nuclear Materials. I'm Dennis Bley, Acting -- well, I'm Chairman of this Subcommittee meeting for SHINE construction permit review.

ACRS members in attendance are Dick Skillman, John Stetkar, Steven Schultz, Ron Ballinger and Joy Rempe. I just ran up the stairs. I apologize.

And we expect to be joined later by Dana Powers. Our consultant Kord Smith is on the bridge line. And Ms. Maitri Banerjee is the designated Federal Official for this meeting.

We have members of the SHINE medical technology team to brief the subcommittee regarding their construction permit application for a radioisotope production facility in the City of Janesville, Wisconsin, for producing moly-99. We also expect to hear from the NRR staff members regarding their review of this Application.

Several Chapters of the SHINE Application, namely Chapters 3, 9, 12, 13a, and 14

are scheduled for discussion today as noted in the agenda. And posted on the NRC meeting website.

The rules for participation in today's meeting were announced in the Federal Register on August 17. Parts of the meeting will be closed to the public to protect security related and proprietary information.

We have designated a 45 minute session closed to the public toward the end of the meeting, as shown on the agenda for this purpose. We did not receive any requests from the public for time to make comments.

We have two bridge lines established. One for the public to hear the deliberations. And an unpublished line to allow certain SHINE and NRC staff personnel to participate remotely. The bridge number and password for the first line were published in the agenda on the NRC website.

To minimize disturbance, the public line will be kept in the listen only mode. Before closing the meeting, we will open the public bridge line to provide an opportunity for members of the public to make a statement or provide comments.

Before we go into closed session, I will ask NRR staff and SHINE to confirm that only people

with due clearance and need to know are in the room. After the public comment period, technicians at the booth will disconnect the public telephone bridge line.

Dr. Corradini has a conflict of interest because of work the University of Wisconsin did supporting the SHINE application and he will recuse himself.

I now invite Dr. Mirela Gavrilas of the NRR to introduce the presenters and start the Briefing. Mirela?

DR. GAVRILAS: Thank you very much. Good morning everyone. Thank you all for being here.

We had a very successful first meeting from the staff's perspective. We accomplished our objectives.

We are primarily to provide you with an open review of NUREG-1537, to introduce the SHINE technology and to lay out the objectives of the staff's review of the construction permit. We look forward to continuing that vein in the second meeting.

We continue seeking your feedback on our construction permit review. And we would like to continue what we started at the first meeting, namely to flag items that will require our attention during

the operations license review.

One more heads up for everybody. The staff is on a pretty aggressive schedule to support the hearing as early as feasible. And we appreciate you all in helping us keep that schedule with your timely input.

With that, I'm going to just give a broad outline of what we're going to talk about today.

ACTING CHAIRMAN BLEY: No, before you do that.

DR. GAVRILAS: Yes?

ACTING CHAIRMAN BLEY: Let me ask, the people on the open bridge line who are participants in the meeting, please mute your phones. You're causing some noise on this end.

We're trying to leave it so that you can comment during the meeting. But keep them muted when you're not talking.

MEMBER REMPE: Mr. Chairman, I noticed this morning that all of our mics are on. And if you're not talking --

ACTING CHAIRMAN BLEY: Well, I hope you turned yours off.

MEMBER REMPE: I did. But I wanted to tell everyone else because I see like even green

lights across the way where people aren't sitting.

ACTING CHAIRMAN BLEY: Thank you.

MEMBER REMPE: And that makes it harder for folks to hear on the bridge line. And I'm hearing a lot of noise. Thank you.

ACTING CHAIRMAN BLEY: Mirela, sorry for the interruption. Go ahead.

DR. GAVRILAS: No problem. So, we have -- what we're going to talk about today is going to be design of structure systems and components, auxiliary system, conduct of operations and preliminary emergency plan, irradiation facility, accident analysis and technical specifications.

I'd like to remind you how we parsed it into the three meetings with the subcommittee. It was whatever was in the staff's opinion ready for your review.

So we know that we're leaving some of the heavy topics for the last meeting. But that's because we wanted to make sure that when we come in front of you things are sufficiently ripe.

And with that, I complete my remarks. And I turn it back to Dennis Bley.

ACTING CHAIRMAN BLEY: Okay, thanks. And I guess I'd say we understand this is a

construction permit application. And we're focused in that direction.

We may ask questions that might be a little more relevant to later work. But we probably want to get those on the record anyway, at least up front.

So, I'll turn it over. I don't know which of you are going to handle it. But I'll turn it over to SHINE.

MR. BYNUM: This is Vann Bynum. I'm the Chief Operating Officer for SHINE. And I'll be giving the initial comments.

First, I wanted to thank the Committee for the comments and discussions that we had in the last meeting. I thought they were very productive and fruitful for us.

And, you know, we came back for more. So, you can question other parts of us on that aspect.

We are convinced we've done a good job. But we also understand that we can always improve. And fresh eyes can always bring new light to problems.

And so that -- for that we're very appreciative of the Committee's hard work and questions. And benefitting from your experience.

The last meeting prompted a lot of

thinking and reflecting on our part. You folks asked us some questions. And you asked some questions about things we hadn't looked at in a number of months, because this process takes a long time.

And that made us go back and think. And made us look harder at some of the areas. And we appreciate that. And you're going to hear some of the results of that thinking and looking, later on today.

And that's it for me. Thank you.

MR. McLEAN: Hi, I'm John McLean with Sargent & Lundy. I'm going to present Chapter Three, Design of Structures. And then Eric Van Abel is going to present the Systems and Components portion of this presentation.

MEMBER REMPE: So while you're waiting to get that changed, I had a hold over question from Chapter Four. But it kind of fits into this topic, so I'd like to ask it.

Apparently in looking through the RAIs, there's an independent peer review that's included in your design development. And has that happened? Or will that happen? And who is part of this?

And maybe Eric needs to answer that. It might just -- you're looking at me blankly. But it

was in some of the material I read that was provided to us perhaps a bit late with the RAIs and the responses.

MR. VAN ABEL: Do you have any idea what the topic was? Or the whole of the design?

MEMBER REMPE: The design of the facility. So there is no independent peer review in part of your QA or design development process.

I can look for the actual RAI and get back to you where I saw it. But, that's not --

MR. VAN ABEL: Yes.

MEMBER REMPE: Because I didn't remember it being discussed. And I just was curious.

MR. VAN ABEL: Yes. I don't -- I'm not sure what you're referring to.

MEMBER REMPE: Okay. So, there is none is the answer. Okay.

MR. BYNUM: While they're getting that sorted out, on the subject of peer review. When you said independent peer review that to me has a certain meaning.

I mean, any good quality program has peer review incorporated as part of it. But an independent peer review and my way of thinking of past experience, is that an outside group of truly

independent folks that come in and do a separate review.

Is that what you're asking about?

MEMBER REMPE: So, somewhere when I was trying to catch up on things and I was looking through material provided to us, between the last meeting and this meeting, I heard there was an independent, or I read the words, independent design review.

And I just remember us discussing it. And yes, I find a good quality program does have a separate group of people reviewing things. And so I just was a little surprised at the response.

And so I'm trying to find where I read that.

MR. BYNUM: Um-hum.

MEMBER REMPE: But apparently it's not happened yet. And so that's not part of your process is what I'm hearing.

And I was curious who the group was. And those kind of questions were going to be followed.

MR. BYNUM: Right.

MEMBER REMPE: But if there isn't one, it's hard to ask who the people are.

MR. BYNUM: Um-hum. No, there has not been a separate outside group come in and do a design

review.

MEMBER REMPE: Yes, and there's no plan to do that?

MR. BYNUM: No.

MR. McLEAN: So, back to Chapter Three. The first thing we want to go over is the facility preliminary arrangement.

The main production facility is essentially a one story building at grade. It has some tank vaults and trenches that go below grade. But the safety related -- all the safety-related areas are protected by thick concrete walls and roof.

The seismic boundary consists of a concrete shear wall substructure as well as a superstructure. The substructure walls are at least three feet thick. And that's mainly grouping by shielding as well as soil loading.

The superstructure walls and roof diaphragm are at least two feet thick. And that's mainly driven by tornado missiles and aircraft impact.

There are adjacent seismic II/I areas in the facility. They have a concrete mat foundation that's separated by the seismic boundary by a seismic gap. So that there's no loading transmitted from the

non-safety-related areas.

And then there's these -- either a steel or a concrete wall superstructure that's designed to ensure seismic II/I protection of the safety-related envelope.

So this is a plan view of the inside of the facility. You can see the safety-related areas are protected by thick concrete walls. The main area as well as the area below. The areas to the left and right are the II/I areas.

MEMBER SKILLMAN: John, let me ask this question please. When we're doing the reviews of the NSSS, we're looking at sliding and overturning and buoyancy.

MR. McLEAN: Um-hum.

MEMBER SKILLMAN: What consideration has been given to sliding and overturning and buoyancy for this facility?

MR. McLEAN: So there was a sliding and overturning analysis done. The -- all the paint falls help resist that sliding.

And overturning, it's really just a one story facility that's pretty wide. So, it has a lot of margin against overturning.

And then buoyancy, the flood level is

negative 50 feet below grade. So buoyancy is not an issue.

MEMBER SKILLMAN: Okay. Thank you.

MR. McLEAN: So design against meteorological damage, the facility is designed for your basic wind loading, which is 90 miles per hour and converted to 100 year wind load, which is 96.3. This is all done per ASCE 7-05.

For tornado loading, it's designed for the tornado wind, suction and missiles. The maximum wind speed used is 230 miles an hour converted to velocity pressure for ASCE 7.

The suction is a differential pressure of 1.2 psi for the Reg Guide 1.76. Applied as an outward pressure to the walls and roof. And missile, this spectrum comes from Reg Guide 1.76.

The missile impacts, global missile impacts are designed by converting them to an equivalent static load in accordance with NUREG-0800. And the tornado load combinations are evaluated per NUREG-0800, Section 3.3.2.

For snow, ice and rain loading, it's a 30 psf snow load converted to a 100-year snow load per ASCE 7. And then the rain load is not considered due to sloped roofs. And the ice load is enveloped by

the design snow load.

MEMBER BALLINGER: I have a -- I had tried to sort that out. It's very confusing. Okay, this slope loading issue, especially the snow plus rain issue.

Where I live, last winter, we had five feet of snow and then rain. And we had ice dams at everybody's house. And everybody's roof is -- lots of roofs were collapsing.

But, in the Application, I couldn't figure out why the issue of the combination of rain plus snow, where the rain increased the weight on the roof, was discounted. At least that's the way I -- that's what I think I read.

And you're saying that ice load enveloped by designed snow load. So, I don't understand that.

MR. McLEAN: Yes, so the rain on snow surcharge, we usually consider a five psf. But snow load here is 30 psf. The snow load in Chapter Two is actually 25 psf.

MEMBER BALLINGER: Right. But there was a unit problem going back and forth, right?

MR. McLEAN: Well, this is the facility -- the structural design of the facility was conservative compared to the actual meteorological -

-

MEMBER BALLINGER: Okay.

MR. McLEAN: Snow load per the -- in Chapter Two.

MEMBER BALLINGER: Okay, so we add five psi to the 30 psi.

MR. McLEAN: Five psf. Yes, to the --

MEMBER BALLINGER: Five psf, excuse me.

MR. McLEAN: To 25 psf. And that accounts for the rain on snow surcharge.

MEMBER BALLINGER: So that -- just that additional five accounts for that -- for the rain?

MR. McLEAN: For the rain on snow, yes.

MEMBER BALLINGER: Gosh. Okay, I -- my personal experience is that the rain really was a lot compared to the snow. But, okay. Thank you.

MR. McLEAN: Well, at that point some of the snow is melting as well.

MEMBER BALLINGER: Yes.

MR. McLEAN: So --

MEMBER BALLINGER: I'll send you a picture.

(Laughter)

MEMBER BALLINGER: I'll send you a picture.

MR. McLEAN: Okay. So, the structural design for thermal, because this is -- the temperature changes are expected to be small, ACI 349 does not require the structure to be designed for thermal loading.

So, the absolute minimum temperature on the surface of the siding or concrete is minus 35. The absolute maximum temperature is 105. Therefore, the thermal gradients are expected to be less then 100 degrees indoor to outdoor.

And then the uniform temperature -- uniform temperature changes against the poured concrete condition are expected to be less then approximately 50 degrees. And per ACI 349.1, we can neglect the -- any thermal loading on the structure.

Water damage, the design base is flood level, caused by a probabilistic maximum flood of the Rock River is 774 feet. The SHINE site is 825 feet. So that gives us a 50-foot margin on the flood.

The lowest point of the building is 29 feet below grade. So there is no dynamic -- there is no flooding concern. There's no dynamic force due to flooding.

The design basis precipitation level is at grade. And the main floor of the building is four

inches above grade. All the exterior walls below grade are at least three feet thick.

And then the water stops are provided at all construction joints below grade. And waterproof coating is applied at the external surfaces below grade.

And then the roofs are designed to prevent pooling of large amounts of water in accordance with the Reg Guide because of the slopes of the roof.

This is just a figure on the probabilistic maximum flood showing the Rock River. It's highest flood level. And then the elevation of the SHINE site.

Internal flooding, the SHINE facility does account for the internal flooding from the fire fighting water volume. Both the fire suppression system activation as well as hose streams give us a maximum flow rate of 550 gpm.

The time duration considered is 30 minutes per NFPA 801. So, all the safety-related equipment in the facility is protected by water damage by either flood protected components or by raising it eight or 12 inches about grade, which is at least 50 percent higher then the calculated water depth to

give us some margin.

Potential failures of pools in the facility, such as the light water pool is not considered because of the robust safety-related design. It's thick concrete. It's designed for seismic. As well as that it has the stainless steel liner, and the pools are below grade.

Seismic analysis methodology. The analysis methodology conforms to NUREG-1537 and the IAEA-TECDOC.

However, there's not a lot of guidance there for soil structure interaction. So, this has been supplemented with the NRC guidance from SRP and Regulatory Guides.

A three dimensional soil structure interaction analysis was performed. It's done in two steps.

First, the free field site response analysis to determine the soil properties using the SHAKE program. And then the SSI analysis is done using a combined soil structure model with the soil properties developed in step one, using the SASSI2010 program.

Seismic input motion. The site -- the peak ground acceleration was determined based on a

seismic hazard assessment for the Janesville site using the 2008 USGS National Seismic Hazard Maps.

The PGA of 0.2 g was selected. And it's used for both horizontal and vertical directions. This equates to a low hazard with a return period of 20 thousand years.

The ground motion response spectrum was calculated based on Regulatory Guide 1.6 using a pga of 0.2. And the acceleration time history was calculated using the -- meeting the SRP 3.7.1 requirements.

Seismic analysis model. That's a 3D structural model that consists of shell and beam elements. This is based on the SAP2000 Model used for the structural design in the facility. It was converted to SASSI.

Because of the expected low strain levels, the structural damping is based on OBE damping values in accordance with the Reg Guide 1.61. And later soil properties were used that were developed from the site soil boring results.

The results from the seismic analysis were in structure response specter were developed for various damping values in the horizontal and vertical directions for critical location to the building.

These are just shown on the slide here are just two samples of the response specter that were developed.

And then maximum seismic accelerations were developed at critical locations in the building. For instance, the center of the upper roof came up with 0.31 g's horizontal and 0.9 in the vertical due to the flexibility of the roof.

And the center of the shear walls gave us 0.41 g in the horizontal due to the flexibility of the shear walls in the outer plan direction. And then 0.31 g in the vertical direction.

The structural analysis model determines the adequacy for seismic as well as other hazards. As I mentioned, there's a 3D finite element model of the SHINE facility structure using -- most grade are using SAP2000.

The reinforced concrete reinforced rate -- the required concrete reinforcement ratio was calculated from the SAP2000 force and moment outputs. The model consists of all the safety-related areas of the facility.

And the wall heights are modeled to the actual height dimensions instead of the center of the roof to adequately capture all the wind and tornado loading.

The mesh aspect ratio for the SAP2000 model is most commonly about one and a half to one. So, for a two foot thick concrete element, the average element size is three foot by three foot. This is limited to a maximum of four to one.

This is just an overview of the structural analysis model, the SAP2000 model pictorially shown.

MEMBER SKILLMAN: John, before you proceed, let me ask a question. Let me take you back to your flooding -- internal flooding, which is your slide nine.

MR. McLEAN: Um-hum.

MEMBER SKILLMAN: Water collection system accommodates fire fighting water volume. You then describe with great detail the seismic work that you did.

What consideration was given to sloshing in the pool such that a sloshing amount can be significantly greater then the 30 minutes at 550 gallons a minute from fire fighting? Sloshing is my concern.

MR. McLEAN: You're concerned about the water getting out of the pool?

MEMBER SKILLMAN: The pool is moving.

MR. McLEAN: Uh-huh.

MEMBER SKILLMAN: It's inducing a wave. And you have over topping on the coming or the berm of the pool. That's your shield for the units, your radiation shield.

MR. McLEAN: Um-hum.

MEMBER SKILLMAN: So, my question is, what consideration have you given for loss of water from the pool on seismic excitation? If none, just say none.

MR. McLEAN: Yes.

MEMBER SKILLMAN: It's a curiosity question.

MR. McLEAN: Right. Gordon, let me just make sure I understand the question. Are you concerned about the water height due to sloshing on the side of the pool?

MEMBER SKILLMAN: Well, I'm concerned about two things. First of all, the pool is moving. It's creating a series of waves.

MR. McLEAN: Um-hum.

MEMBER SKILLMAN: And if those waves correspond with each other, there can be water carried out of the pool. It goes someplace. Or else the building is designed to keep the water in that pool.

If it goes out of the pool, where does it go? And does that become a flooding problem?

MR. McLEAN: Yes.

MR. VAN ABEL: So the --

MR. McLEAN: Go ahead.

MR. VAN ABEL: The pool in the IU cell is over -- there's a wall above the pool that's over 12 feet above the height of the pool.

MEMBER SKILLMAN: Um-hum.

MR. VAN ABEL: So, you know, there's potential for small leakage out of the penetrations and that. But the wave generated in the pool from sloshing, to get out of the IU cell in a gross manner would have to be about the same height as the total depth of the pool, which is about 12 feet.

MEMBER SKILLMAN: So I would interpret from what you're saying, that really can't happen. Even if you shake that pool a little bit, you cannot get a wave great enough in height --

MR. VAN ABEL: Yes.

MEMBER SKILLMAN: To escape.

MR. VAN ABEL: You'd have to move all the water essentially to one side, the whole pool.

MEMBER SKILLMAN: Fair enough. Thank you.

MR. McLEAN: Okay. Structural analysis results. So the walls and slabs in the SHINE facility are designed for axial, flexural, and shear loads per the provisions of ACI 349-06.

Fault walls and slabs are modeled in SAP2000 using groups of shell elements. So using these resultant loads from the SAP2000 model, we designed each element as a reinforced concrete section for 349-06.

These results are presented the ro -- required reinforcement for the walls and slabs for representative elements is presented in PSAR Table 3.4-1.

Aircraft impact results. The global and local aircraft impact analysis was performed using methods consistent with the DOE standard.

The structure is shown to resist scabbing and perforation. The -- like I said before, all the walls are two feet thick. And the required thickness to resist scabbing is about 1.6 feet. And the required thickness for perforation is about 0.8 feet.

MEMBER STETKAR: John, the design for the aircraft impact is for the small aircraft that you're using. It's not been screened out from your aircraft crash analysis, is that correct?

MR. McLEAN: That's correct.

MEMBER STETKAR: So it's not risk withstanding a larger aircraft crash?

MR. McLEAN: It has been designed to withstand a larger aircraft.

MEMBER STETKAR: It's -- I'm sorry I was --

MR. McLEAN: It has not.

MEMBER STETKAR: It has not?

MR. McLEAN: It has not.

MEMBER STETKAR: Okay. Thank you.

MR. McLEAN: The concrete reinforcement as specified would make sure that we could withstand the impact from the global analysis. And then the building trusses that you saw in the model before are shown to resist buckling.

MR. VAN ABEL: All right. This is Eric Van Abel with SHINE Medical Technologies. I'm going to discuss Section 3.5 of the SHINE PSAR, which is design of systems and components.

Certain systems and components are considered important to safety in the SHINE facility because they perform safety functions either during normal operations, or they're credited for those safety functions during accident conditions.

SSCs must be capable of performing their design basis functions under the bounding conditions of normal operation or any accident where they're required to function.

SSCs that are determined to have safety significance are designed, fabricated and tested commensurate with criteria in ANSI/ANS 15.8. And that ANSI standard is implemented through SHINE's Quality Assurance Program Description or QAPD.

Records for safety systems that are determined as safety significance, are maintained throughout the life of the plant.

MEMBER REMPE: So Eric?

MR. VAN ABEL: Yes?

MEMBER REMPE: Back to my earlier question. I found where I found this cita -- or reference about independent design reviews.

And it's an RAI. Your response -- or SHINE's response RAI G1.

MR. VAN ABEL: Okay.

MEMBER REMPE: And it says that design verification of safety-related SSCs is performed as you just said, in accordance with this SHINE QAPD, which states, independent design review shall be used to verify the adequacy of design by one or more of

the following. And it has four options.

And it sounds like again that you do have some sort of independent design reviews, whether you use alternate calculations or something done by a different group. And so again, I'd just like to understand your process.

Is it someone in the company that you just find a different organization to do this with all the design work you've done to date? Or how do you guys do this?

MR. VAN ABEL: Yes, I don't quite remember that response in particular. To me, I believe the response is referring to independent reviews of technical documents within the company.

MEMBER REMPE: And so you have documents at this point, right? And so how do you guys implement it? I mean, what's done?

MR. VAN ABEL: Well for -- you know, for example, for calculations, there's any calculations that's determined to be safety related.

So you have a calculational procedure that states what the requirements are for the reviewer. The reviewer has to be independently capable of performing the calculations themselves. It has to review, you know, the design and what's the

assumptions, the methodologies to ensure that calculation is done correctly.

MEMBER REMPE: But you do it with someone else in your company that's doing that?

MR. VAN ABEL: In the company, yes.

MEMBER REMPE: Okay. Thanks.

MR. HENNESSY: I'd like to amply that a little bit. In addition -- this is Bill Hennessy speaking. When we receive design documents from our vendor partners, which come in with their own independent review and approval, we also do a technical or there's acceptance review of that document.

So, our engineering staff will review that document technically, not just a glance at it. And ensure its right. So, we get that and that fully are documented and processed and approved as well.

MEMBER REMPE: Thank you.

MR. VAN ABEL: Next slide please. All right, I&C systems are provided in the SHINE design that can monitor variables over the anticipated ranges for normal operation, accident conditions and to ensure safe shutdown is monitored.

The SHINE system design is based on defense-in-depth practices. With a strong preference

for engineering and passive controls over administrative controls.

The single failure criterion is applied to our safety systems. So that ensures that we have sufficient redundancy and an independence at a single failure of an active component does not result in loss of capability for the system to perform its safety function.

So during an initiating event in the accident analysis, we assume that there's also a concurrent single failure of an active component in a safety system.

MEMBER SKILLMAN: Eric, before you go on. On your first bullet, would you describe to us how you know your instrumentation systems are accurate?

MR. VAN ABEL: Well, the accuracy of instrumentation systems would be based on the -- first of all, the manufacturer's specifications. You know, we're usually purchasing these instrumentation systems and the manufacturer will have specifications and data sheets that provide the accuracy in the instrumentation.

We'll provide -- we'll perform start up testing of safety systems to verify that the parameters are within range of what we expect. Bill,

anything you want to add to those?

MEMBER BALLINGER: I think what Member Skillman is talking about is how do you verify that the instruments are reading properly going forward?

MEMBER SKILLMAN: Well, I'm going to let them answer. That's exactly where I'm going. I come from the background you got to understand the instruments are accurate. You got to calibrate them in some standards.

And you know that they're not changing in the course of time that you're depending on them.

MR. HENNESSY: Right. Exactly. Those instruments --

MEMBER. SKILLMAN: I wanted you to answer the question.

MR. HENNESSY: Those instruments that are safety related will be in tech specs and as such will have surveillance requirements that require frequencies that will ensure they're within calibration and operable prior to use.

MEMBER SKILLMAN: Yes, sir. Got it. Thanks.

ACTING CHAIRMAN BLEY: And nothing for the ones that are not safety related?

MR. HENNESSY: Well, we'll have testing

and we'll -- I won't call it surveillances. But we'll have calibration procedures and processes for the non-safety related ones of course.

ACTING CHAIRMAN BLEY: Thank you.

MEMBER REMPE: On the prior slide, you have some words about commensurate with an ANS standard instead of just meeting the criteria in the standard, the ANS or the ANSI/ANS standard.

MR. COSTEDIO: Yes, we're going to meet the ANSI standard.

MEMBER REMPE: So commensurate means you're --

MR. COSTEDIO: Means meet.

MEMBER REMPE: Okay.

MR. COSTEDIO: Yes.

MR. VAN ABEL: Yes, next slide, slide 19. So SHINE has a definition for which SSCs are safety related. It's those SSCs that are required to perform the six functions listed on this slide during normal operations or during accident conditions.

The first is the integrity of the primary system boundary. Remember the primary system boundary is the TSV, the TSV dump tank and the TSV off-gas system. And that's a direct analog to power reactors.

The capability to shutdown the target solution vessel and maintain the target solution in any safe shutdown condition. The capability to prevent or mitigate consequences of accidents which could result in potential exposures is comparable to the applicable guideline exposure as set forth in 10 CFR 20.

And of course that includes the 100 millirem exposures to the public. That all nuclear processes are subcritical, including an improved margin of subcriticality.

That acute chemical exposures to an individual from licensed material or hazardous chemicals produced from license material could not lead to irreversible or other serious long-lasting health affects to a worker. Or cause mild transient health affects to any individual offsite.

Or that an intake of 30 milligrams or greater of uranium in soluble form by an individual outside the OCA does not occur. Note that these are -- next slide Jim.

Note that these are a combination of the Part 50.2 definitions for safety-related components. And the first half there, one through three and the Part 70 requirements for safety classifications,

which is four, five and six.

So we incorporated both. Next slide.

MEMBER REMPE: So Eric? Again, the target solution vessel is made of Zircaloy and it's going to be designed to the intent of ASME BPDC Section 3, which I have no idea what's in that section anyway.

But anyhow, there's some -- one, there's -- is there enough experience? And again, it basically says to the intent of the ASME. And again, that's why I was asking the other question about commensurate.

What background are you relying upon to make sure that you -- there's some welding involved, to make sure that the welding's done in a way that's going to hold up?

Because Zircaloy is not so easy to weld is my understanding.

MR. VAN ABEL: So I think there are two questions. And I'll try to answer them separately.

The first one is the intent. And the reason intent is stated there is because Zircaloy is not a material contained within the allowable materials in the boiling pressure vessel code.

And we chose Zircaloy because we felt,

you know, the best properties for our application. And we are working with Oak Ridge National Lab to ensure that we have -- and there's a large history with Zircaloy materials to know their mechanical properties under radiation as well.

We're working with Oak Ridge National Labs to ensure we have a comprehensive materials property set to use for the vessel design. So that's why intent is in there.

Just because if not, we --

MEMBER REMPE: Okay. The work with Oak Ridge talks about corrosion and irradiated properties. Does it include looking at welding and how to properly do that work?

MR. VAN ABEL: Yes. Yes. So, Oak Ridge is doing welded samples as well. They're doing tests of Zircaloy welding with a couple of different methods that we're looking at. E beam welding and a TIG welding technique.

And they're irradiating those samples. They're doing hydrogen charging on samples looking for sensitivity to hydrogen uptake on those samples as well.

MEMBER REMPE: Thank you.

MEMBER BALLINGER: Then again, there are

very specific procedures, ASTM procedures and the like for welding certain zirconium alloys which require post weld T treatment and bake-out and those kinds of things. And you're aware of those?

MR. VAN ABEL: Yes.

MEMBER BALLINGER: Okay.

MR. BAN ABEL: We're working with Oak Ridge. They're -- I'm not the materials here today to talk to you about that.

But we're working with people that understand those issues to make sure that we have the proper procedures in place once we manufacture the vessel. And make sure that we can do, you know, we'll have testing following fabrication.

We'll also have, you know, installed, in place testing. And we'll have coupons that we'll have in the vessel during irradiation that we'll pull out periodically to test for mechanical properties as well.

MEMBER BALLINGER: Yes. That part is no issue, I don't think. It's the fabrication event and subsequent QA on the fabrication process and what's happened afterward to avoid delayed hydride cracking and things like that.

MR. VAN ABEL: Yes.

MEMBER BALLINGER: That's where my concern in. Because that's where I have experience with bad things happening.

MR. VAN ABEL: Yes. We're aware of that. And we haven't developed the specific requirements for the fabrication process yet.

MEMBER BALLINGER: Okay.

MR. VAN ABEL: But yes, it's definitely on our mind. All right, slide 20.

SSCs that are required to perform a safety function or are necessary to prevent the degradation of the safety function of a safety-related SSC are designed to withstand the effects of our design basis earthquake. Which, you know, was just previously talked about earlier in this Chapter.

And safety-related SSCs are designed as Quality Level One components per SHINE's QAPD. And then full measure of the QAPD is applied to these SSCs.

Selected SSCs that support or protect the safety function or safety-related equipment are designated as Quality Level Two. And Quality Elements are applied commensurate with the importance to safety of that system.

And Quality Level Three is applied to

non-safety SSCs that do not support to protect the safety function or safety-related SSCs. So that's the balance of systems. Thank you.

MR. LYNCH: All right. I will say in addition to those of us sitting here, we also have Greg Hofer, who is the primary author of this Chapter. He wasn't able to physically be here today. But he's on the phone to help answer questions as well.

All right, I'll get started. Okay, I'll quickly go over this. Just a few things for the licensing basis. I know you've heard a lot of this before.

Again, since we're primarily licensing the site under 10 CFR Part 50, those are the -- most of the regulations we're following.

But following our guidance, we are allowing some use of -- some information from Part 70 and NUREG-1520 to inform the design of the radioisotope production facility side.

One other thing I want to highlight on here, also while the general design criteria in Appendix A don't specifically apply to SHINE, in some instances, SHINE has looked at the general design criteria and said hey, there are some good ideas in here. We're going to apply those to our facility.

So, in those instances, they actually have some charts. We look at those and say hey, if this is what they're designing to, we do look at that.

So, there are some elements in there. But not -- we're only holding them to what they are actually designing to.

But I just wanted to bring that up because I'm sure you -- in this Chapter I know there some mentions of how they were applying some of those general design criteria.

All right. And I'll turn it over to Steve and Mary.

MR. MARSCHKE: Okay. I just wanted -- this slide is just a summary of what the areas of work facility is designed to, meteorological damage, water damage, as the SHINE presentation just indicated to you.

So these are some of the, you know, the facility is designed to withstand -- actually, oh, I'm sorry. The facility is designed for these types of incidents. And you can see, we've got wind, tornados, snow, ice, rain as was talked earlier.

Also, there was seismic. And again, as John mentioned in the SHINE presentation, the facility is designed for the site to withstand seismic

events. And also aircraft impacts and external exposures.

Again, --

ACTING CHAIRMAN BLEY: Stephen, maybe you could address a little bit for us, it comes up every new facility we look at, what Ron Ballinger asked about earlier.

You know, in our everyday experience, it seems that if you get a big snow fall and then you get rain come on it, you see a lot of damage beyond what you see from even snow twice that big. Like it really gets heavy.

And what's the modeling under that, that let's us kind of decide the snow's melting, it must be melting almost as fast as the rain's coming, because the calculations don't show a big effect. And I'm seeing big effects too.

MR. MARSCHKE: Yes. I wish I could answer that. I'm not seismic analysis.

ACTING CHAIRMAN BLEY: That's not seismic.

MR. MARSCHKE: Well, I'm not snow load either. I'm not structural analysis, let's put it that way. I'm filling in for -- like Steve mentioned, Greg Hofer, who is the primary reviewer and also --

ACTING CHAIRMAN BLEY: Well, maybe he'd want to say something.

MR. MARSCHKE: Yes, maybe Greg is on the phone. If he wants to say something about that.

But also, a lot of the structural analysis was done by another individual, who is also medically unavailable to us at this time, Ray Vollert, V-O-L-L-E-R-T. He did the structural analysis.

And so, I mean, we can jot that question down and get back to you about it. But, I mean, if Greg, do you --

ACTING CHAIRMAN BLEY: Let's try Greg. Yes, Greg, could you?

MR. HOFER: Yes. This is Greg Hofer here. Yes, I have to -- I would defer to Ray on this one. He did the structural analysis.

ACTING CHAIRMAN BLEY: Okay.

MR. HOFER: So you would have to ask Ray that question.

ACTING CHAIRMAN BLEY: That's fine.

MR. LYNCH: All right. I got it written down.

MEMBER BALLINGER: And I'd like to reinforce that again. It just doesn't -- I don't know, it doesn't sort of pass the smell test if you

will on the increase in load because of rain.

MR. MARSCHKE: We will, like I said, Steve has it written down. We will get back to you on that.

Safety-related structure systems and components. Again, the definition of safety related and items related -- relied on for safety comes out of Part 70.

Those were the two qualifications that were initially considered. And subsequently, as SHINE mentioned in their presentation earlier today, they have removed the classification of items relied on for safety.

And basically just have a single classification of safety-related items. And that's the definition here, which has been -- the six items here, which were developed during the RAI process with interaction between the staff and SHINE. We came up with this list.

ACTING CHAIRMAN BLEY: And this is a list of facts kind of. So anything that would affect any of those six items.

MR. MARSCHKE: Yes. If it adversely affects the integrity of the primary system boundary, then it would become safety related.

MEMBER SKILLMAN: Stephen, let me ask you this. It's interesting that we've got the two definitions from 50.2 safety-related, and 7.4 IROFS in the -- on the Part 70 applications IROFS are generally administrative.

They are instructions for barriers, instructions for ventilation. An IROF might be, unless this ventilation fan is functioning, a person may not enter this area. It's commonly used for centrifuge plants and fuel plants.

But more specifically an IROF is not generally a hardware item. Well, that certainly is true, well, it's mostly true. What I was really trying to get at is, in parsing this definition has the IROF portion been eliminated?

MR. MARSCHKE: IROF -- as far as I know at this point in the design process in the SAR, IROF has been eliminated. Unless the --

MR. LYNCH: It has.

MR. HOFER: Greg Hofer here. Basically what came out of all this during the initial part of the review, is they were classifying structure systems and components either as safety related or IROFS.

And it became confusing as to what was

going on. Why would a component be one and not the other. And as the discussion ensued, this is why it was -- the classification of structured systems and components was combined into this one set of definitions.

MR. MARSCHKE: So I don't think they were using IROF the way that you were describing it, as an administrative type of situation.

MR. LYNCH: Mary, did you have something on that you wanted to say?

MS. ADAMS: Yes.

MR. LYNCH: Or do you want to -- okay, go ahead.

MS. ADAMS: Okay, yes. This is Mary Adams in the Division of Fuel Cycle Safety and Safeguard and Environmental Review.

IROFS, it feels like we definitely have a preference for engineered safety features over administrative controls. And so as part of the fuel cycle review of the radioisotope production facility, we focused on our -- and because this is a construction permit, not an operating license, we focused on structure, systems and components that are engineered features.

Passive engineered. Always a preference

for passive engineered features, safe geometry, that sort of thing. Active engineered features are always preferred over any administrative controls just because they're generally more reliable.

So, when SHINE decided to stop confusing us with SR's in a radiation facility compared to the IROFS in the radioisotope production facility, Fuel Cycle didn't really have a problem with that.

You know, you can call them IROFS or you can call them SRSSCs. As long as they still meet the same availability and reliability criteria that we put in NUREG-1537 Interim Staff Guidance.

Does that answer the question? We recognize that there will be administrative controls. Operators are going to have to do stuff.

And that the operator training and qualification program and the plant procedures and the audit and assessments and all that stuff that happens in -- that we'll talk about in Chapter 12, Conduct of Operations, some of that can be put off, including administrative controls, some of that can be put off until the operating license.

But for passive engineered controls and active engineered controls that we think need to be installed or constructed under the construction

permit, we focused on those. And they have to meet these criteria to the extent that they apply to meeting those criteria in an accident analysis.

MEMBER SKILLMAN: No, I understand the distinction that you're making between hardware engineering safety features and admin. I was just trying to get clear in my mind if in the slide that you show on slide five, if there is a remnant of the admin IROFS that flow into the six items in slide six.

Of if all of the items on slide six are intended to be taken care of by hardware fixes? By hardware?

MS. ADAMS: So I think your question is, are administrative controls, operator action, included in safety related structure, systems and components. The answer is yes.

Except that the administrative controls won't necessarily be in the construction permits. They'll come later in the operating license.

MEMBER SKILLMAN: I would understand that. Okay. Thank you. That helps, thanks.

MR. MARSCHKE: This slide shows the two items of structure, systems and components which we -- need to be further addressed. We believe need to

be further addressed in the FSAR.

Control room habitability. The control room itself is considered to be safety related. But many of the sub -- the systems that support the control room, HVAC, lighting, breathing air, communications, are not.

The Applicant has provided information in response to an RAI that these issues will be addressed as part of the FSAR. The other one is a radiation zone -- ventilation zone three, safety classification.

Again, you can see on the slide the Applicant has stated that it's a transition zone between confinement of the radiation controlled area and the ventilation. It's supplied by radiation control area air handling units.

And during the operating license review, we'll have to need clarification of whether or not this radiation zone -- radiation ventilation zone three is safety related or not.

MEMBER SCHULTZ: Stephen, isn't that -- doesn't that seem too late to identify or explain why at the OL review that this does not need to be safety related? And that these issues associated with control function are not safety related?

Shouldn't those decisions be made and determined now?

MR. HOFER: Greg Hofer here. Basically, since all control and ventilation power is part of Part Two, which is safety related, and also it says there the Applicant has stated part of the boundary.

We're trying to understand how it is not already safety related. And why they continue to say that it is non-safety-related and want more qualification for that -- for the prospective statement.

I don't think there is from what we've seen so far, that there's going to be much of a modification change here. But there might be.

From when we come to start looking at the operating license. And mainly is half the systems.

MEMBER SCHULTZ: But you are pursuing it with the Applicant now is what I heard you say?

MR. HOFER: We are still discussing it, yes.

MEMBER SCHULTZ: Still discussing it. Thank you.

MR. LYNCH: Turn it over to Mary.

ACTING CHAIRMAN BLEY: I think, I'm not sure if this is where Steve was headed with that one.

But I'm sitting here kind of wondering if we don't design it in now, would it be hard to do later?

I think that's --

MEMBER SCHULTZ: Well, that's exactly it. And so these are fundamental responsibilities for the facility that the operators have. Breathing air, do they have adequate lighting in order to perform the function in normal operations as well as any emergency?

MR. HOFER: And in response to the RAI that was put out about these, they provided details for the control room that they were going to comprise that system so that there was adequate lighting, adequate HVAC, breathing air, and et cetera.

That was a very, very, very long response to our RAI. And it seems basically on this one that information did appear on how they're going to do it in the FSAR.

We were not looking, you know, just so that is all there for everyone to see. Because right now in the PSAR, that information doesn't show up.

That's basically where control room habitability one is coming from.

MEMBER SCHULTZ: Well, I'm still looking at the last sentence on this slide. And not quite

understanding, given the robustness of the response to the RAI.

Why we can't make a determination to move forward with a classification that makes sense. Rather then during the OL review the Applicant will clarify why it should not be safety related.

I'm trying to understand the lack construc -- the lack of constraint or the constraint here. Whatever you want to call it.

MR. HOFER: At the time when this was only -- well, the last round that we went to was in June. And the, you know, and the position of the Applicant was still that they felt that this was a non-safety related system.

And we haven't done another cycle of review. And obviously then I was out of the picture of being in the hospital. So, I don't know if they haven't put out anything since then.

MR. LYNCH: I think essentially what we've said is at this stage of the review, based on the level of design that SHINE has provided that at this time we will go with their classification of non-safety.

But we are still -- it being non-safety related. But we flagged it. And as the design

matures and we understand it better, we're going to take another look at it.

I think that's most of what we're committing to here.

MEMBER BALLINGER: So what you're saying then is that this look that you're talking about, would occur before somebody puts shovel in the ground? So that if there is construction issues that are associated with this, they're settled before that happens?

MR. LYNCH: Well, not necessarily. You know, if the design matures and they need to change their design then from what's -- we put in the construction permit, then they need to apply for an amendment to their construction permit.

And that is completely possible. And you know, that's not something that we're expecting not to happen at all. We think there could be changes to design.

But if they need to change the design, they need to come to us. And that's kind of a risk that they take on themselves.

MEMBER STETKAR: Well, but on the other hand, if there are issues where there's a strong indication that the design needs to be fixed now,

just punting it off until later doesn't sound all that responsible.

And I specifically use the word responsible.

MR. MARSCHKE: Um-hum. But I think if you -- I mean, what I heard from Greg, I mean, what I heard from Greg is that the discussion is continuing. It's not that we really have --

MEMBER STETKAR: Well, we'll discuss this more when we get to Chapter Nine because there are many examples. You're focusing on a couple of specific functions here. I have many more in Chapter Nine.

So in about a half an hour we'll get into this.

MR. LYNCH: Understood.

MS. ADAMS: My turn. Okay. SER Chapter Three documents NRC staff evaluation of the principal, architectural, and engineering design criteria for the SSCs that have been identified by the analysis in the PSAR to ensure RPF safety and protection of the public.

The SHINE facility and system designer, based on defense-in-depth practices, and I think there was a slide about that. I won't read what the

-- there's a definition of defense-in-depth practices.

In Section 3.1 of the PSAR, SHINE presented design criteria for SSCs and the RPF. A list of the SSCs is provided in a Table 3.1-1. There's 65 of them.

The codes and standards that are used as guidance for design of the facility SSCs are listed in Table 3.1-2. NRC guidance documents used in the design of the SHINE facility are listed in Table 3.1-3. And there are 26 of them, NRC guidance documents.

Design information for the complete range of normal operating conditions for various facility systems are found throughout the PSAR. Postulated initiating events and credible accidents that form the design basis for the SSCs located in the irradiation facility and the RPF are discussed in PSAR Chapter 13, which I think we're discussing in September, 13b.

Table 3.1-2 describes the quality standards commensurate with the safety functions and potential risks that were used in the design of the SSCs. Staff reviewed the criteria for the design and construction of SSCs that are required to ensure safe RPF operation, safe RPF shutdown and continued safe

conditions, response to anticipated transients, response to potential accidents, and control the radioactive material.

Staff reviewed the proposed design criteria to ensure the design criteria are specified for each SSC that's assumed to perform an operational or safety function. And that the design criteria include references to applicable up to date standards, guides and codes.

Staff reviewed the criteria to ensure that design criteria are stipulated for the complete range of normal RPF operating conditions. And to cope with anticipated transients and potential accidents.

Staff reviewed the criteria to ensure that the design will include redundancy to protect against unsafe conditions in the case of single failures of RPF protected and safety systems. And that the design will facilitate inspection, testing and maintenance.

Staff reviewed the design criteria to ensure that the design would limit the likelihood and consequences of fires, explosions and other potential manmade conditions. And that quality standards are proposed that are commensurate with the safety

function and potential risk.

Staff reviewed the design criteria to ensure that the RPF will be designed to withstand or mitigate wind, water and seismic damage to RPF systems and structures. And that the design basis consider the function, reliability, and maintainability of systems and components.

The reviewers compared the specified design criteria with the proposed and analyzed normal RPF operation. Response to anticipated transients, and consequences of accident conditions applicable to the appropriate SSCs assumed to function in each function in each Chapter of the PSAB.

Staff concluded that the proposed design criteria are based on applicable standards, guides, codes and criteria. And their application will provide reasonable assurance that the facility SSCs can be built and will function as designed and required by the analysis in the PSAR.

The design criteria provide reasonable assurance that the public will be protected from radiological risks resulting from operation of the RPF.

Meteorological design basis describing the most severe weather extremes predicted to occur

during the life of the facility, are provided in Section 2.3 of the PSAR, which we discussed in the June meeting.

Design criteria for facility SSCs to withstand the most severe weather extremes predicted to occur during the life of the facility are provided in Section 3.2 of the PSAR.

SSCs whose failure during a tornado event that could affect the safety related portions of the RPF, will be either designed to resist the tornado loading or the effect on the SS -- on the safety-related structures from the failure of these SSCs or portions thereof will be shown to be bounded by the tornado missile or aircraft impact evaluation.

The portion of the SHINE facility inside the seismic Category One boundary is not vented during a tornado event. Tornado dampers are provided at the seismic Category One boundary of the facility to ensure venting does not occur through the HVAC system.

Pressure doors other means will be used to prevent significant pressure fluctuation within the facility due to a tornado event.

Staff reviewed the design basis for all SSCs that could be affected by wind and other meteorological conditions as discussed in Chapter

Two, Site Characteristics of the PSAR. Staff concluded that the design criteria provide reasonable assurance that SSCs will perform their safety functions as specified in the PSAR under potential meteorological damage conditions.

For the design, SHINE will use local building codes, standards and NRC guidance to ensure that significant Meteorological damage at the facility is very unlikely.

With respect to water damage, the design basis precipitation levels and flood levels and groundwater levels of the SHINE facility are described in PSAR Section 2.4. The local PMP event creates a water level about level with grade.

But we talked about all that. I think I'm going to skip over some of that because SHINE already covered what these -- what the protections would be.

Staff reviewed the design basis for all SSCs that could be affected by predicted hydrological conditions at the site. Staff determined that the design criteria will provide reasonable assurance that SSCs would continue to perform required safety functions under water damage conditions.

For the design, the Applicant used local

building costs as applicable to help ensure that water damage to SSCs would not cause unsafe RPF operation, would not prevent safe RPF shutdown, and would not cause or allow uncontrolled release of radioactive material.

With respect to seismic damage, Section 2.5 and 3.4 of the PSAR states that seismic analysis criteria for the SHINE facility will perform to IAEA-TECDOC-1347, which we've talked about. Which provides generic requirements and guidance for the seismic design of nuclear facilities other then nuclear power plants.

Additional criteria in NRC Reg Guides and NRC 800 provide -- NUREG-800 provide more detailed guidance to the seismic analysis of the SHINE facility. Staff reviewed the design basis of RPF SSCs that are required to maintain function in case of seismic events at the facility site and determined that the RPF design basis provide reasonable assurance that the RPF can be shutdown and maintained in a safe condition.

The seismic design is consistent with local building codes to provide assurance that significant damage to the facility and associated safety functions is unlikely.

The Applicant demonstrated that all potential consequences from a seismic event are within the acceptable limits considered or bounded in the accident analysis of PSAR Chapter 13 to ensure that conditions due to a seismic event would not pose significant risk to the health and safety of the public.

Staff had concluded that the design criteria to protect against seismic damage will provide reasonable assurance that the RPF structure, systems and components will perform the necessary safety functions described and analyzed in the PSAR.

And that it will provide reasonable assurance that the consequences of credible seismic events at the RPF are considered in the results of the Chapter 13 accident analysis, ensuring acceptable protection of the public health and safety.

With respect to systems and components, Section 3.5 of the PSAR describes the design basis for design construction and operating characteristics of safety-related SSCs in the RPF. The design basis for systems and components required for safe operation and shutdown, is established within three categories, design basis functions, design basis values and design basis criteria.

Code-drive requirements are established for fabrication, construction, operation, testing, inspection, performance and quality. The codes include National Consensus Codes, National Standards, NRC Guidance Documents.

Systems and components within the RPF are described in PSAR Section 3.5b. There is some overlap of systems across the facility boundary and they are discussed as appropriate for the limiting safety classification.

PSAR Section 3.5a and 3.5b discuss the conditional application of Appendix A to 10 CFR 50, General Design Criteria for Nuclear Power Plants, and 10 CFR 70.64, Requirements for New Facilities or New Processes at Existing Facilities as Good Design Practice.

The Chapter 13 accident sequences for credible events define the design basis events. The safety-related parameter limits for these events are detailed in PSAR Chapter 13, which we'll discuss in September.

The safety-related parameter limits ensure that the associated design basis provided in PSAR Section 3.5 are met. More specific details on how the facility design or operation conforms to the

design basis are located in other individual sections of the PSAR.

SSCs that are determined to have safety significance will be designed, fabricated, erected, and tested commensurate with the criteria set forth in ANSI/ANS 15.8, as implemented by the SHINE Quality Assurance Program Description.

Appropriate records of the design, fabrication, erection, procurement and testing of SSCs that are determined to have safety significance, will be maintained throughout the life of the plant.

The design addresses natural phenomena hazards, fire protection, environmental and dynamic effect, chemical protection, emergency capability, utility services, inspection testing and maintenance, criticality safety, instrumentation and controls, and defense-in-depth.

The SHINE facility and system control designs are based on defense-in-depth practices. The design incorporates a preference for engineered controls over administrative controls, where we talked about these engineered controls, independence to avoid common mode failures and incorporates other features that enhance safety by reducing challenges to safety-related components and systems.

MEMBER STETKAR: Mary, I hate to interrupt you because you're on a roll. But, you said independence to avoid common mode failures. How does independence avoid common mode failures?

MS. ADAMS: How does independence avoid common mode failures?

MEMBER STETKAR: Yes. How does independence avoid common mode failures? Are you familiar with common mode failures?

MS. ADAMS: Yes.

MEMBER STETKAR: Okay. Diversity avoids common mode failures. Independence doesn't. I can have 50 identical nominally independent items. And they can all fail due to the same common mode.

So independence has no bearing whatsoever on common mode failures in that sense.

ACTING CHAIRMAN BLEY: Right. Yes.

MEMBER STETKAR: There are other types of failure mechanisms such as --

ACTING CHAIRMAN BLEY: And there are other layers of independents.

MEMBER STETKAR: There are other areas on independence, but --

ACTING CHAIRMAN BLEY: I think maybe, and I'm going to try to help Mary here a little. You

narrowed down I think what I heard her say.

Where I thought you were when that statement came out, was you were talking about referring passive engineered features and some other independent things to avoid common mode. My interpretation was you were getting rid of the human common mode.

MEMBER STETKAR: No, see I wasn't thinking human. I was thinking an independent --

ACTING CHAIRMAN BLEY: So I'm not sure where you were headed with it.

MEMBER STETKAR: Independent SSCs.

ACTING CHAIRMAN BLEY: Maybe you want to think about that and get back to us at some point.

MEMBER STETKAR: Independence by itself, if you're just talking about two nominally independent, you know, pump A and pump B for example, is not a barrier against common -- certain types of common mode failures.

MS. ADAMS: And I would understand. If those two pumps both have the same types of dependence between them.

MEMBER STETKAR: No, that's a different type -- that's a functional or physical dependence. It's not the fact that if for example there is a

common manufacturing defect in both of those nominally identical pumps. They may be vulnerable to the same common mode failure.

It has nothing to do with their electric power supplies. It has nothing to do with place within the room. It has nothing to do -- if one is a turbine driven pump and one is a motor-driven pump, that's diversity.

And other then the fact that they might have the same internal shaft and impeller, which is unlikely in most hydrogen --

ACTING CHAIRMAN BLEY: If I can help with my weight, I'll try.

MEMBER STETKAR: Okay.

ACTING CHAIRMAN BLEY: What John's talking about, people more often call redundancy rather then independence.

MEMBER STETKAR: Yes.

ACTING CHAIRMAN BLEY: And independence has lots of different definitions and applies at different depths of -- if you take a component it can apply it at the level with the power supplies, it can apply it at the design. It can apply at all other areas.

But certainly redundancy doesn't protect

that common mode.

MEMBER STETKAR: Yes. The type of common mode that I'm talking about, you're right. That's a better elaboration on terminology of that.

MS. ADAMS: Okay.

MEMBER STETKAR: People often confuse independence and redundancy on that -- in that sense.

MS. ADAMS: On the whole Fuel Cycle looks at reliability. We want to make sure that a high consequence event as defined, is highly unlikely.

And if you can achieve that using one single passive engineered control, then that's good enough. If you have two active engineered controls, then we have to look a little more closely about availability and reliability to perform their intended functions.

Whether its independent diverse or redundant, reliability is the bottom line.

MR. LYNCH: Well, we'll look into clarifying what word was actually meant there.

MEMBER SCHULTZ: Mary, while we pause for a moment, I wanted to ask a question related to what -- a topic you have covered and the Applicant covered also.

And that was related to the

implementation of their quality assurance program. As Eric had mentioned and was in their slides that they have a program that they're applying for design fabrication and implementation later.

My question is, is that a program that you've thoroughly reviewed? And have you reviewed any of the Applicant's implementation of their Quality Program specifically for design of course at this point?

What's been the level of staff review related to the program itself?

MR. LYNCH: It's the same estimated Quality Assurance Program for construction. We have -- our quality -- our presentation -- our full presentation on quality assurance will be in September.

But we have done a full review of their Program. And as far as our actual inspections go with that, that's going to start once construction begins.

MEMBER SCHULTZ: That's enough for now Steven. Thank you.

MEMBER REMPE: So, if they've designed a component, did you go through and look at the actual -- take a component design and -- or spot check it,

or what level of effort and exchange has there been?

MR. LYNCH: I think more of that, at least from a quality assurance perspective, more of that's going to happen when we start, you know, once we approve their Quality Assurance Plan, with the construction permit, then we would start going out to the site and going to, you know, going to vendors and looking at what they're doing and the design of the components.

But that, I don't -- what you're ask -- what I think you're asking, we haven't done that yet.

MEMBER REMPE: But it will be done out once they've started construction and --

MR. LYNCH: Yes.

MEMBER REMPE: Paid for all these components to be built and everything like that?

MR. LYNCH: And that will be part of the quality assurance inspection. We are developing construction inspection programs where quality assurance inspections, we actually have an inspection procedure dedicated to that. For quality assurance inspection.

MEMBER REMPE: And for the design of the components, in some cases you might actually go through it. Again, this partly my experience in how

much detail you have at this point.

And the same questions will occur when we get into the accident analysis. And when you start getting into the details.

MR. LYNCH: Yes. And I think as far as those construction inspections for quality assurance, I actually have the developer of that procedure is going to be here later this afternoon and he can speak. I have him -- he has a few slides on that and he can probably speak in a little bit more detail on that this afternoon.

MEMBER REMPE: Thank you.

MEMBER SKILLMAN: Steven, it would help if you would telegraph your punch here. At the last meeting, several of us raised the importance of Appendix B to 10 CFR 50.

I recall your kind of saying we're going to take a real close look at that because the template to that time had been the ASME program.

MR. LYNCH: Yes.

MEMBER SKILLMAN: And to Dr. Schultz' question, I'd be curious, have you given greater consideration so to Appendix B?

MR. LYNCH: Yes. I was hoping to -- when we have all of our quality assurance reviewers here

in September to really tackle that issue. But, we are -- as of now, I mean, I think our position is that we don't need to apply Appendix B.

But when we have everyone here, I do want to go through and explain why we are not using it.

MEMBER SKILLMAN: Okay. Thank you.

MR. LYNCH: Yes.

MS. ADAMS: My understanding is that my reviewers in Fuel Cycle are indeed looking at all of the baseline criteria that are in Part 70.64 for a new facility. About fire protection and natural phenomena hazards and that sort of thing.

So, -- and Part 70.64 grew out of, in 1999, grew out of Part 50, Appendix B -- A, and at the time that the new Part 70 Subpart H rulemaking was happening, we looked at those general design criteria from Part 50 and selected which ones were appropriate for fuel cycle facilities. Or for facilities like this.

And so the reviewers in Fuel Cycle who were looking at the radioisotope production facility did look at the general -- those baseline design criteria that are in 70.64 as incorporated into the interim staff guidance.

Okay. Single failure. With respect to

single failure, mechanical instrumentation and electrical systems and components required to perform their intended safety function in the event of a single failure will be designed to include sufficient redundancy and independence, here we got these words, such that a single failure of any active component does not result in the loss of the capability of the system to perform its safety functions.

Design techniques such as physical separation, functional diversity, diversity in component design, and principles of operation will be used to the extent necessary to protect against a single failure.

So, we don't know what these components are. You know, there's the list of what they are. You know, my favorite example is the bubble type dampers on the noble gas removal system. All we know is that they designed to close within a certain amount of time.

Now we don't have the manufacturer's specifications on those bubble-tight dampers yet. But SHINE has committed to select and purchase bubble-tight dampers that meet those criteria.

So, -- and those criteria, according to the accident sequence we evaluate, are good enough.

Now, during the construction inspection, NRC inspectors will have to make sure that the component that SHINE actually purchases and installs does indeed meet the criteria that they committed to in the construction permit.

Section 3.5.1 of the PSAR describes classification of systems and components important to safety. Systems and components in the SHINE facility are to be classified according to their importance to safety in quality levels and seismic class.

3.5 provides the top level guidance used in developing these classifications during preliminary design with the support of regulatory guidance, reviews, hazard and operability studies, accident analysis, ISA and national Consensus code requirement.

PSAR Table 3.5-1 contains a summary of SSC classifications developed facility wide. Certain SSCs at the SHINE facility are considered safety related because they perform safety functions during normal operations or as required to prevent or mitigate the consequences of abnormal operational transients or accidents.

The purpose of PSAR Section 3.5 is to classify SSCs according to the safety function they

perform. In addition, design requirements are placed upon such equipment to ensure the proper performance of safety function when required. A listing of these SSCs and their safety classifications are provided in PSAR Table 3.5-1.

SHINE uses the modified definition from 10 CFR 50.2 to develop the definition of safety-related SSCs. And we talked about this a couple of time, what those -- the six criteria are.

Quality assurance requirements are provided in the QAPD. The SHINE QAPD has been developed in accordance with ANSI 15.8, which we've already talked about.

Section 3.5.2 of the PSAR describes plant safety-related SSCs that will be designed to withstand the effects of a design basis earthquake. And remain functional to meet the safety-related criteria. I think we talked a lot about that already.

NRC staff reviewed the design basis for the systems and components that are required to function. And are described in detail in this or other PSAR sections.

NRC staff determined that the design criteria, included consideration of the conditions required of the systems and components to insure safe

RPF operation including response to transient and potential accident conditions analyzed in Chapter 13b of the PSAR.

Staff verified that the systems and components that will be required to ensure safe RPF conditions were considered. And they're operating conditions were analyzed to ensure function.

Staff determined that the design basis of the systems and components provide reasonable assurance that the facility systems and components will function as designed to ensure safe operation and safe shutdown of the RPF.

MEMBER REMPE: Again, just an information type, trying to understand the process question. So, they've done some accident analysis and come up with design specifications for certain components.

And you can grant them a construction permit just based on that. But you didn't really do an independent analysis of the design basis accident, did you? With independent tools or anything like that?

MS. ADAMS: Correct. We don't -- yes, we don't have the design basis accident -- we do not -- well, we'll get to this when we talk about Chapter 13 in September.

MEMBER REMPE: Right.

MS. ADAMS: Well, actually we're going to talk a little bit about 13a today.

MEMBER REMPE: And the question I have is then okay, so then you grant them the construction permit and then there's going to be some interaction, because they're going to be pouring concrete where you'll develop the capability to independently review their accident analysis.

And then they will -- at that point when they say okay, everybody agrees this accident analysis is correct and the components can -- they've got the right specifications. And then they go buy them and the process goes forward.

But, I kind of had thought maybe they might be wanted to buy some of those components after construction and the concrete's poured. But if they are financially conservative, they would wait until after you go forward.

That's the schedule at a high level. I'm just trying to understand. Because I wasn't involved in years gone by, when people did construction permits and licenses. And I just -- and operating approvals and all that.

And I just to me I thought after the

construction permit when I look at -- right now like the 52 process, people are pouring concrete and buying components and things like that. But this is a little different and things could change when you do your independent evaluation of the analysis.

MS. ADAMS: And what you'll see in Chapter 13b discussion in September is that, as I remember, Chapter 13b, SHINE said in the PSAR, that there is something like 400 accident sequences in the RPF. I hope my memory is right.

And that something like 50 of those accident sequences can result in intermediate or high consequences as defined. We have reasonably detailed descriptions of about five of them.

And what you'll hear in September is that Fuel Cycle Staff looked very closely at those particular accident sequences and determined that SHINE's methodology for doing the accident analysis was sufficiently detailed and adequate.

That we trust them to do the rest of the 51 accident analyses correctly. And to designate the IROFS that are available and reliable such that they can meet the criteria.

That's what 10 CFR 70 Subpart H, it's what 70.65 authorizes us to do. Is to look closely

at the methodology and to determine whether the Applicant staff is smart enough and has a good enough methodology for doing their accident analysis.

We don't review every single one of their accident sequences.

MEMBER REMPE: Okay.

MS. ADAMS: As much as we would love to.

MEMBER REMPE: No, I just was wondering of the timing of when that's done. And especially like with what we'll be talking about this afternoon.

Because it sounds like that that's going to happen later in a lot of cases.

MS. ADAMS: Okay.

MR. ADAMS: And I think part of it is, and indeed, there's a lot of discussion we had is what the regulations in 50.34 and 50.35 say. The regulations are not detailed. They allow a lot of issues to be put off until the FSAR stage.

And you know, that's -- I think it's a good thing that we're going to, you know, that we will have this discussion I think. Because that was one of the areas we talked about.

I think, you know, some of these RAIs you see and some of these issues are basically a message that this is something that has to be looked at in

greater detail. And indeed, may result in the Applicant having to do something different at the FSAR stage.

But, it's part -- it is the lati -- the wide latitude that the regulations allow at this stage. It basically says you can still be doing research that you're the -- you know, numbers associated with your design can still be in the range of versus I know how -- I know what I have.

It -- the regulations allow a great deal of latitude at this point.

MEMBER REMPE: But then --

MR. ADAMS: And the ability to go forward with a lot of issues to be closed later on.

MEMBER REMPE: But if something comes up at the last minute, then everyone starts complaining that the regulator cost more and things like that. And so that's going to be the down falling of it.

MR. ADAMS: But that -- I believe that's a discussion we've had with the Applicant. And a message we clearly sent to the Applicant that by, you know, by addressing things now versus addressing things later bring different responsibilities.

MEMBER REMPE: Yes. Okay. Thank you.

MR. LYNCH: Okay. I think in the

interest of time, I think we've got through the meat of the presentation.

I think these last couple of slides are just highlighting regulations again, guidance we used. Still using NUREG-1537. And we'll talk about all of this. 50.35 is what we're evaluating and against then.

We've talked about some of these. But we do have, you know, based on RAIs, we have responses. SHINE has said, you know, some of this analysis will continue on into the FSAR.

And this is kind of a summary list of those items that when we've asked RAIs and gotten responses back from SHINE that we're going to look at again and revisit in the FSAR.

ACTING CHAIRMAN BLEY: Okay, thank you. I have a couple of points I want to make before we take a break.

We're a little behind schedule, but we have some slack in the afternoon. So we should be okay. Although there's a couple of topics coming up that may stretch us out even more.

I just wanted to mention that, you know, both of you showed a slide that defined how they were using safety related. And I don't think we got

anything from the Members about that at this point in time.

It looked pretty good to me. On the other hand, from the obvious things people have been telling me, and some of these will be coming up in the next sessions, we're going to have quite a few questions about how that list of six conditions that lead you to safety related have been applied.

And some we're having a little trouble understanding. So we want to see that.

Also, we have our consultant Kord Smith on the line. Kord, do you have anything you want to say at this time? Or do you want to wait until later?

CONSULTANT SMITH: I think mine can wait until later.

ACTING CHAIRMAN BLEY: Okay. That's good. We're going to take -- Dick?

MEMBER SKILLMAN: May I make a comment please?

ACTING CHAIRMAN BLEY: Sure.

MEMBER SKILLMAN: Dr. Bley, thank you. I would like to go back to the diversity versus redundancy conversation just for a second.

So, each of the eight irradiation units has four dump valves. Is that accurate? As I see

the plumbing?

One of the --

MS. ADAMS: It's an irradiation facility, it's an RPF.

MEMBER SKILLMAN: Well, but each has two dump valves, just two. All right, that's even a greater concern.

Back in the day when we were doing NSSS's, we learned to have different types of valves, just like John Stetkar mentioned. Sometimes having redundancy doesn't give you the diversity that you really want.

And building on Dr. Rempe's question about where are you in the process to begin to buy hardware, I think now is the right time for a caution to really internalize this diversity versus redundancy question. Because if you're preparing to buy dampers, controllers, expensive hardware that will be underwater and not very accessible, you would not want to be bitten by the diversity versus redundancy question after you've already committed your money for what is very expensive hardware.

And that it was a hard earned lesson for us when we were going NSSS designs a long time ago. And a lot of us had to go back and catch up. Cut out

equipment. Put in different equipment.

But it seems that that is a topic that needs to be part of this Chapter 3. And we'll probably discuss it also in 9. Thank you.

ACTING CHAIRMAN BLEY: Okay. At this time we'll recess until 10:25. See you all back here then.

(Whereupon, the above-entitled matter went off the record at 10:08 a.m. and resumed at 10:26 a.m.)

CHAIRMAN BLEY: We're back in session; we'll continue on with the Auxiliary Systems. Okay.

MR. RICOHERMOSO: I'm Eusebio Ricohermoso of Sargent & Lundy, I'm representing the heating, ventilation and air conditioning systems, otherwise called as HVAC. The SHINE production possibility is designed with four ventilation zones; three of them are in the radiological controlled area, we call it RCA, and one on the very clean area. The three that are in the RCA are the Zone 2 --- Zone 1, Zone 2 and Zone 3, and the number is based on the designation of the label of the principal operation between them in order to control the flow from one contaminated area to another.

MEMBER STETKAR: Rico, you folks don't

believe in drawings apparently. As a back up slide anywhere, do you have a drawing of RVZ1, 2 and 3? We're sort a visual type group here, and you know, listing things gets lost on people.

MS. KOLB: Yes, we have backup slides, we have a flow diagram and a building layout; the layout is security related so we're going to pass those out in hard copy.

MEMBER STETKAR: Okay.

MS. KOLB: They're working on it.

MEMBER STETKAR: Thank you. It helps when you start explaining how these are all tied -- I know what it is because I looked at them, I doubt many of the other members have looked at them in detail.

MR. RICOHERMOSO: As I mentioned earlier, it is maintained between the confinement zones, which are the RCA by ensuring that the air flow travels in one direction from zones of lower potential for contamination to zones of higher potential for contamination. Facility Ventilation Zone 4 is outside the RCA and is slightly positive pressurized with respect to the atmosphere. Next slide, please. RCA Ventilation Zone 1, which is RVZ1, which I'm going to be using that, are areas where high level of

contaminations are anticipated during normal operations until supply air from adjacent RVZ2 is basis, that's where the air is coming from. Air inlets that are close to the Zone 1 are equipped with automatic isolation dampers, which are--they're closed, and it also has manual isolation dampers and HEPA filters on the inlet and the exhaust side. Exhausts include automatic isolation dumpers to a level of confinement at the specific RVZ1 area and local HEPA filters.

CHAIRMAN BLEY: Are they exhaust fans or just the supply fans?

MR. RICOHERMOSO: We have both isolation dampers; automatic isolation dampers in such a way that there is a normal or abnormal air condition, they will isolate the whole facility. So we have isolation dampers that isolate the whole building. Okay. Automatic isolation dampers in the supply and exhaust are safety related. They isolate the plant, they signal when engineered safety features activation system, called ESFAS, or radiological integrated control systems, which is called RICS. Additional safety related isolation dampers located downstream of the final filters that we have filters on the exhaust Zone 1. Next slide, please. Our

serial ventilation Zone 2--

MEMBER SKILLMAN: Excuse me, before you proceed, based on the set of arrows that you showed, RVZ1 is less than two, which is less than three, which is less than ambient?

MR. RICOHERMOSO: Right.

MEMBER SKILLMAN: One would assume that RVZ1 is for the fairly low differential pressure?

MR. RICOHERMOSO: Exactly. It's very negative.

MEMBER SKILLMAN: Very negative; hold that thought. What consideration has been given to the ability of the operators to exit against the negative pressure door that's opening into the next higher pressure, or close a door where the negative pressure is so low? I make a comment because even a couple of inches of differential pressure, or even a fraction of an inch of differential pressure on a large door is almost not overcome-able by a normal person.

MR. RICOHERMOSO: Those are--they're designed to be part of the door design, but I believe they should have operators.

MEMBER SKILLMAN: What consideration has been given to it is my question. Is SHINE aware of

it? I'll leave it to SHINE to--just an open question. If you get the delta P high enough, you can trap operators, and that's my point.

MR. HENNESSY: Excuse me, RVZ1 areas are not really occupied.

MEMBER SKILLMAN: Okay, and if an operator gets in there for some reason and you're operating at those high delta Ps, I would assert that he could conceivably get trapped is my point.

MR. HENNESSY: With hot cells and glove boxes, but hot cells mostly in the radiation unit itself, which are not occupied, and they would be closed by shields, heavy shields, plugs and that type of thing. So if we were to go into one of those areas, we would isolate the ventilation system first.

MEMBER SKILLMAN: Would that be controlled by a procedure?

MR. HENNESSY: Yes, it would be.

MR. VAN ABEL: But your point is a very good point, and that is something that we have to consider if we do the detailed design.

MEMBER SKILLMAN: And I offered a plan where we could get trapped; we could become entrapped because of the delta P, and we could actually adjust the delta P to trap people. So we knew that that was

a feature. Thank you.

MR. RICOHERMOSO: Continuing on, we're still on RVZ2; these are areas where airborne contamination could be present during normal operation, but it's not expected routinely or else it shows a breach upon RVZ1 confinement area. The RICS supply air from the RCA Zone 2, which contains filters in cooling coils and supply fans. Additional layer is cascaded into RVZ2 areas from RVZ3 areas through airlock door leakage that was due to negative pressure differential. Exhaust --- general room exhaust and fume hood enclosures were also present. The pressure of RVZ2 is also transferred to RVZ1 area through RVZ1 area air inlets, which has filters. RCA ventilation zone 2 there's a supply and exhaust system and air flow control valves reacting to maintain the design the zone pressure and ensuring that the zone pressures are negative with respect to atmosphere in RVZ3. Safety-related isolation dampers, which are automatic, are provided in supply valve at the RCA and exhaust duct system downstream of the final filters controlled by radiological control system to provide confinement. The final point, ~~where they're cooling there, it~~ I would look at the diagram, is the pockets filter that was at discharg~~ed~~ to the vents.

So, next slide place.

RVZ3 are areas where airborne contamination is not expected during normal facility operation. It consists of RCA air locks. During the last presentation, the question was raised about RVZ3. RVZ3 is not a system; it's a zone, and it gets the air from Zone 2, and it's maintained at positive with respect to Zone 2, and Zone 4 also provides air to the air locks. Okay, so just a bit of clarification that RVZ3 is not a system; it's a zone. Facility ventilation Zone 4, which is FVZ4, are areas outside the RCA, but within the production facility building. It is supplied by independent air on the units, and it's controlled by a facility controlled system which are not safety related.

MEMBER STETKAR: Now before we get to fire protection, just go back to the last slide to avoid confusion. I have several questions. First, let's talk about FVZ4, because on the record, FVZ4 provides ventilation and room cooling for the following locations: the safety related uninterruptible power supply rooms; the room that contains the cabinets for the target solution vessel reactivity protection system, TRPS; the room that contains the cabinets for the engineered safety

features actuation system; the room that contains the cabinets for the radiological integrated control system; the room that contains the cabinets for the facility integrated control system; the main control room and the normal AC power switch gear rooms. Essentially, everything in the plant. It's characterized as having two 50 percent capacity air handling units, not two 100 percent capacity; two 50 percent capacity air handling units, and I for the life of me can't figure out why it's not safety related. If it cools and provides ventilation for many rooms that contain safety related equipment and functions, and I'm not even talking about main control room habitability. So why is it not safety related?

MR. RICOHERMOSO: Okay that--the ecovent in those areas support the equipment, those are not used for projects.

MEMBER STETKAR: I'm sorry. I'm talking about safely shutting down all irradiation units, safely shutting down the facility. ESFAS, the appropriate reactor protection, all of the control systems, all of the cabinets for all of that stuff; all of which is digital. My little computer here doesn't like it when it gets hot. So why is that system not safety related? I've asked the staff to

really look into that system, and just put that on the record, because you don't need to answer. You've already claimed that it's not safety related. I fundamentally differ with that conclusion.

MR. RICOHERMOSO: All right, let's go back to the definition of safety-related--

MEMBER STETKAR: I'm sorry, I'm not an attorney; I'm an engineer. I'm not an attorney; I'm an engineer, and we have had many experiences in nuclear power plants, and I don't care what you want to call this facility, where failures of these types of systems have gotten people into real trouble. So I have no notion why this isn't safety-related. Now let's put this on the record; don't try to answer it now because you're likely to dig yourself a bigger hole than you want to be in now.

MS. KOLB: Thank you; we understand the comment.

MEMBER STETKAR: Second related topic because it's a system you're not even discussing today, is the chilled water system. The chilled water system provides cooling for everything in the entire facility, including FVZ4. The chilled water system, I can't even find a diagram for the chilled water system; it's vaguely mentioned in the PSAR,

it's not evaluated as best as I can say--find in the integrated safety analysis; if the chilled water system goes, I lose the cooling for all of the rooms that I just mentioned, plus I lose the cooling for all of the process systems plus the cooling for all of the irradiation unit systems. So I have no idea why the chilled water system is not safety-related.

CHAIRMAN BLEY: I'll just toss something in there. When digital systems begin to heat up the hardware part of your digital system, you don't know what's going to happen. They fail clean, they fail dirty.

MEMBER STETKAR: So I've got that in; I'm surprised you didn't even mention the chilled water system today, because as far as I can tell, it's the most important support system in the whole facility, and you're not even talking about it today.

MS. KOLB: I'd like to--we didn't include the chill water system although it's in Chapter 9; we thought we had covered in the time--due to time constraints, we had mentioned it in Chapter 5 in the previous one; this is why we didn't include it this time.

CHAIRMAN BLEY: At the last meeting?

MS. KOLB: At the last meeting; that's

correct.

MEMBER STETKAR: You mentioned it, but it's described in Chapter 9; it's not really talked about in Chapter 5. It's mentioned as cooling water for this system for RCPS. I lose track of the acronyms.

MEMBER SKILLMAN: I'd like to build on John's comment. One of the lessons we learned over the past many years in nuclear is ventilation systems don't burn you, they don't radiate you, and they don't make you get wet. They don't wet you, they don't irradiate you, and they don't burn you. And so it's very, very easy to overlook the importance, the personal safety importance and the functional importance of the ventilation systems. They're almost taken for granted just like we do in this room today, but their failure modes can really cause major plant issues and major people issues. Thank you.

CHAIRMAN BLEY: And one last thing before we go on with the fire, what consideration was given to how you would deal with fires in the design of the ventilation system?

MR. RICOHERMOSO: We provided--on the design, we'll provide ~~five numbers on~~ fire barriers or the fire dampers on the fire boundaries--

CHAIRMAN BLEY: That's just to close things off. Okay. You'll provide the fire protection?

MR. ALDIERI: Yes. My name is Joseph Aldieri; this is the correct spelling of my name, not the one on the slide. I'm also with Sargent Lundy. The SHINE facility fire protection system is design criteria of NFPA-801, the standards for fire protection for facilities handling radioactive materials. The fire protection system is normally supplied from two separate pressurized storage tanks, backed up by a city water supply. There are two 100 percent capacity fire pumps to be pumping, typically a motor driven fire pump, and the second one being a diesel-driven fire pump. The SHINE fire protection, furthermore, will comply with ANSI requirement 15.17, the standard for fire protection program criteria research reactors. It's a very brief 13-page document; it just really summarizes, in relation to 805, a very simple fire protection program elements, retention depth, et cetera. Next slide.

Our analysis evaluated potential occurrence of fires within the SHINE facility. We documented the capability of the fire protection systems and provide a reasonable assurance to achieve

safe shut down and ensure the fire protection requirements established in the NUREG-1537 have been applied to the SHINE facility are sufficient. Again, we learned they're basically the same as you'll see in other documents preventing fires, including limiting combustible materials, detecting, controlling and extinguishing fires to limit the consequences, and protect the systems required for shut down as necessary. The SHINE facility is divided into 21 fire areas; each of them are separated from each other by fire barriers such as walls, floors, ceilings, penetration seals, doors and as you mentioned, fire dampers where applicable. A fuel and fire rating resistance will be required for high combustible loadings for adjacent rooms containing SSCs, a different fire train, basically the construction, even though it's--all of them will probably meet three hour construction requirements regardless. Efforts to identify fire protection system design features necessary to minimize both the occurrence and the consequences of fire for the SHINE facility, as well as life safety considerations. These include again fire detection, suppression and passive protection. Next slide.

MEMBER STETKAR: Joseph? And I don't

know, tell me if this is somehow security related, and we can talk about it later. I had some questions about specific fire areas and what's in those fire areas and how they're treated. Do I delve into anything security related if I talk about those?

MR. ALDIERI: It depends which one it is.

CHAIRMAN BLEY: I want to say this, as long--it would better if we could save it, but as long as we don't talk about specific locations of material, we're okay.

MEMBER STETKAR: I'm not talking about locations of controlled material, if that's the concern.

CHAIRMAN BLEY: Then we should be fine.

MEMBER STETKAR: We should be fine?

CHAIRMAN BLEY: Yes.

MEMBER STETKAR: Okay. Let me get into it, and then it's cut you off at the knees or whatever--

MR. ALDIERI: I have memorized the 21 areas, so--

MEMBER STETKAR: Oh, you have? I couldn't remember them all.

MR. ALDIERI: I have my computer; I can pull it up.

MEMBER STETKAR: Pull it up, the figure 9a2.3-1 or whatever; it'll help. Or FA2.6-2 also helps.

CHAIRMAN BLEY: John, before we go forward, if one of you two can tell us something about what you're looking at in the pictures, it'll help us.

MEMBER STETKAR: Yes, okay. Actually if--for the benefit of everybody, there was a picture this morning in the first presentation that showed the layout of the whole facility, and it'll suffice for most of this, except--

CHAIRMAN BLEY: For Figure 4? Page 4?

MEMBER STETKAR: Page 4, yes, if you guys can--

CHAIRMAN BLEY: In Chapter 3?

MEMBER STETKAR: In Chapter 3. It helps a little bit; it doesn't help an awful not, but what I'm going to be talking about are the areas on the bottom part of this figure in particular.

CHAIRMAN BLEY: In this room?

MEMBER STETKAR: I'm looking at fire areas 11, 12, 13 basically and 21, so they're down in the control room, that area.

CHAIRMAN BLEY: The hallway. Okay.

MEMBER STETKAR: This is kind of a follow on from my FVZ4 rant, but I notice that there are two trains of safeguards, ESFAS, Train A and Train B, and in fact, they're in separate fire areas. However, the target solution vessel reactivity protection system seems to be--all the cabinets seem to be in one room, it's fire are 13, which also has half of the ESFAS trains. All of the radiological integrated control system cabinets seem to be in one room, fire area 12, so I'm curious because these are systems that are shared among all 12 radiation units. I mean, it's not -- you don't have a separate room for each of your radiation units; this is a completely shared system. So I'm curious why nominally redundant, for example, radiological integrated control system and target solution vessel reactivity protection system are included in single fire area, in the room. Why is that?

MR. ALDIERI: I don't have the list of all the equipment that's in rooms, I just--

MEMBER STETKAR: Yes, that's why if you look at Figure 7A2.6-2, I could go look at it--

MR. ALDIERI: In the PSAR?

MEMBER STETKAR: In the PSAR, it doesn't show you individual cabinets, but indeed it does give

you a list of the names of the types of cabinets in each area, and it even shows you sort of the physical locations of the cabinets in each of those areas around the control room, those rooms around the control room. And that's all I have to base this on; I couldn't find stuff in the fire hazards analysis that had that amount of detail. So my basic question is why, and how have you dealt with that from the fire hazards analysis perspective? And a related question to what Dr. Bley mentioned earlier, is when you look at your fire hazards analysis, right now it's a very, very high level kind of simplistic analysis.

MR. ALDIERI: Correct.

MEMBER STETKAR: It does not seem to address things like spurious actuations; all it says is an analysis defining consequences of the fire breach fire area; this is stated as loss of function, which means to me a clean failure rather than the effects of spurious actuations, which are now required, at least for nuclear power plants, for both so far deterministic and probabilistic assessments, and we need to look at heat-related, smoke-related damage that can cause spurious actuations. And that further brings into question this notion of having

protection--all of the protection system in one room, and half of the safeguard stuff in the same room.

MR. ALDIERI: I guess I can answer that kind of briefly. As you mentioned, this originally was a high level; they separated everything based on how they separated various components.

MEMBER STETKAR: Right.

MR. ALDIERI: I was not--the long form answer would be that a shut down analysis type of assessment would then occur.

MEMBER STETKAR: On the other hand, it sort of draws questions, really. This is an area, this is one of the areas where I'm kind of not quite sure when it's resolved, because this is now a building layout, and we're talking about a construction permit here, which means physical structures and walls and space allocations and things like that. This is not the type of thing you typically go back and--you might not have enough room to put up enough partitions, and if you do put up enough partitions, it might get so hot in those little rooms under normal circumstances that my little laptop computer doesn't like to be in there. People have found that problem later in terms of retro fitting fire barriers to a pre-existing design.

MR. ALDIERI: Again, I would default that. I would need to probably coordinate that with the system engineers of the sub-components and evaluate that.

MEMBER STETKAR: Well my question is if you haven't thought about it now, it might get awfully difficult to think about it later, to fix it later.

MR. ALDIERI: I guess we'll note the question and assess it, and to answer it, I would probably also use fire protection techniques to mitigate those as well. For example, as we do in the nuclear industry, early warning detection or air sampling systems which detect fires well before, like days before. So that could be a defense method where I could put air sampling inside a cabinet, which many plants are doing now under 805. So--

MEMBER STETKAR: We're not trying to design it right now; I'm trying to draw attention to it.

MR. ALDIERI: I'm saying that those would be the considerations that I would take into account, to answer your question more effectively.

MEMBER STETKAR: Okay.

MR. ALDIERI: I'm not saying I'm solving it that way, but that could be an example.

MEMBER STETKAR: I'm just surprised because you did separate ESFAS Train A and Train B; correct?

MR. ALDIERI: Noted.

MEMBER STETKAR: Okay. And also your safety-related uninterruptible power supplies are in separate rooms; they're in 11 and 21. So you got those, but the other ones not so much.

MR. ALDIERI: I just recall during this stage there was a lot of shuffling of rooms and trying to make space.

MEMBER STETKAR: And that's why I bring it up now, because space allocation--I've actually worked with plants who after concerns about fire, put up intermediate partition walls--and we're kind of all familiar with this--then they got into problems with room ventilation because they didn't have enough ventilation flow. They had seismic problems because they just put up block walls that could fall down. I mean it's--it can be a real nightmare.

MR. ALDIERI: Oh yes, and now your deviation from your sprinklers, your detector are not-- code violations, and the list goes on. That business has been very good for me.

MEMBER STETKAR: Okay.

MR. ALDIERI: I'm sorry. I've spoken so--last slide if I may is--

[Off the record comments]

MR. ALDIERI: The last slide is fire protection process diagrams, and this is a very typical site layout, you have the two independent water tanks, we do share the city water supply. Again, they're all cross connected where the two pumps are cross connected with a typical ring header, so if you have any short leg out, or hydraulically suctioned out, you can always provide water to the plant from two different directions, so you're always assured in providing water supply. Again, you'll see sectionalized valves, again, that are just spaced such that you can always lose one leg and provide the alternate means. And then hydrants, again just variously located around based on a general site layout. One question was asked, why two tanks, we have a city water supply. If during the later stages we verify that there's enough flowing pressure, that can be revisited, but this is a typical template design for meeting most standard designs if anybody has any questions on that.

MEMBER STETKAR: I had one more question. It doesn't have anything to do with hardware or

building layout, but I need some clarification. On the PSAR, I got kind of confused about what on site fire responders are assumed to be able to do versus offsite fire responders. And it's clear that you take credit for the offsite fire department; I'll get into that in a moment. But I found a quote in the PSAR that says class--this is inside the buildings now--"Class 1 standpipes are provided for manual fire suppression capability in the SHINE facility. Class 1 systems include 2.5 inch connections; the 2.5 inch connection is not provided with a hose; it's there for a trained firefighter use only." So I've got standpipes, but I don't have hoses. And yet you're taking credit for the fire department to come in and put up the hoses and fight the fires; is that correct?

MR. ALDIERI: That's correct.

MEMBER STETKAR: So if I'm in the plant and I want to try to use a hose, it's not there? Well, I've got the little hand-held--it mentions that personnel trained in the use of portable fire extinguishers are assumed to voluntarily conduct firefighting efforts on fires at the incipient stage. So if I have a fire burning and I've got a little hand-held fire extinguisher and I want to go in there and fight it, I can do that; but if I want to put a

hose stream on it, I can't; I've got to wait for the fire department to show up, right?

MR. ALDIERI: Right, and historically speaking, most fires, even in the nuclear industry, are put out by fire extinguishers, and the problem in most plants now is when--having untrained people use hose stationed incorrectly. So a lot of plants, even Canada, in the CANDUs, they are removing all the hose stations and just relying then on a fire brigade, a trained fire brigade who are trained in structural firefighting, to then use the equipment versus just having them available. So it's kind of a lessons learned over time that there's been very little value added by having the hose cabinets and stuff in the thing where you have sufficient protection effects by your detection and your suppression systems are such that you can, if you really needed to, then you really want--if it's that bad, you really want someone trained and qualified.

MEMBER STETKAR: On the other hand, when I look at the discussion in the PSAR about fire protection programs, it says in the SER anyway--and I'll ask the staff about this later--"finally, the Applicant stated that periodic training will be provided to both the SHINE fire brigade members and

offsite fire support organizations regarding permitted manual fire suppression techniques at the SHINE facility." That leads me to believe that you have a fire brigade, but you're telling you don't because you're not--

MR. ALDIERI: I don't know if they do or they don't. I'm saying if they do have a fire brigade, even then, the fire brigade even in nuclear power plants would bring their hoses in for a variety of reasons. One, there's maintenance issues about typically maintaining, qualifying and how to historically test them, and they'd rather bring in their own equipment. In other industries as well, fire departments don't rely on that the programs established for the maintenance of the hose stations are adequate, and rather bring their own equipment.

MEMBER STETKAR: It's interesting because we deal with a lot of nuclear power plant license renewals, and the line item on the license renewal typically is--there used to be questions about inspection and maintenance of hoses, and licensees now have characterized the fact that the hoses are replaceable and they've committed to replacing the hoses. They do inspect the standpipes to make sure that they're not corroded and they're

capable, the valves are capable of being opened. Power plants do have hoses.

MR. ALDIERI: Correct.

MEMBER STETKAR: So your allegation that power plants don't have installed hoses is not correct.

(Simultaneous speaking.)

MR. ALDIERI: -- houses they don't have them at--

MEMBER STETKAR: No, they're inside. They're inside the plants.

MR. ALDIERI: Oh. I've seen some where they're taken them out, and again, I give the example where I did the evaluation for the other OPG facilities where they decided to take them out because it was a problem. Not across the board.

MEMBER STETKAR: Okay.

MR. ALDIERI: Not across the board.

(Simultaneous Speaking.)

MR. ALDIERI: If they decide to have a fire-trained fire brigade, that can be--

MEMBER STETKAR: We'll get it on the record and we'll have to be a bit cognizant of time, because we have some other things here. Does Janesville have a full time municipal fire

department?

MR. ALDIERI: Yes.

MEMBER STETKAR: They do? Okay. Thank you.

MEMBER BALLINGER: I have--I think it's a dumb question, but I'm looking at that schematic. Is that a schematic or is it actual piping, P&ID diagram? In other words, there's no isolation valve; if something happens to that cross connector between the two tanks, we're done for. In other words, if you develop a hole, that pipe, that cross connect pipe fails, there's no way--

MR. ALDIERI: Right, there should be a cross--yes, I said that there's a cross--

MS. KOLB: This is not a P&ID; it's a schematic.

MEMBER STETKAR: A lot of the schematics don't show manual isolation valves at this stage in the game; that's sort of--

MR. ALDIERI: It's got the big picture point of view, correct. And in fact, once you get the final design, one tank may go away, so it's just kind of representative of a site layout. Any other questions?

MEMBER STETKAR: Not on fires.

MR. ALDIERI: Okay.

MS. KOLB: Hi, I'm Catherine Kolb, I'll be talking about the other ancillary systems that are covered in Chapter 9. As we mentioned previously, Chapter 9 also contains some discussion of systems that were previously covered in the previous ACRS meeting; we won't be revisiting due to time constraints. So the first system we're covering today is the tritium purification system. This, if you remember from our previous meeting, the neutron driver supplies tritium for its operation; this is the system that does that. It consists in our PSAR description of two TPS gloveboxes with separate trains. The TPS, the tritium purification system receives the mixed tritium and deuterium gas from the neutron driver, removes impurities, separates the hydrogen isotopes and buffers supplies to return to the neutron driver. It also monitors gases effluence and scrubs the glovebox atmosphere for tritium that may escape during the process.

Safety functions are provided to minimize tritium releases, and this is done using a confinement system which consists of the gloveboxes themselves, the outer jackets of the double walled piping that transfer tritium outside the glovebox, and then

confinement isolation valves. The cell volume is also sized to maintain the tritium concentration below the lower flammability limits in the event of a leak into the glovebox.

Next set of systems, this schematic on slide 33 is to reorient ourselves on how the gas handling systems are arranged in the facility. So during irradiation, we produce off-gas; after an irradiation, the off-gas system, the power system is purged into the noble gas removal system that's on the next slide, and then after the noble gas removal system, it is sent to the process vessel vent system, and then to RVZ1, which you have the schematic from earlier, and to facility exhaust stack. So next slide.

The noble gas removal system is a safety-related system; it stores fission product gases that are generated in the irradiation process. It stores them for at least 40 days of decay prior to sampling and release. The decayed off-gasses when they are released, they're released to the process vessel vent system, or PVVS. The off-gasses are monitored to ensure radioactivity levels are below regulatory limits for discharge to the environment. The process vessel vent system, in addition to

receiving off-gas from the NGRS system, it also receives off gas from the various process vessels in the RPF. The area also includes an acid gas scrubber, that's a packed column with sodium hydroxide, with caustic, to remove the acids that would be expected to be in the off-gas, since we're using uranyl nitrate and uranyl sulfates in our plants. The treated off-gasses are transferred to the RVZ1 exhaust system, which contains filters so the gas passes through final filters before being released. PVVS is also used to maintain the process vessels at a slightly negative pressure for contamination control.

MEMBER STETKAR: Before you go to the next slide, because we're getting to a different system, one of the functions that you mentioned on this slide a PVVS, the process vessel event system is to maintain hydrogen concentrations below the lower flammability limit. You just do that by dilution flow, right?

MS. KOLB: That's right. Yes.

MEMBER STETKAR: You're just basically keeping the flow to--okay. I just needed to establish that on the record. The PVVS exhaust into RVZ1, as you've quoted here, in Chapter 9 I find a statement that says "The PVVS blower continues to

operate, even if the RVZ1 exhaust system is no longer functioning." Okay. On the other hand, RVZ1 goes away and isolates on a lot of stuff, so if RVZ1 is isolated, I'm not getting any through flow with PVVS, it's--the blower might be running, but there's nowhere for the flow to go. So if the blower is running and there's nowhere for the flow to go, it sounds like hydrogen will increase, and it sounds like I might have a hydrogen flammability problem. Have you thought about that?

MS. KOLB: I don't have the details about it right now.

MEMBER STETKAR: Okay. It's on the record now.

MR. VAN ABEL: Yes, we have thought about that, and where we're going to vent that exhaust to. Whether up, past the dampers --

(Laughter.)

MEMBER STETKAR: Yes, how will hydrogen by exhausted under those conditions?

MR. VAN ABEL: And that's the thing is we have to look at the accident sequences done, if you have a passive--

MEMBER STETKAR: Well it's all--all of the RVZ1 is powered for non-safety stuff and I found

a lot of statements that said the dampers fail closed on --

(Simultaneous Speaking.)

MEMBER STETKAR: -- So there's a whole bunch of ways that RVZ1 is designed to isolate; not so much on PVVS because there isn't much in there. It's just a blower.

Member REMPE: Well as part of your effort to try and figure out what to do with it, will you have some sort of concentration monitor located there?

MR. VAN ABEL: -- monitors for hydrogen.

Member REMPE: Right. Will it be located at a location to represent that type of sequence or occurrence if it accumulated there too?

MR. VAN ABEL: It could.

MEMBER POWERS: You're going to carry your acid gasses into your gas accumulation systems?

MS. KOLB: The TOGS system? Yes, the scrubber is downstream of the NGRS tanks.

MEMBER POWERS: Are you going to get an accumulation of ammonium nitrate crystals on the systems?

MS. KOLB: TOGS is coming from the TSV, which uses uranium sulfate that's being irradiated,

so we wouldn't expect significant nitrates in NGRS.

MEMBER POWERS: You're not going to get any nitrates in the system at all?

MS. KOLB: I don't -- it directs --there's not direct input from a system using nitrates or uranyl nitrates into the NGRS. That's all going into the PVVS, but those are in the RPF.

MEMBER POWERS: What is your acid gas?

MS. KOLB: Sulfuric acids in NGRS. In PVVS, they'll be from the UREX system where we use nitric acid, there will be some nitric -- caustic, or acid gasses from nitric.

MEMBER POWERS: And there's no possibility of getting cross contamination here of nitrate in the system?

MS. KOLB: Into the decay tanks? No, because the IF --

(Telephonic Interference.)

MS. KOLB: -- uses uranyl sulfates. And I guess to finish up this slide, that's the PVVS, Dr. Bley; it dilutes the evolved gasses and it captures nova gasses from the process vessel events. And now we'll be moving on to--this is another simplified diagram to show how the next system fits into the plans. In the previous meeting, we talked

about the irradiation and how the uranyl sulfate goes to the dump tank, it's transferred to one of three super cells in the RPF, the extraction and purification portions of the processing recovered in Chapter 4; now we're talking about the packaging system, which is the last third of the super cell. Next slide.

So that will be the MIPS system, molybdenum isotope product packaging system. This is where we receive the moly-99 product collection bottle from the molybdenum extraction and purification system. Once in the packaging area of the super cell, it goes through an assay and quality control; the product is then moved from product collection bottle and placed in an inner product shipping bottle that's expected to be a stainless steel bottle per our customer requirements, and the inner product shipping container is loaded inside an outer shipping cask, which is a shielded container half barrel size for -- it's reusable.

Next, we have discussion about the -- I'm sorry, I thought there was a question. We have a discussion about the radioactive liquid waste systems. We have the aqueous radioactive liquid waste storage system. This consists of two liquid

waste storage tanks; they each provide around 40 days of buffer storage capacity for wastes produced from normal processes, for routine effluence and some non-routine operations such as maintenance and flushing activities. The waste is sampled to verify the chemical and radiological composition prior to entering the tanks, and also prior to feeding the liquid waste evaporator, which is next, that is in the radioactive liquid waste evaporation and immobilization system. This is where we evaporate the liquid waste to reduce its volume. We then immobilize it using a cement formula, Portland cements, produce solid waste for shipping and disposal as radwaste.

Next, we have the radioactive drain system. This is where any spills or leaks of radioactive liquids in processing areas are collected in the system. The drain lines are sloped to a criticality-safe sump catch tank, which is sized to contain a potential leak from the largest tank with fissile material. That criticality-safe tank, once the liquid is in the sump catch tank, it can be sampled and characterized if needed, and the liquid may be treated with acid or caustic to address the pH. A question in the previous ACRS meeting, we had

a brief discussion about red oil prevention features. This will also be covered--is also included in PSAR Section 13b.3.1.2, but we're adding it here since it was brought up in the last meeting. The Defense Nuclear Facility Safety Board documents, TECH-33 recommends controls where organics have the potential contact with nitric acid. The controls are for temperature, pressure, mass and concentration of nitric acid.

(Telephonic Interference.)

MS. KOLB: -- uses these recommended controls in addition to organic impurity monitoring for degradation products of tributyl phosphates and residence time controls in the solvents to prevent red oil events in our facility. SHINE will continue to evaluate industry experience and review the available literature regarding red oil events and apply this information during detail design as appropriate.

MEMBER REMPE: So how much below? I assume you're going to have like monitors to monitor temperature and concentration, or some sort of accountability system, but how much below?

MS. KOLB: Below the temperature?

MEMBER REMPE: Or all four of those

parameters where it's appropriate to say that, I mean pressure, temperature and concentration. How much margin are you going to have to make everyone feel comfortable? I think last time there was a thing about that you talked to some experts at Argonne, and they said it wouldn't be a problem, and so how much below, and is it documented somewhere? I haven't read 13B, the PSAR, but if the experts feel so comfortable with it, how much below are you going to have to be?

MS. KOLB: Well I think I'll move to the next slide. So these are the systems where we evaluated for red oil prevention features, and these are the various controls that apply to those systems. As to your question on margin, it depends on the specific process, but for example, in the UREX process, the extraction and the scrub portions of that are expected to be at about 25 degrees C, whereas the strip and the wash portions are expected to be at about 50 degrees C. We understand that's--you don't want to go all the way up to the 130 degree C limit that's mentioned in the documents, because there have been industry experience on potentially red oil events happening at lower temperatures. So our set points for our alarms, we haven't specified

them yet, but based on the normal operating characteristics of the processes, we do have a considerable margin.

MEMBER REMPE: If--I haven't read 13B yet, but if I read it, will I see somewhere where it says the areas of concern where you had the least margin, is there a table or documented numbers of these places are going to probably the most critical places, and we have this much margin?

MS. KOLB: No, we don't have that level of detail in 13B. It has--the paragraph that talks about red oil is in that section I mentioned under chemical accidents, and we considered chemical accidents as one of the exothermic potential runaway reactions --

MEMBER REMPE: So for the meeting, which unfortunately I'm going to miss the September subcommittee meeting, but will you have that kind of information available in the presentation for us to provide us some sort of indicator, and I'll read the transcript afterwards or get the slides in advance and --

MS. KOLB: We can do that, but the--if you look in Chapter 4, there is a description of how the processes are and our expected temperatures for

each of the processes.

MEMBER REMPE: And so if I look at the best temperature, and I'm interested in all four parameters, and so I'd like to know where you feel the most critical parts--locations would be and how much margin you have there because again, I think with the transcript last time, I remember reading someone say yes, the experts have looked at our processes and they feel very comfortable that this isn't an issue. And so I'd like to know what makes the experts feel comfortable.

MS. KOLB: We will prepare a presentation about that. The information you're looking for is spread throughout Chapter 4, so it's not all in one--

MEMBER REMPE: Yes, so it would help me. Thank you.

CHAIRMAN BLEY: I'd push that a little further and one of you referred to these as limits; to the best of my knowledge, nobody knows what happens in the red oil reaction, but from a handful of events, they confirmed that those events were all above those conditions; that doesn't say they can't happen otherwise. So the more you can avoid those conditions, and I guess I'd be interested in, as Joy says, how far we're staying away. If the

temperature's quite low, that's nice; if we have a good vent, that's really nice, and what kind of controls there are. Are there things, automatic monitors and alarms, or is this taking a sample every six hours or you know, what are we doing? So we'd be interested in all of that.

MS. KOLB: I understand. Any other questions? All right, that concludes our Chapter 9 presentation.

CHAPTER 9 STAFF PRESENTATION

MR. LYNCH: All right, here we go. I'm going to turn it over to Steve here.

MR. MARSCHKE: This is the same situation as we had in Chapter 3; I'm filling in for Greg Hofer. Greg, are you still on the phone?

MR. HOFER: I'm here.

MR. MARSCHKE: Good. First slide is basically just the list of all the systems which appear and which are discussed and provided in Chapter 9. The focus of our review was primarily on the HVAC system and the fire protection system. The fifth slide over--

MEMBER STETKAR: That's pretty interesting; why didn't you pay any attention to the chilled water system?

MR. MARSCHKE: Greg, do you have an answer for that? I mean didn't--I don't know if Greg didn't pay any attention to it, but all eyes that will be back were focused on the HVAC system and fire protection.

MR. HOFER: Well basically, they didn't provide very much information on the chilled water system, and I was spending an enormous amount of time trying to find out exactly how the HVAC system itself works. So--and that did not come about for -- a lot of noise, can people turn off your mics? Can you guys hear me?

MEMBER STETKAR: Yes.

MR. HOFER: Basically, it was just trying to understand the HVAC system, and a lot of my RAIs were kind of circling on that, but I never got around to, and they didn't provide very much information on the chilled water system at all, and time ran out.

MEMBER STETKAR: Okay, my point is I see a lot of stuff in the SER that looks at ventilation in terms of radiological controlled areas; I don't see an integrated review of the entire facility's support systems. I'll just leave it that way. I brought up with the Applicant regarding environmental controls.

MR. HOFER: I agree.

MEMBER STETKAR: And not just focusing on the things like the main control room, but for the entire facility. Heat removal, integrated heat removal from both the primary--I call it the primary side and the secondary side of radiation units and radioisotope that are--I didn't see that type of review being done, so just be careful.

MR. HOFER: Okay.

MR. MARSCHKE: This is a continuation of the list of the auxiliary systems that are discussed in Chapter 9. We did have a couple of RAIs on the material handling subsystem. The next slide just says that the following slides talk about the systems that we did have RAIs on. We looked at the HVAC system, the same system serves the radiation facility and the radioisotope production facility. As was discussed by SHINE, there is 4 subsystems providing both normal services and emergency services, and as I mentioned, we did write a number of RAIs and responses during the construction permit review. Fire protection system in a single system for both facilities, protects the facility from fire damage, provides fire detection and suppression, provides a means to safely shut down the facility in case of a

fire, and includes a fire hazard analysis. Again, we generated a number of RAIs on the fire protection system, and SHINE provided responses to those. We found them acceptable for the CP review.

MEMBER STETKAR: You're okay with having the reactor protection cabinets all in the same, you know, all radiation units in the same fire area?

MR. MARSCHKE: I think we'd have to go back and take another look at that, as you pointed out this morning.

MEMBER STETKAR: Okay.

MR. MARSCHKE: The material handling system again, it serves the entire radiological control area, provides overhead cranes and other heavy lift equipment. It's equipped to move and integrate radioactive material, and it's been designed to inadvertent criticality. We did generate RAIs requesting exactly what the system was designed to, and in response to the RAIs, SHINE has indicated NUREG-0612 would be used, and we found that acceptable. This is a radioisotope production facility.

MS. ADAMS: Since we spent a lot of time already talking about the HVAC system, I won't--I'll skip a lot of my talk; that's good. Staff evaluated

the PSAR for operations and functions of the HVAC system during the range of RPF operations. The design bases were compared with requirements from PSAR Chapters 4B RPF Description; 6B Engineer and Safety Features; 7 Instrumentation and Control Systems; 11B RAD Protection and Waste Management; and 13B Accident Analysis, and there will be a lot more detail about the HVAC system in those remaining sections of the safety evaluation report.

Staff review of the design basis and functional and safety characteristics of the HVAC systems shows that the proposed systems will be adequate to control the release of airborne radioactive materials during the range of RPF operations in compliance with the regulations. PSAR Section 9B1 discussed all sources of radioactive material that could become airborne in the RPF process areas from the full range of process operations. The analyses demonstrate that the radioactive material is controlled by the HVAC system; it could not inadvertently escape from the process areas, and there will be some more details about that in our Chapter 11 SER.

The analyses show that the distributions and concentrations of the airborne radionuclides in

the RPF are limited by operation of the HVAC system so that during the range of RPF operations, no potential occupational exposures are likely to exceed the design bases derived in Chapter 11. PSAR Section 11.1.1.1 states that gaseous activity from the TSV and process operations is held in the noble gas storage tanks until radio decay has reduced the activity such that releases are below the 10 CFR 20 limits. Annual average airborne radioactivity concentrations are determined per Reg Guide 4.20, which uses the stack release rate and annual average relative atmospheric concentration, chi over Q values, to determine the annual average radionuclide concentration for each radionuclide at the location of the maximally exposed individual, which is the nearest point on the site boundary and the nearest full time resident. The methodology in Reg Guide 1.111 is used with the meteorological data in PSAR Section 2.3 to calculate the chi over Q values.

Staff determined that the HVAC system is an integral part of a confinement system at the RPF. The design of the confinement system and analysis of its operation provides reasonable assurance that it will function to limit normal airborne radioactive material to the extent analyzed in PSAR Section 91

and Chapter 11, which is where the nuts and bolts will be. The potential radiation doses will not exceed the limits of 10 CFR Part 20 and are consistent with the facility ALARA program. Staff evaluated the handling, protection and storage of S&M when it's not in the irradiation facility, both before it is inserted and after it's removed.

Staff reviewed the equipment and systems for receipt of new SNM ~~S&M~~; systems and methods for movement, physical control and storage of new SNM ~~S&M~~ within the facility; methods, analyses and systems for secure storage of new and irradiated SNM ~~S&M~~ that will prevent criticality under all conditions of moderation during storage and movement--and this is a big deal to look at too also in September--systems and methods for inserting SNM ~~S&M~~ into the irradiation facility and for removing target solution from the irradiation facility--this is where the irradiation facility and the RPF talk to each other--systems and components for radiation shielding and for protecting irradiated target solution from damage during removal from the irradiation facility, movement within the RPF and storage.

As will be discussed in Section 6B3 of the SER, that's the criticality section, staff has

determined that the design of systems, components, and methods for handling, moving and storage target solution outside the irradiation facility will provide reasonable assurance that under normal and credible abnormal conditions, all nuclear processes will be subcritical, including use of an NRC-approved margin of subcriticality for safety. The systems and components for handling, moving and storing target solution, including insertion and removal from the irradiation facility, are designed to prevent damage. Staff has determined that the design of systems and components for handling, moving and storing target solution demonstrate that the facility's staff and the public are protected from radiation, and that radiation exposures will not exceed the requirements of 10 CFR Part 20, and will be consistent with the facility ALARA program.

Staff evaluated the systems used to handle new and irradiated target solution, compared the designed bases with those in PSAR Chapters 4, 6, 11 and 13, and the requirements of 10 CFR 50.34, and focused on the design features that control radiation and prevent criticality. Staff have determined that the analyses in PSAR Section 6B3 and 9B1 show that S&M storage features will ensure that plan to

implement the applicable requirement for 10 CFR 70.24 for criticality monitoring are also acceptable. Staff has determined that proposed methods for assessing irradiated target solution radioactivity and potential exposure rates are adequate to avoid overexposure of the staff, and that will be detailed some more in Chapter 11. Staff has determined that methods for shielding, cooling and storing irradiated S&M will provide reasonable assurance that potential personnel doses will not exceed the regulatory limits of 10 CFR 20 and will be consistent with the facility ALARA program.

Within the SHINE facility, byproduct material is generated by the fission and irradiation of target solution in the TSV. Byproduct material is regulated under 10 CFR Part 30. The eight auxiliary systems that process byproduct material in the RPF are in Slide 9. There they are. PSAR Sections 9B5.1.1 through 9B5.1.8 describe for each of these eight auxiliary systems the following five items: the types and quantities of radionuclides authorized in each one of the systems; the rooms, spaces and equipment to be used; the general types of uses, including processing and packaging for shipment; the provisions for controlling and

disposing of radioactive wastes, including special drains for liquids and chemicals and air exhaust hoods for airborne materials, with design bases derived in Chapter 11 of the PSAR, and provisions for radiation protection, including shielding materials with design bases also derived in PSAR Chapter 11.

Staff evaluated the five items for each of the eight auxiliary systems. Staff compared the design bases for the eight auxiliary systems with the commitments developed in other chapters of the PSAR, especially Chapters 11, Radiation Protection and Waste Management, and 12, Conduct of Operations, and evaluated agreement with the acceptance criteria. Staff concluded that auxiliary facilities and systems will be designed for the possession and use of byproduct materials produced by the irradiation facility and sources, especially nuclear material. The design bases include limits on potential personnel exposures that are in compliance with 10 CFR 20 and are consistent with the facility ALARA program. The design features are expected to provide reasonable assurance that uncontrolled releases of radioactive material to the unrestricted environment will not occur.

With respect to cover gas control, we

talked a lot about that too, the PVVS and the noble gas removal system. Everything's already been said about that. PSAR Sections 9b6.1 and 9b6.2 describe the following for both the PVVS and the noble gas removal system. There are blowers for maintaining negative pressures over tank contents and differential pressure instrumentation to monitor differential pressure across the blowers, compressors for maintaining pressures in the NGRS tanks and pressure and radioactivity of the instrumentation to ensure no gas is leaking and to determine the level of radioactive decay, acid gas scrubber pH meter to monitor the condition of PVVS scrubbing solution, and radiation monitors for monitoring the potential release of radioactive materials. The sections describe methods and systems for circulating, processing, decontaminating, recovering and storing the contained gasses in the PVVS and NGRS. It described methods for diluting hydrogen gas that could result in radiolysis of the coolant. Analysis of the potential effect on RPF safety and operation if the characteristics of the gas mixture are changed are provided in PSAR Chapter 13, Accident Analysis.

Staff concluded that the PVVS and NGRS will be designed to capture and treat the expected

off gasses at their anticipated concentrations or constituents under normal and accident conditions, and that the design basis pressures can be maintained. Staff concluded that processing, storing and recombining radiolytic gasses, as well as safe disposal of spent scrubbing solutions, HEPA filters and charcoal filters have been acceptably incorporated into the design. PSAR Section 9B7 describes 19 other auxiliary systems in the RPF; these are slides 10 and 11. Big long list of them. For each of these other auxiliary system, SHINE provided their design bases, system descriptions, operational descriptions, and safety functions. Staff concluded that the design and functional descriptions of the auxiliary systems provide reasonable assurance that they will conform to their design bases. The design, functions and potential malfunctions of the auxiliary systems are not likely to become initiating events that we need to hire intermediate consequences associated with the RPF or to cause radiation exposures to exceed the limits of 10 CFR 20. No function or malfunction of the auxiliary systems is likely to interfere with or prevent safe shutdown of the RPF.

MEMBER STETKAR: Stop right there; go

back to the previous slide, just because -- was the facility instrument air system? The description of the facility instrument air system in the PSAR states "the FIAS is not safety related; a more detailed system description will be provided in the FSAR." Pretty hard for me to figure out what it does. I did however in Chapter 5, when I looked at interfaces with cooling water systems, identified the fact that the pneumatic control mechanisms--I'm assuming those are air operated valves, but I don't know--for the primary closed loop cooling system and the white water cooling system and for the radioisotope protection facility cooling system, I couldn't find out when they said pneumatic control mechanisms for the chilled water system because I couldn't find anything on the chilled water system, either.

Now, since you've done a review, and you know that it's adequately safe and you can't have bizarre initiating events from any of these things, half those valves fail, if they are valves, on loss of air pressure. If--they might fail closed, which might make temperatures go up, or they might fail open, which might make temperatures go down. This facility is not so good if temperatures go down in parts of the facility. So I'm curious how you made

the conclusion that there aren't any design initiating events or that everything about these 19 systems is okay, because I couldn't figure out anything about the instrument air system or what it might do.

MS. ADAMS: Yes, we'll get to that in Chapter 13B--

MEMBER STETKAR: Well I'm sorry, 13B doesn't address loss of instrument error; I went to took there.

MS. ADAMS: Yes, I had to look there, too. It's one of the 400 accident sequences that we didn't get detailed descriptions of, and SHINE determined if, assuming loss of instrument air that's in one of those 400 accident sequences that they didn't provide the descriptions of to us, that SHINE had evaluated that initiating event and concluded that no consequences would be either intermediate or high, in which case they don't have to tell us about it and in that case, the instrument air system doesn't even need to be in IROFS or our safety related system. So--

MEMBER STETKAR: It'll come up in final reviews, so I'm just telegraphing it right now.

MS. ADAMS: So if we think there should

be an intermediate or high consequence, then yes.

MEMBER STETKAR: I don't know because I don't--I can't guess what it might do. It might not be.

MR. LYNCH: Okay. To kind of finish this up so we can get it back on track, again, this is just high level. I also wanted to point out on the regulatory basis and review criteria, one thing as far as fire protection goes, with our review we are mostly using our guidance and our NUREG, but SHINE is using NFPA-801, as it's implemented in Appendix R. Appendix R is not something we can hold the facility to, with the regulation as written it only is with nuclear power reactors, and that's consistent with what we apply to other non-power reactors. So--but if SHINE is using that standard, that's what we will evaluate against. But just something I wanted to clarify there.

MEMBER STETKAR: Steve. I want to just put on the record for the SER you may want to go back and look at Section 9a2.4.3, where there is that quote that says "the Applicant stated that discussions have been initiated with"--I'm sorry, I'm quoting the wrong thing. It's 9a2.3.4.4.2.3. I'm trying to read things. 9a2.4.3, "periodic training will be provided

to both SHINE fire brigade members," and I took a quick look through Section 12 that talks about operational programs; the words "fire" or "brigade" are not mentioned in there anywhere. So it's not at all clear your conclusion that they're going to be trained; they might not even exist.

MR. LYNCH: I'm making a note of it; we may be able to address this during emergency planning, when that reviewer is here, because I know that is something we looked at SHINE's coordination with emergency responders and how they were doing that. So when he is here for that presentation, we can hope--we will follow up, but maybe we'll have no answers today.

CHAIRMAN BLEY: I want to go back to Mary with a question. It's a construction permit review; we said as long as the applicant has lifted this list of their 400 scenarios in the processing plant, and said there is no significant consequences, they don't have to show it to us. Is that just a construction permit, or is that when we get to the operating license as well?

MS. ADAMS: Operating license as well.

CHAIRMAN BLEY: Thank you.

MR. LYNCH: And just to close this out,

I think this is just talking about that we're looking at 50.35 again, and one thing I do want to emphasize, so this is again highlighting a few items that we will be--that we identified and SHINE has said that they're going to provide more detail on at the FSAR that we will look at, but also I do want to, because obviously you know we weren't sitting in front of you, that we heard you, that we are going to look at and come back to you and talk to you about RVZ3, FVZ4 and the chilled water system. We will be back to address that further.

MEMBER STETKAR: We didn't have many questions about RVZ3.

CHAIRMAN BLEY: Not yet. I'm sorry to come back to this same thing. We're looking at the two facilities, the radiation facility and the processing facility. If both of them, for an hour or for the operating license, we only look at even the single failure analysis for systems that have been designated safety-related systems? Is that true? We heard earlier about looking at single failures, but I think whoever was talking about that was talking about the radiation facility, and did we look at single failures in the processing facility as well, or only if they reported--we looked at the

report of them. So if you didn't see a system like the one John was talking about, the instrument air, and it wasn't a safety-related system, you don't have any way to look at it is what you're telling me?

MEMBER STETKAR: To give you an example, even if I come back to this FVZ4, the information that I can find about it is it's got two supply fans, each of which is characterized as a 50 percent supply fan. So if that is indeed true, there a single failure can take out that entire system. Right now, it's characterized as non-safety related, but because of my previous comments, I have no question about that. So the question is who looks at single failures, even in places where there seems to be evidence that a single failure can take out an entire system?

MR. LYNCH: I'll have to follow up on that with you. But I understand the question, you know, for single failure analysis where there's non-safety related systems, I'll follow up and ask--

MEMBER STETKAR: Those that are currently characterized as non-safety related systems because of an analysis that may have been done by the applicant, but you may not have looked at very carefully.

MR. LYNCH: Yes. Understood. I'll go back to our reviewers and look past that.

MS. ADAMS: Okay. If a system isn't in an accident sequence that could lead to an intermediate or high consequence, then it's kind of outside our accident analysis review.

MEMBER STETKAR: And there's two reasons that could be. Could it be that somebody looked at it carefully, identified what could happen, and determined that it could not lead to an accident sequence, or it could be that they didn't look at it, or didn't look at it very carefully. There's a couple of reasons why it might not show up in those accident sequences that you (a) haven't seen, and (b) focused your attention on if you could see them.

MS. ADAMS: And what you'll see when we talk about Chapter 13B Accident Analysis is that focused on our methodology. Does SHINE have a good methodology of using a good systematic accident analysis that will consider all the potential sources and all that. And so we did--we focused a lot more on the methodology that SHINE followed to do the accident analysis than we could on each individual accident sequence.

CHAIRMAN BLEY: In the review--

MS. ADAMS: See how we do it in fuel ~~field~~ cycles.

CHAIRMAN BLEY: And now we've got a combined machine. In the reviews of the combined device, the same techniques to review the systems in the radiation facility as we did in the processing facility, or did we each bring our own set of tools and use the ones we usually use? So are they consistent or might we be very inconsistent in looking at those two major subsystems of the facility?

MS. ADAMS: I have a good deal of radiation facility accident analysis.

CHAIRMAN BLEY: Sure. Thank you.

MR. ADAMS: I think that the methodology that's normally applied in that review was the methodology. So the answer is that the methodologies, there's inconsistencies between the methodologies.

MR. LYNCH: But I think the inconsistencies too are based on the types of accidents we expect in each facility as well. You know, I think our methodology, especially looking at maximum hypothetical accidents that we'll talk about, but I don't think that methodology would work for the types of accidents that we see in the RPF necessarily.

You know, there are different accidents that we wouldn't see on either side. We are looking at those combined and what the impact on the facilities would be, but I think that's why they are different. We used our methodologies that we were comfortable with in those areas.

MEMBER STETKAR: But if you listen to, for example, some of the stuff that I've been saying this morning, first of all, I don't care, okay. I look at the whole facility. The whole facility has a shared chilled water system that removes heat from everything. The facility has a so-called non-safety related ventilation system that provides cooling for all of the rooms that contain all of the control and protection cabinets for the whole building. Who's looking at that integrated part? You're telling me yes, we think that we put the two pieces together; we captured things. It's not at all clear; who's looking at the whole facility?

MR. LYNCH: My understanding is that our reviewers are looking at those systems under their reviews on each side of the facility.

MEMBER STETKAR: But see, that qualification is what's bothering me; on each side of the facility.

MR. LYNCH: Well, I mean if they're looking on the radiation facility side, that reviewer should be looking at that on the other side and vice versa. So while we have reviewers on each side, they are looking at what's happening on the other side as well.

MR. ADAMS: I think we clearly understand the point you're making; I've written it down.

MS. ADAMS: This is Mary Adams. I'm thinking about NUREG 1537, the part of it that I don't read has a list of specific accidents that need to be analyzed in a research and test reactor, and I forgot what they are. There's like five of them in Chapter 13, and they're things like loss of coolant accidents, which don't really, can't really apply to the radioisotope production facility. So that was why we developed the interim staff guidance to NUREG 1537, because the radioisotope production facility looks not unlike a fuel cycle facility, so the accident analysis methodology integrated safety analysis is more appropriate for the RPF, but less appropriate for the irradiation facility.

MS. BANERJEE: Can I ask a question, please? This is Maitri Banerjee. Did staff do any kind of audits? I mean, that will give the ability

to go in and look at the more detailed analysis, or they just reviewed the methodology? They didn't do any onsite audits of SHINE, did they?

MR. LYNCH: No, we have not.

MS. BANERJEE: Thank you.

MR. BYNUM: I have a question. That was in Chapter 19--

MR. LYNCH: Well yes, there was an audit for the environmental review; that's part of the normal environmental review process. The audit process is not something we typically utilize for the safety review.

MEMBER REMPE: To follow up on Maitri's question, do you have the authority--you could have done an audit if you wanted to, to have a more detailed look at what they did?

MR. LYNCH: Well, for those--for instances where we needed additional detail and documents that were maybe just references in the PSAR, those were documents we would ask to have submitted on the docket.

MEMBER REMPE: But if you wanted to review a design calculation for a component, do you have the authority, you can go do that if you want to?

MR. LYNCH: We could go do that, but what we've done is--yes, we could go look at that, but if it's something we want to reference in our PSAR, we ask them to submit it on the docket. So we have asked them to actually submit calculations to do that. So instead of just going and saying show us everything you have, we've found that instances where hey, we really want this calculation to support as far as for Chapter 11 for the radiological release analysis, we did ask them to support actual calculations so we could go review that. So I guess it's more the spot check where there's those areas that we really wanted those documents.

MEMBER REMPE: Because earlier I guess I got the impression no, we're not going to do that until we get to the operating license stage, but you did do some detailed audits of their calculations--

MR. LYNCH: In a particular area.

MEMBER REMPE: --in some areas where you thought it was needed?

MR. LYNCH: Yes.

MEMBER REMPE: Thank you.

MEMBER BALLINGER: On the follow up section, what do you mean by "natural gas pipeline combustible load?"

MR. HOFER: Yes, basically I had a question as far as the boiler room, which is one of the fire areas, and because of the adjacent rooms, which--I don't want to say which rooms those are, I had questions on the fire loading, suppose there was a fire in that room, in the blower, how long it would take before you'd be able to, you know, my concern was would the wall at the end of the loading as far as until you could get outside somewhere wherever the isolation valve is, outside the plant, step down the gas pipeline. And the response I got back is basically the walls will maintain the amount of gas that gets burned in the room. Well, by basically since we didn't really have any details on the combustible loading for any of the rooms at this point, I deferred to the FSAR, they're going to have to supply an analysis on what the combustible load is going to be in that room before they can go and remotely isolate the gas pipeline, and to make sur that the fire is contained in that one fire area.

MEMBER BALLINGER: Thank you.

CHAIRMAN BLEY: All right, any other questions? We're a little bit late, but we weren't going to finish at 2:00 anyway. So I think we'll take our lunch break now, and we'll continue on

starting at 1:00.

(Whereupon, the above-entitled matter went off the record at 11:53 a.m. and resumed at 1:00 p.m.)

ACTING CHAIRMAN BLEY: The meeting will come to order.

I misspoke earlier, the meeting's scheduled to go to 5:00 and we're a half an hour behind. We probably will not catch up given some of the things that are coming, but maybe we will in this one.

Who's taking us through the Conduct? Okay, Jim, go ahead. Jim, microphone, green light.

MR. COSTEDIO: I do want to say that the PSAR does say that SHINE will have a fire brigade. SHINE will have a fire brigade and Operations will be in charge of that.

ACTING CHAIRMAN BLEY: It's not mentioned in Chapter 12.

MR. COSTEDIO: No, it's not. But I believe that Chapter 9 is probably more of an --

(SIMULTANEOUS TALKING)

MR. COSTEDIO: About the operational structure, SHINE utilized the ANSI/ANS 15.1-2007 Development of Tech Spec for Research Reactors as

guidance.

The functional levels and assignments, the operating organization are the Level I individuals are responsible for the medical isotope facility license. The Level II individuals are responsible for facility operation. Level III individuals are responsible for day to day operation of shift. And, Level IV are the operating staff.

There's the operational structure. The operators report to the shift supervisors. The shift supervisors report to the plant manager. The RP supervisor reports directly to the Environmental Safety and Health manager and has communication lines with the shift supervisor.

The Review and Audit Committee reports to the plant manager and has communication lines with the Ops manager.

The ES&H manager and Ops manager report to the plant manager and the plant manager reports to the Chief Operating Officer.

MEMBER STETKAR: Jim, just -- you had to bring it up so I had to look. Where in the PSAR does it say you have a fire brigade?

In Chapter 9 it says there's a room that's call the Fire Brigade and HAZMAT room and the

description is the Fire Brigade and HAZMAT equipment is stored in this fire area.

MR. COSTEDIO: Well, that's it. Well, I mean --

MEMBER STETKAR: Okay, thank you.

MEMBER SKILLMAN: Jim, let me ask this question.

MR. COSTEDIO: Sure.

MEMBER SKILLMAN: And it shows up on the SHINE presentation in your flow of slides only on this diagram. Why is the Review and Audit Committee reporting to the plant manager? Contrary-wise, why is not that committee reporting to the Chief Operating Officer and is completely independent from the plant manager?

MR. COSTEDIO: Well, I want to say that that's the -- I have to pull up the ANSI standard, but I think that's the guidance from the ANSI standard on the reporting requirements and that's why we chose to do it way. We're just following the standard.

MEMBER SKILLMAN: I'd like to ask you to consider that between now and the next meeting. I think industry has shown that an Audit Committee that's reporting to the people that are operating the plant, they may not be as thorough in inspection and

perhaps as intrusive as they need to be.

And, by reporting to the Chief Operating Officer, yes, it develops a contest, but perhaps that tension is health for the health and safety of the personnel in the facility.

MR. COSTEDIO: Understood.

MEMBER SKILLMAN: Thank you.

MR. COSTEDIO: Yes, go ahead.

MR. HENNESSY: I believe this committee is more like a PORC which just reviews changes to plant and that type of thing is not a QA function.

MEMBER SKILLMAN: I wasn't suggesting QA.

MR. HENNESSY: Okay, I just wanted to make sure.

MEMBER SKILLMAN: And, I wasn't suggesting PORC. PORC should report to the plant manager. I agree with that.

MR. HENNESSY: Yes.

MEMBER SKILLMAN: But Review and Audit suggests to me the capability to be fairly intrusive in records and in behavior. And, in fact, to ring a bell if it needs to be rung at the right level. And, to do so without peril.

And, if they're reporting to the plant manager, it's almost a conflict of interest.

Thank you.

MR. COSTEDIO: Thank you.

SHINE Medical Technologies is the entity with the legal responsibility for holding the construction permit and the facility operating license.

The Chief Executive Officer is responsible for overall management and leadership of the company.

The CEO provides direction to the Chief Operating Officer and reports to the Board of Directors.

The Chief Operating Officer reports to the CEO and is responsible for the all the operational aspects of the company including operations, safety, quality, environmental including radiation protection, regulatory affairs and security.

The plant manager's responsible for site operation. The operations manager reports to the plant manager and is responsible for day to day operational activities.

The shift supervisory responsibilities include the safe operation of the site and authorizing day to day work activities.

Senior operators and operators

responsibilities include conforming to applicable rules, regulations and procedures for operation of the facility.

The quality manager reports to the Chief Operating Officer and the responsibilities include overseeing review and audit of plant operations by Review and Audit Teams.

The environmental safety and health manager reports to the COO and responsibilities include managing matters regarding the environment, safety and health including radiation protection.

The radiation protection supervisor reports to the ES&H manager and the responsibilities include establishing and implementing the RP program.

Staffing, SHINE provides additional resources and personnel and materials to safely operate the facility.

The facility staffing considerations including minimum staffing levels, allocation of control functions, overtime restrictions, facility status updates during turnover between shifts, procedures and training will be defined in the FSAR.

SHINE establishes and maintains training programs for personnel performing, verifying and managing facility operation activities to ensure that

suitable proficiency is achieved and maintained.

SHINE in suing the ANSI/ANS 15.4-2007, the American National Standard for Selection and Training of Personnel for Research Reactors.

MS. BANERJEE: Maitri Banerjee here. Slide 44 and Slide 47, it looks like on 44 that the ES&H manager reports to the plant manager. But then, 47 says he reports to the COO.

MR. COSTEDIO: Yes, the ES&H manager should be reporting to the COO.

Thank you, thank you very much. We'll have to fix that.

Selection and training of personnel, records of personnel, training and qualifications are maintained. Required minimum qualifications of facility staff will be provided in the FSAR.

The license operator training program, including the requal training program will be developed and implemented in accordance with 10 CFR 55 as it pertains to non-power facilities.

And, that's all I have.

MR. LYNCH: Did you want to say a couple of words on this first slide here, Diane?

MS. MLYNARCZYK: I'm Diane Mlynarczyk. I am an engineer for ISL.

The Applicant stated that conduct of operations is a philosophy of working in a formalized, disciplined manner.

MEMBER STETKAR: Is your mic on?

MS. MLYNARCZYK: Yes, I'll just speak louder. Maybe be closer to the mic.

And that the ConOps program emphasizes safety in every aspect.

The areas that are addressed in it include organization, review and audit activities, procedures, required actions, reports, records and you can see a list on the thing.

SHINE has stated that some of these will be addressed in the FSAR.

MR. LYNCH: And, just to quickly highlight some of the things we'll be looking at, you know, what are the conditions of licenses? You know, licenses under 50.54 is having licensed operators at the controls.

Part 55 talks about requirements for licensed operators, so that's something we will be looking at in detail at the operating license and still looking at 50.34 and 50.35. And, our primary guidance document for all of this is still NUREG-1537.

MS. MLYNARCZYK: Okay. The staff

performed a thorough and complete section by section evaluation of the information presented in Chapter 12 of the PSAR as supplemented by responses to the RAIs to assess the sufficiency of design performance of conduct of operations in support of issuance of a construction permit.

There are 13 subsections in Chapter 12, but we're going to look at the first six of them here and the other ones are addressed at a later date.

Section 12.1 is concerned with SHINE Medical Technologies organization.

Areas of reviews in this section include organization and structure, functional responsibilities of individuals and groups, organizational aspects of the radiation protection program, the production facility safety program, staffing and selection and training of personnel.

The Applicant has stated that some of these areas will be detailed in the FSAR including staffing considerations for reactor operations including the details of training programs, minimum qualifications for facility staff and the authority of the radiation staff with respect to facility operations.

It also details the projection facility

safety program.

After reviewing Section 12.1 against the acceptance criteria, the staff had two Requests for Additional Information.

So, the staff -- in the first one, the staff asked the Applicant to include the Review and Audit Committee and the radiation safety function in the organization chart and describe the responsibilities of them both.

Additionally, staff noticed that this -- noted that this section should clearly show who has the responsibility for the safe operation of the facility and for the protection of the health and safety of the facility staff and the public.

Applicant responded that the Review and Audit Committee will report to the plant manager, which we addressed. And, the radiation protection supervisor reports to the environmental safety and health manager.

They provided an updated operational organization chart showing these reporting and communication lines and stated that they would put these updates in the FSAR.

The Applicant also stated that the chain of command established in the function organization

chart has the responsibility for safe operation for the SHINE facility.

In the second RAI, the staff requested that SHINE include a reference to the preliminary plans for a licensed operator training program and requalification programs, provide a review of planned compliance with 10 CFR 55 and indicate if minimum requirements will exist for facility staff.

In their response, the Applicant stated they would include these items in the FSAR and that SHINE will comply with the requirements of 10 CFR 55 as it pertains to non-power facilities.

The staff reviewed both RAI responses for Section 12.1 and found them to be satisfactory.

ACTING CHAIRMAN BLEY: Did you ask for anything about minimum staffing?

MS. MLYNARCZYK: I asked them to include it.

ACTING CHAIRMAN BLEY: I see the --

MS. MLYNARCZYK: They said they would include it in the FSAR.

ACTING CHAIRMAN BLEY: Okay.

MS. MLYNARCZYK: Yes.

Section 12.2, Consider Review and Audit Activities, and as a result of the review for Section

2, three RAIs were generated.

The first one noted that additional information was needed as to who holds approval authority for the review and audit activities and how the committees communicate and interact with facility and corporate management.

In their response, the Applicant responded that the plant manager holds approval authority and detailed the committee interaction with facility management including when and to whom meeting minutes, reports and deficiencies are reported.

The Applicant also committed to updating the FSAR to include this information.

In the second RAI for this section, staff noted that 10 CFR 50.59 safety reviews needed to be included on a list items to be reviewed.

The Applicant responded that the FSAR will be updated to include this review.

In the final RAI for this section, staff asked the Applicant to include a minimum list of items that should be audited and details of the audit function.

The Applicant responded that they will expand the definition of the audit function in the

FSAR and included more details on what will be audited, who will participate in the audits, audit frequencies and details of deficiency reporting and report submission.

The staff reviewed the RAI responses for the three RAIs for this section and found them to be satisfactory.

MEMBER SKILLMAN: Diane and Steve, I would like to reinforce my prior comment to the SHINE team on your Slide 14.

I, at least as individual, would challenge whether or not that audit team should report to the plant manager and I would just ask you to please give consideration to that and you do.

MR. ADAMS: I'd like to respond to that.

I haven't, you know, studied the documentation, but looking at the organizational chart, I agree with your concern.

The NRC standard says that the review and audit committee reports to Level I management. That's normally the person we see as being the licensee.

For example, at the university, it would be the university president, you know, or Dean of Engineering or that type of level. It's normally not

someone that's in direct control of the operation of the facility.

So, the fact that they have the committee reporting to Level I is consistent with the ANSI standard if the plant manager is Level I. That's something we'll have to look at closely.

So, I share your concern and we'll look at it.

MS. MLYNARCZYK: Okay, Section 12.3, concerns Operating Procedures.

There was one RAI in this section and in that RAI, staff asked the Applicant to discuss details about their procedure program including basic topics, the procedures will address method for their review and approval and the process required to make changes, noting that 10 CFR 50.59 might apply.

In their response, they listed basic topics the SHINE procedure would cover, noting that specific procedures will be developed in accordance with the SHINE QAPD.

They described the method for the initial review, approval and documentation of procedures listed in Part A, noting that reviews will occur prior to activities being initiated.

The response also noted the review levels

for substantive changes, minor modifications and temporary deviations.

And, finally, the response discussed the process required to make changes or revisions to the procedures. They noted this process includes a screening for 10 CFR 50.59 applicability.

The staff reviewed the RAI response and found it to be satisfactory.

MEMBER SKILLMAN: May I ask this please? In your review of the SHINE responses to the RAIs, is it clear that the SHINE team sees 50.59 as the screening process for a license amendment versus being a change process in and of itself?

MS. MLYNARCZYK: Well, it was clear that when there was going to be revisions they would do a screening of 50.59. Beyond that, I don't have any details at this time.

MEMBER SKILLMAN: Let me make my point for the record.

Over the years, many licensees used 50.59 as the change process. When, in reality, a 50.59 is a screening process to determine whether or not there needs to be a License Amendment Request. And, that's a very different issue.

There needs to be a rigorous change

process. And, oh, by the way, the change process may trigger the need for a 50.59 to invite whether or not there needs to be a License Amendment Request, but those are really two separate processes.

MS. MLYNARCZYK: The Applicant deferred to the FSAR, the sections on required actions, reports and records.

The staff found it acceptable to defer these sections because they are not required for a construction permit.

These sections will be thoroughly and completely reviewed in the FSAR.

Staff finds that the Conduct of Operations sections meet the applicable guidelines as follows.

SHINE has presented a complete facility organization which includes all organizational relationships which are important to safety and described the responsibilities of persons in that structure.

SHINE has described acceptable staffing requirements. Staff will meet requirements acceptable for non-power reactors. And, SHINE has deferred to the FSAR describing a radiation safety organization.

SHINE has deferred also to the FSAR details on the Review and Audit Committee membership, charter and rules for that committee that included a minimum list of items for the committee to consider.

They have proposed an acceptable set of required procedures appropriate to the operation of the facility and have described the review and approval process for those procedures and for making changes or temporary deviations to existing procedures.

Overall, the SHINE PSAR and RAI responses for the Conduct of Operations section supplies sufficient information for a construction permit.

The staff finds that the deferral of certain information to the FSAR to be acceptable because it is not required for a construction permit. Those portions that have been deferred will be completely and thoroughly reviewed at that time.

Accordingly, SHINE has met the appropriate regulatory requirements and acceptance criteria.

ACTING CHAIRMAN BLEY: I noticed that both your SER and the PSAR refer to on a few lines ConOps with caps.

MS. MLYNARCZYK: Yes.

ACTING CHAIRMAN BLEY: And how that's going to make everything wonderful. But I don't see any references to ConOps. I've seen a program that NRC funded through one of the labs that worked in that area extensively. What's ConOps mean to you?

MS. MLYNARCZYK: Well, I wasn't really familiar with it beyond what they have here. So --

ACTING CHAIRMAN BLEY: What they have here says we're going to implement ConOps and it's going to make the world wonderful. And you said something like that back, they're going to ConOps and that's a great thing.

MS. MLYNARCZYK: Well --

ACTING CHAIRMAN BLEY: So, is it a specific program? Is it --

MS. MLYNARCZYK: Oh, I didn't view it that way.

ACTING CHAIRMAN BLEY: -- just vagary or what's it mean?

MS. MLYNARCZYK: I just viewed it as their Conduct of Operations section. I didn't have any preconceived or any prior --

ACTING CHAIRMAN BLEY: So, it's just this chapter?

MS. MLYNARCZYK: So, I -- just -- yes,

this is --

ACTING CHAIRMAN BLEY: Okay.

MEMBER REMPE: Item 2 on Slide 21, it gets -- I mean what I'm reading about with Dennis's question more about minimum staffing levels because it says here they've describe the facility staffing requirements that demonstrate their ability to safely operate the facility to protect the health and safety of the staff and public.

And, I guess what I'm also thinking about is the number of operators and where does that get reviewed if it's not here and decided upon?

MS. MLYNARCZYK: That's true. I guess they did say that minimum staffing was going to be in the FSAR.

MEMBER REMPE: So, that's something that has --

MS. MLYNARCZYK: It does do something else that had it in there.

MEMBER REMPE: -- in that ought to be corrected --

MS. MLYNARCZYK: Yes.

MEMBER REMPE: -- a bit more? And then, I think that is an issue that comes up a lot right now, not just at this facility but a number of

operators.

MR. ADAMS: Right. So, it comes from a couple of places.

One, there's regulations in 50.54 that as far as licensed folks go, you know, have a requirement by the regulations who needs to be there and when.

Also, there's in ANS 15.1, there's a discussion of minimum staffing that needs to be done but, you know, given the uniqueness of this facility, that's something we're going to have to look into and make sure we're comfortable that there's sufficient staff and minimum staffing will, in all probability, be a technical specification requirement.

MEMBER POWERS: When you look at operations and staffing requirements and the like, do you also look at lay up of the facility?

So, the NRC comes in and finds gross safety violations and forces them into a lay up for six months, do they know how to lay up this facility?

MR. ADAMS: I'm not sure I fully understand what you're asking.

MEMBER POWERS: Suppose we have a red finding and we take the keys away from them.

MR. ADAMS: Yes?

MEMBER POWERS: And say, lay this

facility UP until you give us justification for continued operation?

MR. ADAMS: And, we have a facility that's in a situation like that at the moment.

MEMBER POWERS: Now? Do they know how to do that with this facility?

MR. ADAMS: That's normally a question of the tech specs and what we look at in conduct of operations is what needs to be done if the facility goes into a medium-term shut down, long-term shut down, permanent shut down. What, for example, surveillance requirements, what surveillance requirements need to be continued to be performed even though the facility's not operating? What things can you defer? What things can you not defer?

So, if that's the question you're asking, the answer is yes, that's something that gets considered in the development of the surveillance requirements for the facility, staffing requirements, so yes.

MEMBER POWERS: And, that was considered here? What do they do?

MR. ADAMS: I'm not sure we're at that depth of detail at this point for construction.

MEMBER POWERS: The trouble with process

facilities is always the same. When you think in terms of construction permit, is you're going to have to clean the lines. And you have to have a way to clean the lines and then you have to store the cleaning solutions that you purge out of it so it can't be left out of the construction.

I mean you have to make specific provisions in the construction to do that. Did we do that?

MR. ADAMS: The answer is I think that's something we need to look at. You know, there's a regulation that says that you -- and, you know, the extreme example of shutting down, but decommissioning that you -- when you design your facility, you design it with the fact that keeping in mind that, at some point, you're going to need to shut it down and, indeed, you know, draining systems, flushing systems, that's all part of that.

MEMBER POWERS: That's one of them. It's the one that frequently gets overlooked in these things is the six-month shut down, not the permanent shut down, but it's going to be down for six months, something's going to happen. You know, I mean it could be a regulatory thing, it could be just simply a piece of maintenance where you can't get a piece a

part.

MR. ADAMS: Sure, that could be, you know, I would see that as one -- as one of the, you know, one of the procedures that the facility would have on how to go into a short or long term shut down. Something that --

MEMBER POWERS: Well, the question is, at this stage, it's not whether it has a procedure, but is it going to require hardware provisions for that or not?

MR. ADAMS: I'm not sure we've delved into that, but I'm making a note.

MEMBER POWERS: Okay. It's a non-trivial concern when you have organic nitric acid contact potential because about three-quarters of our major red oil incidents have occurred because of situations in where there was a hiatus in operation and we had long-term contact of organic and nitric acid in a radiation field.

MR. LYNCH: Did you have anything you wanted to add, Mary?

MS. ADAMS: I just have a couple of things to add.

One of them, in about Section 12.1 about organization. We also -- fuel cycle also cares a lot

about the independence of the safety function from the production function so that the safety function has the authority and the ability to shut down the process if they think anything is unsafe. So, we'll be looking at that in that FSAR.

Also, the ISA team, there are acceptance criteria for the team that actually does the Integrated Safety Analysis, the Accident Analysis Review, just to make sure that qualified people are on that ISA team. And, that any time that changes are made in the facility and an ISA needs to be revisited, that the Applicant or the permittee or the licensee uses qualified personnel to do those Accident Analysis Reviews and revisions.

Also, with respect to operator training and qualification, we haven't seen that program yet in great detail either. But, the guidance documents, because 10 CFR 55 is for operator -- for power plant operators, it doesn't really help us very much when you're operating the radioisotope production facility.

So, our vision as laid out in the ISG is that operators could be qualified by meeting the training and qualification acceptance criteria that fuel cycle put in NUREG-1520 and that we would find

that acceptable if the operators, other RPF, could be qualified using those acceptance criterion in the guidance document.

Nothing else to add.

ACTING CHAIRMAN BLEY: Okay. Nothing more from the committee.

Thank you.

I guess we'll move on to the Accident Analysis.

MR. VAN ABEL: All right, my name's Eric Van Abel. I'm an engineer with SHINE Medical Technologies. I'm going to be discussing Chapter 13A.2, so this is the Irradiation Facility side of the Accident Analysis.

We'll discuss the RFP, the radioisotope production facility side at a following meeting, the next meeting.

All right, to begin with, the basis for identification of accidents, we performed an Integrated Safety Analysis ourselves with a Hazards and Operability Study that was performed, a HAZOPS, and a preliminary Hazards Analysis. Both of those went into our Integrated Safety Analysis.

That was one source of identification for initiating events. And, the other source were the

prescribed initiating events and accidents to look at in the final ISG augmenting NUREG-1537.

MEMBER REMPE: So, Eric, what's the status of the Integrated Safety Analysis? Has it been submitted to the staff?

MR. VAN ABEL: No, no. We responded with some of the details of scenarios in that from the ISA in response to RAIs, but the ISA itself has not been submitted.

MEMBER REMPE: And, is this like what we heard about earlier with the fact that you've picked a few sequences for them to look at, but will they get to look at the whole broad spectrum and say, oh, we think you may have picked a different one? Or is this -- or do they -- how does that interaction go?

MR. HENNESSY: You want to say anything on that, Jim, on the submission during the FSAR for the ISA?

MR. COSTEDIO: The requirement gets submitted with the operating license.

MR. HENNESSY: The summary?

MR. COSTEDIO: The ISA summary gets submitted with the license.

MEMBER REMPE: Okay, so, if they see a sequence or they decide when you submit that with the

operating license that you may not have picked the most severe conditions that they wanted to see and you've picked valves and different things and components based on your analysis and they say, oh, no, I think that that isn't quite the right analysis then you're at risk in --

MR. HENNESSY: We would have to evaluate that different chain of events and make sure that we have enough safety systems to bound the accident.

MEMBER REMPE: Okay.

MR. VAN ABEL: All right, the ISA was performed with a group of team members in a range of disciplines including criticality, safety, nuclear process safety, people experienced in PRA and risk analysis, process and system engineers familiar with the systems.

The design -- the ISA was done on the preliminary design information available at the time. We plan to reevaluate that as we develop more design information.

We have a set of P&IDs to look at to go through what valves and predicts or can fail. So, we plan to update this during detail design.

Initially, qualitative evaluations are performed within categories of accidents and then we

down select for those with consequences and perform quantitative evaluations of the consequences.

ACTING CHAIRMAN BLEY: Can you give us a little detail on what you mean by quantitative analysis?

MR. VAN ABEL: The analyses covered in the presentation here, analyzing a spill of solution and disbursable aerosols picked up by the ventilation system and calculating how much xenon, krypton, iodine a person could be exposed and calculating a dose from those events.

ACTING CHAIRMAN BLEY: All right. So, you tracked from the release point to a receptor somewhere --

MR. VAN ABEL: Yes.

ACTING CHAIRMAN BLEY: -- and calculated the doses?

MR. VAN ABEL: Yes. We'll describe the limiting events in each category in the following slides.

ACTING CHAIRMAN BLEY: Okay, okay, so we'll wait for that. Did you calculate anything about the likelihood of the events?

MR. VAN ABEL: No.

ACTING CHAIRMAN BLEY: Okay.

MEMBER STETKAR: Eric, before you get into it, because the next slide is just going to get us into details here.

But, in the introduction when we talk about accidents and initial conditions and assumptions, there's a statement that says because the SHINE facility is being designed to withstand external events such as tornados, seismic or manmade external hazards, scenarios that involve multiple irradiation units are not analyzed further.

In addition, several internal events were eliminated as possible MHAs due to the design of the facility.

Now, as I mentioned earlier this morning, there are a large number of support systems that, indeed, can affect multiple irradiation units and can affect irradiation units and the radioisotope production facility.

And, I, for the life of me, can't find any assessment of those events other than to suddenly dismiss them saying, we don't think they're important.

What evaluation was done of those and where is it document?

MR. VAN ABEL: The --

MEMBER STETKAR: Because I looked at the RAI response and I couldn't see them in at least the list of things that were in there.

MR. VAN ABEL: There's a -- yes, there's a section later on in Chapter 13 where it talks about interaction events, functional, spatial, system interactions --

MEMBER STETKAR: Okay, if you want to wait until then --

MR. VAN ABEL: Well, we can talk about it now, it's not --

MEMBER STETKAR: No, let's -- if we're -- we'll talk about it later. But, the rest of you can be thinking because that question's going to be answered in that section if you want to postpone it.

MEMBER REMPE: I have a question about your response back to Dennis. Because, earlier, or in your response, RAI 6b.3-3, the SHINE ISA summary states that any one of the following three independent acceptable sets of qualities could define an event as not critical and, therefore, not having to be considered in the ISA, an external event for which the frequency of occurrence can conservatively be estimated as one -- or as less than once in a million

years.

So, and then there's several other things you talk about, multiple actions and things like that.

But, there is some effort at one place where you talk about -- I even for not credible is less than 10-6.

MR. VAN ABEL: Yes, yes. We didn't calculate, you know, whether a TSV is going to rupture with a certain amount of frequency.

MEMBER REMPE: But an external event --

MR. VAN ABEL: But accidents were excluded on judgment basis as being not credible or not or being credible or not credible based on principles of physics and judgment of the team involved.

I think the specific definition you're referencing was the not credible definition used for criticality safety requirements of what we specifically find for criticality safety.

MEMBER REMPE: Okay, since I don't have the ISA, I assume the summary might apply to more than one thing. But -- across the board, I think that must not be true if I had the -- I might know that, but I don't, so we'll have to go with what you're saying.

ACTING CHAIRMAN BLEY: Well, I'd be interested in, if you can clarify a little bit, how you applied judgment to declare things not credible?

You know, if they are physically impossible, that's one thing, that's certainly not credible. If they're physically possible, what kind of basis did you use for deciding when you would call them not credible? And I'm not even sure what that means, but maybe you can define it, too, if you want to say that because the other definition doesn't fit.

MR. VAN ABEL: So, for example, the irradiation unit cells are all individual cells with approximately six feet of concrete between the cells. We didn't find any way from physical processes where a release inside of one TSV would cause another one of our irradiation units to have an accident.

ACTING CHAIRMAN BLEY: Okay, so that says it's not physically possible --

MR. VAN ABEL: Yes.

ACTING CHAIRMAN BLEY: -- in your judgment?

MR. VAN ABEL: Yes.

ACTING CHAIRMAN BLEY: No use to argue with that, I'd buy that one. Was that always the case or were there some where you could see ways but

you just said, well, I still don't think it's really credible?

MR. VAN ABEL: Not that I can --

MEMBER REMPE: Well, wait a second. Item 2, again, this was apparently just for criticality things, but it says a process deviation that consists of a sequence of many unlikely human actions or errors for which there's no reason or motive.

So, again, it sounds like, again, without quantifying those actions, a couple of actions, no, throw it out. I don't know how -- again, I don't have the full document. I'm just kind of reading the RAIs and trying to put the pieces together and I could have misunderstood something, but I just am seeing that.

MR. VAN ABEL: Yes, I mean there -- for that criticality not credible definition is used to exclude things that have an extremely low frequency of occurring. For one would be a typhoon at the SHINE site.

MEMBER REMPE: But this is human actions.

MR. VAN ABEL: Yes.

MEMBER REMPE: I said Item 2, I'm beyond external events, I'm in the human actions.

MR. VAN ABEL: The human action sequences

look at what the operators are trained at doing in the criticality safety analyses and, you know, for example, would we have containers of uranium powder, you know, would an operator take that powder and stack multiple cans on the floor when we have --

ACTING CHAIRMAN BLEY: Did you read the Tokaimura event? Other criticality events?

MR. VAN ABEL: I'm vaguely familiar with it, yes.

ACTING CHAIRMAN BLEY: It would be good to get more than vaguely familiar with the ones that have really occurred when you're making judgments about what's not going to happen.

MR. VAN ABEL: Yes. Yes, those --

ACTING CHAIRMAN BLEY: Because, in principle, none of them are going to happen but they do.

MR. VAN ABEL: Yes. And I understand.

MEMBER REMPE: And then, the other --

MR. VAN ABEL: The --

MEMBER REMPE: Go ahead, I'm sorry, I didn't mean to interrupt you.

MR. VAN ABEL: The criticality safety stuff is not really covered in 13a.2. That's really a 13b question. That's criticality safety processes

are in the 13b Chapter where that's -- there's more, just my opinion, there's more qualitative aspects of, you know, what can happen when you're processing uranium and you don't have a set device like a reactor where you have control rods that can only move in and out since you have failure mechanisms.

When you're processing liquids and you're moving them around, there's more human interaction inventions.

MEMBER REMPE: So, that definition was solely based on 13b things and there's not attempt at similar things for the 13a stuff.

But, that's the other question I was going to ask later, but I'll mention it here. The fact it's, I guess, on the bottom of an upcoming slide about that the most limiting MHA was in the RPF.

So, 13b stuff are the most limiting and is there any way that those most limiting events can affect the irradiation units? I mean, you've talked about a six-foot concrete wall, but -- and this kind of was brought up this morning about interactions between one and the other.

And, I get it, the 13b stuff can't ever cause any sort of big explosion with a red oil event that affects the IU is the kind of question I'm

wondering. And, that has been evaluated?

MR. VAN ABEL: Yes. I mean we looked at the interactions between the RP IF and the IF, but, you know, we transfer solution from the IF ~~IPF~~ to the RPF and back and forth, we have comp systems, ventilation systems, are based in the RPF and they service the IF facilities.

So, that was evaluated in the ISA and it's documented in the functional interaction section. And, I'm sure we'll have questions on the ventilation system when we get there.

MEMBER REMPE: Okay.

MR. VAN ABEL: But, yes, it was looked at.

MEMBER REMPE: Okay.

ACTING CHAIRMAN BLEY: We've kind of mixed you up. Coming back to 13a, I want to make sure I understand right because one day we'll get to see parts of the ISA I supposed and I'll be interested in looking at it.

But, as I understand what you told us, to your memory, you think that the things that were dismissed as being not credible in 13a were things that, in your judgment, were physically impossible, they just couldn't happen?

MR. VAN ABEL: Yes.

ACTING CHAIRMAN BLEY: Okay.

MR. VAN ABEL: Next slide?

These are -- this slide, Slide 53 and the following Slide 54, are the list of accident categories. I'm not going to spend time going through them here because each one is described in the following slides individually.

So, if we can go to Slide 55?

MEMBER STETKAR: You did look at reduction in cooling? You didn't look at increasing cooling? It's not credible that right after you load a batch you can get really cold cooling in there?

MR. VAN ABEL: Yes, yes. And, it's actually covered -- it's under a different category.

MEMBER STETKAR: The activities insertion stuff?

MR. VAN ABEL: Insertion of excess activity.

MEMBER STETKAR: Okay, thank you.

MR. VAN ABEL: Yes.

Okay, 55?

So, the IF postulated MHA, Maximum Hypothetical Accidents. The MHA was postulated for both the IF and the RPF and the IF, we postulated MHA

and with the target solution vessels, the off gas systems, the light water pools, the accelerators, the tritium purification system and the cooling system.

It should be noted that the ISG augmenting NUREG-1537 defines the MHA as not being required to be a credible event. It states the MHA can be a non-mechanistic failure that just bounds the other accident categories and provides a delta sets greater than the other accidents analyzed.

And, as was mentioned before, the most limiting MHAs in the RPF, which we'll cover when we talk about 13b, but we kept the IF postulated in MHA just for completeness.

The IF postulated MHA is a release of irradiated target solution into the IU cell. So, it's a result of the TSV losing integrity. And, remember, the primary system boundary is the TSV, the dump tank and the off-gas system.

And we assumed there's a rupture ~~an eruption~~ in the primary system boundary and that the support structure that's holding the TSV has also ruptured. It's just a non-mechanistic failure that's assumed as the initiating event.

At the time of the accident, the TSV has a maximum inventory present in the solution that we'd

expect and was operating at ten percent over power, over the licensed power limit, and was a maximum.

Of course, we won't -- I said it would be with maximum inventories we would expect, but we would never expect to operate over the licensed power limit, just for clarity.

The maximum fission product carryover between the irradiation cycles that occurs right and the end of the cycle when we have the greatest fission product inventory in the subcritical assembly and there's no decay that happens while we're irradiating.

As we discussed before, there's isolation between the IUs and assuming that only one IU is affected by the event, there's no means of interconnection that would cause an event in the same -- another event in another IU cell.

The ventilation system's operating normally at the time of the event. And, a large assumption is that we remove the presence of the pool. We assume there's no pool present when this occurs, so the target solution spills right onto the floor of the IU cell.

The target solution batch spills on the IU cell and that spilling action is generally is the

motive force for disbursal.

So, the target solution is released onto the subcritical assembly without the pool. The airborne radioactive materials are pulled into the ventilation system. That high radiation signals the ventilation system actuates the isolation dampers we discussed at our last meeting the bubble tight isolation dampers and initiated alarms, high radiation alarms to initiate evacuation.

The release fractions are given here and I think it's easier to look at the next slide that'll show the same release fractions but just in a graphical form.

So, this shows the simple assumptions used for the analysis.

MEMBER STETKAR: Now, those are simple assumptions. What's the basis for them?

MR. VAN ABEL: Any one in particular you want to cover or you want just me to cover basis on each one?

MEMBER STETKAR: No, I asked the general question, but start with the 25 percent because you use that -- that's ubiquitous throughout.

MR. VAN ABEL: Yes.

MEMBER STETKAR: I don't care whether

it's irradiation units or out in the radioisotope production facility, it's always assumed that 25 percent is released and then everybody is miraculously out of the area regardless of how it was released or where it was released to.

MR. VAN ABEL: Yes, for this particular event, there's no motive force for generating this rupture in the TSV and there's no motive force to force the liquid out. This is a vessel sitting there at ambient pressure at relatively low temperature, 60 degree Centigrade, and there's no driving force, there's no high pressure.

MEMBER STETKAR: No, I --

MR. VAN ABEL: There's nothing to drive it out.

MEMBER STETKAR: I meant don't funnel me into a specific scenario because this assumption is used throughout Chapter 13 --

MR. VAN ABEL: Yes, and --

MEMBER STETKAR: -- regardless of where I am.

MR. VAN ABEL: There's different bases for this.

MEMBER STETKAR: Even when I'm pumping the stuff actively.

MR. VAN ABEL: Yes, and I can -- the pumping one is -- our pumping rate is expected to occur over two hours because of the extraction process takes a while. And so, the pumping rate is quite slow. So, that was judged within the first ten minutes. It was acceptable to use 25 percent of the solution leaking out. That's the normal pumping of the entire volume occurs over a period of approximately two hours.

MEMBER REMPE: So, there's not been any sort of analysis for any of these assumptions to back it up? And, will there be any sort of calculations done for -- before the operating license or the FSAR is submitted?

MR. VAN ABEL: Well, the -- we think the release fraction of 25 percent in the first ten minutes is very conservative. But, the actual release rate would be much less than that if there was no motivating force.

MEMBER STETKAR: No, you think, but have you done calculations to show how much you can pump?

MR. VAN ABEL: Not --

MEMBER STETKAR: How much you can spill? That's what we're asking.

MEMBER REMPE: Yes, and --

MEMBER STETKAR: I think that maybe you could do more. Okay? So, we two think different. But, I don't have any basis for my thought, I'll admit that.

MR. VAN ABEL: Yes, we don't have a calculation for that at this point.

MEMBER POWERS: You don't have access to Jofu Mishima's database?

MR. VAN ABEL: I don't think so.

MEMBER POWERS: You might want to look at that because I think it will let you relieve these targets or at least justify why they're bounding in a lot of cases.

Jofu was looking primarily at plutonium issues but I mean what he has done is essentially collected the 10,000 experiments he did on various accident releases of solutions and things, and fires and all kinds of stuff and put it into a database and that's used for safety analyses at DOE process facilities.

And, I would at least have that on my desk as a basis for saying well, I took 25 percent and it's less than what Jofu -- and I think, I mean it's appealing to authority to be sure, but it's authority based on thousands and thousands of

experiments looking at these things.

MEMBER REMPE: So, for those of us who aren't familiar with this database, could you spell the last name? I don't know just what document you're talking about.

MEMBER POWERS: Mishima.

MEMBER REMPE: Mishima? Okay.

MEMBER POWERS: Jofu Mishima, he was at Hanford. I mean he's a real nice guy and he put this -- he put the database together for DOE and it's used pretty routinely. There is an official document for DOE and I'm sure I cannot come up with the reference on it because I had the original -- I have Jofu's original and I might not.

But, I think if you just look up Jofu Mishima it'll pop out on -- or you can just call somebody at DOE and maybe they can point it to you because they use it fairly routinely for their accident analyses.

MR. VAN ABEL: Okay. I'll look into that.

MEMBER SKILLMAN: I would like to ask a question.

MEMBER POWERS: And he does things like spills and boiling and chemical reactions, you know,

solution and cause the solution to foam up and things like that. You know, how the DOE's five factor formula. I mean you've kind of got it here is, it's so much released and so much gets out of it.

MR. VAN ABEL: Yes, same formula.

MEMBER POWERS: But it gives you fractions of those and there's no physics, this is what he observed and then it's kind of correlated and things like that.

And then, the upshot is they're probably horribly conservative if the truth were known, but --

MR. VAN ABEL: Is that a -- was that an input to the NUREG-6410 fuel cycle?

MEMBER POWERS: That's a NUREG. Jofu's is a DOE thing and I don't know whether the NRC has adopted it for anything.

MR. VAN ABEL: Yes, that's what I was wondering if they had --

MEMBER POWERS: But, it could be. But, I mean that's how I would go about like ten percent of airborne material leaves the cell, I mean, okay, that's good. What did Jofu say? And I think it's about ten percent.

MR. VAN ABEL: Yes.

MEMBER SKILLMAN: Well, let me ask this.

I'm following your presentation, but I'm following it through the text of the PSAR because your --

MR. VAN ABEL: Yes.

MEMBER SKILLMAN: -- slides in the PSAR are kind of are, you know, together. They're in harmony with each other.

The statement in the Section 13a ~~off of~~ 2.1.1.2 is under Accident Conditions, the release is mitigated by filters in the RVZ1 and isolation of the IU cell by the inlet and outlet dampers.

Now, on your slide between Box 2 and 3 from the top on the right hand side, what assumption do you make regarding the rate at which those dampers close? Can those close with a nice slow action such that one percent is really very underestimating how much is getting through before the isolation occurs or are those dampers instantaneous?

MR. VAN ABEL: We plan to, for detail design, do a modeling in the cell and figure out what the actual dispersion would be and how much would get past the damper at certain flow rates in the ventilation system.

MEMBER SKILLMAN: So, we're back to John's question of justifying the basis of your analysis?

MR. VAN ABEL: Yes. Yes.

MEMBER SKILLMAN: And, it's very hardware related.

MR. VAN ABEL: Yes, it absolutely is very hardware related.

MEMBER SKILLMAN: Okay, thank you.

MEMBER REMPE: Because, in addition, in that same section, you talk about alarms working, there's a lot of other things that you're talking about, two people evacuating like John mentioned.

But then, it sounds to me like at some point you are going to be doing some modeling and some calculations and the staff will, at that point, review it and --

MR. VAN ABEL: Yes, the particular thing I was --

MEMBER REMPE: -- changes.

MR. VAN ABEL: -- thinking about was the target solution spilling out of the vessel when we were talking before, the modeling of the release fractions and the transport into the ventilation system. We plan to look at all that during detail design in detail.

MEMBER REMPE: Okay.

MEMBER STETKAR: You know, just throw

this out before we get off this, it'll help me later.

Have you specific a flow capacity of the target solution transfer pump, the irradiated transfer pump?

MR. VAN ABEL: I believe we have a flow capacity for it. I think it's in the piece hardware. I don't --

MEMBER STETKAR: It's not in the piece, I looked for it.

MR. VAN ABEL: The transfer's not?

MEMBER STETKAR: Yes.

MR. VAN ABEL: I thought we had that. We had the horsepower I think at least.

MEMBER STETKAR: Yes, the horsepower. If anybody knows it, I'd appreciate it. I can do a back of the end flow calculation here in a minute if anybody has it. If not, that's okay.

MR. VAN ABEL: So, for the worker dose assumptions, it's assumed that 25 percent of the material is released into the IU cell and they're exposed then to ten percent of that material that goes out through the penetrations in the cell.

If you remember, the IU cell is nominally at negative pressure relative to the surrounding environment and penetrations are sealed.

We're assuming for this accident that ten percent of the material that's disbursed in the cell leaks out during those ten minutes which you ignore any type of dispersion time, we assume instantly comes out, instantly defuses and moves through the penetrations for this assumption.

For the offsite release assumptions, the target solution release begins off the target solution's released into the TSV and total of one percent released from the TSV, sorry, and a total of one percent of the material that becomes airborne from the spilling action is -- but, it goes past the dampers and is pulled into the RVZ1 train and that then passes through the HEPA and charcoal filters in the train and is subsequently released.

The items mentioned on this slide in Slide 59 are common to the other accident analyses and then discuss just something to note.

The HEPA filters are assumed to remove 99 percent of particulate. The carbon absorbers are assumed to remove 95 percent of iodine.

And the dose conversion factors that were used for the analysis are ICRP-30 and we plan to -- we've submitted an RAI response to the staff that we plan to update these analyses using ICRP-72

during detail design as well.

And, it's the workers are assumed to evacuate from the RCA within ten minutes and we've done initial calculations on the transit time for the workers and that's in the worst case location that we come up with that's approximately three and half minutes for them to come out.

And we recognize that there is also pre-recognition time that you have to account for the personnel to become aware of the alarm and then the time necessary put their equipment in safe configuration before they leave. So, that's where the ten minutes is, we think, bounding.

MEMBER SKILLMAN: Eric, does that evacuation path study recognize the location of the filters and the radiologic burden that may be in the filters at the time the workers are trying to exit?

MR. VAN ABEL: No, it does not. It has them going out the RCA exit which is near the HVAC trains as shown on the figure there. But, that's something definitely to consider.

MEMBER SKILLMAN: Then, what might be the radiation levels off of those filters and what would the impact be on those workers as they are trying to evacuate?

MR. VAN ABEL: I don't know the radiation fields at this time.

MEMBER SKILLMAN: Is that something that you will determine?

MR. VAN ABEL: Yes, we will have to ensure that that's not a -- we have to ensure that the egress route for the workers is a route that exposes them to the minimal amount of radioactive materials.

MEMBER SKILLMAN: But at the construction permit time, if you're going to locate the filters perhaps in the same corridor or an exit path, you need to understand that you're going to have to have a significant amount of shielding to protect those workers because the very devices that are protecting the public are holding isotopes that can irradiate the workers.

MR. COSTEDIO: We're not going to build that until the design is done so we'll know prior to putting the equipment in whether we need to do that or not.

MEMBER SKILLMAN: Well, if you're laying it out ventilation corridors right now and the ventilation corridors are where the people need to exit, you've got a situation that needs quite a bit

of engineering right now.

MEMBER SCHULTZ: Eric, the filter numbers, the removal fractions, do those assume bypass around the filter or is that a separate assumption?

MR. VAN ABEL: Filters are comprehensive. Those are applied as is shown there. And the filter, the details of the filter testing and what fractions amount allowed to be bypassed in that will -- that's an item planned for detail design.

MEMBER SCHULTZ: Okay, thank you.

MR. VAN ABEL: Next slide?

The calculated dose consequences to the worker from the event are approximately 3.1 rem TEDE which is below the regulatory limit specified in 10 CFR 20.1201. The doses to the public individual at the site boundary are 17 millirem which is below the regulatory limit specific in 10 CFR 20.1301.

MEMBER POWERS: When you think about HEPAs, do you think about knock-through?

MR. VAN ABEL: I'm sorry, couldn't hear you.

MEMBER POWERS: Do you think about knock-through?

MR. VAN ABEL: Knock-through?

MEMBER POWERS: Radioactive particle gets on there, it decays, knocks it through the building.

MR. VAN ABEL: Oh, knock-through?

MEMBER POWERS: I mean 99 percent HEPAs will do a little better than that, but with knock-through, maybe they do less.

MR. VAN ABEL: Yes, we haven't looked at that.

As I touched on a few things here, there are a lot of conservativisms in this calculation. One, the TSV is normally at below ambient pressure and there's no driving force for this large leak to occur in the vessel. There's no driving force to force the liquid out of the vessel, even then, there'd normally be a pool on the other side of the vessel.

The pool would also prevent the direct generation of aerosols because normally if this were to occur with the leak in the TSV, the liquid would go into the pool and there wouldn't be aerosols generated. They would dilute in the pool and reduce the releases.

Noble gases --

MEMBER POWERS: Would there be bubbles coming up through the liquid?

MR. VAN ABEL: Yes, there would be bubbles. There would be some releases, absolutely.

And noble gases are assumed in this event to completely leave the solution as it is spilled.

Next slide?

The next event category was excess reactivity insertion. Excess reactivity insertion was identified as requiring quantitative analysis to the potential elevated doses.

And, one of the items that was looked at in this category of accidents was potential chemical changes in the target solution. And, those were analyzed and no consequences were identified assuming the target solution's prepared in the RPF side of the plant, it's prepared as a batch and the testing and independent verification of the parameters for the target solution are performed on the RPF side before it's transferred to the IF side.

And precipitation of uranyl peroxide has been evaluated by Argonne National Laboratory and the addition of metal sulfate to the solution is expected to prevent precipitation.

MEMBER REMPE: So, is that done like a full-scale test? Is it a long duration test? Tell us a little bit more about what's going on out there

at Argonne?

MR. VAN ABEL: They're doing a variety of experiments. They've done -- they're not a whole TSV, they're representative.

MEMBER REMPE: What scale is representative? I think I saw somewhere of like 500 is it liters or something? I can't remember what it was. But, is it one-tenth scale? Half scale? What is it?

MR. VAN ABEL: They're doing the experiments for like the microtron where they're doing really the irradiation for this particular event. Those are small test tube type scale.

MEMBER REMPE: So, is it going to be representative and will -- how do you know that you've got confidence that you're doing something that's a representative size that will give you the necessary insights?

MR. VAN ABEL: Well, the insights are, at the right power density, the precipitation does not occur. At the right power densities in the system, that there is no precipitation in the solution.

MEMBER REMPE: Even if -- I don't know much about this. This is not my area. But, I thought

with time, that the solution's properties would change. And so, do you do it over an appropriate time scale, too?

MR. VAN ABEL: Yes, yes. Argonne is doing the work, which SHINE's not doing. Yes, Argonne is doing it over -- you know, they've looked at the kinetics of the -- they've modeled the kinetics of the reactions and computer codes and now they're implementing their testing with actual solutions under irradiation.

MEMBER REMPE: Oh, okay. So, they are doing it under irradiation?

MR. VAN ABEL: Yes, under irradiation to look for precipitation.

MEMBER REMPE: And, how do they test under irradiation out there at Argonne?

MR. VAN ABEL: They have a linear accelerator and a neutron producing target that they hit it with.

MEMBER REMPE: Okay. So, it's representative but the scale is a lot smaller but you believe that the processes of concern are being modeled appropriately?

MR. VAN ABEL: Yes.

MEMBER REMPE: And, this report has been

sent to the staff yet? I saw a 2012 report, but the work's ongoing, so it's not done yet?

MR. VAN ABEL: The work's not done yet, that's correct. It's continuing.

Another point I'll just mention is Argonne -- Argus Reactor in Russia is run at higher power densities before as well, too, with uranyl sulfate solution.

MEMBER REMPE: Okay, thank you.

MR. VAN ABEL: Positive reactivity can also be added to the system, to the TSV, by void collapse. So, void collapse could be due to any type of pressurization of the head space such as from deflagration, hydrogen burning.

The reduction in void fraction causes a reactivity insertion in the TSV. The temperature of the TSV during event would stay constant or increase because of the extra heat production added to the solution.

The figure on the lower right there shows the schematic representation of the k-effectives. The top is the cold zero power. That's as we start up and we bring the system, fill up the system with uranium and bring it up to our desired k-effective value.

And then, the hot flow power, HFP at the bottom there, is as we increase the power in the system by turning on the driver and adding tritium to the target chamber in the driver.

And then, there's a water loss that occurs from water hold up in the TSV off-gas system. And that's a small increase in reactivity.

And then, there's -- that's a normal occurrence. And then, we assume there's a maximum deflagration event that occurred which, for this analysis, was 200 psi, just to bound all of our other analyses which are, I think I mentioned at a previous meeting, our maximum deflagration event was evaluated to be 50 psi.

And, as you can see, the reactivity remains very suppressed below even where you started and it was subcritical when you started.

MEMBER SKILLMAN: But, Eric, you started a k-effective between [proprietary] and [proprietary].

MR. VAN ABEL: I think the actual k-effectives are proprietary.

MEMBER SKILLMAN: It's got to be in the PSAR. I'm reading out of the PSAR.

MR. VAN ABEL: I think it's in the

brackets so it's withheld from public disclosure.

MEMBER SKILLMAN: Not with -- it should. Not in the first IF and I apologize if I've misspoken relative to confidential information.

Here's the question, though. You're really close to one. What conservatism should we expect is in that number to the side of safety?

MR. VAN ABEL: So, the --

MEMBER SKILLMAN: I mean, you're starting at a very high k-effective. Whatever the number is, if this number is accurate, you're starting very close to one.

MR. VAN ABEL: Yes.

MEMBER SKILLMAN: So, what's the margin of error? What confidence should we have that this isn't understating your k-effective?

MR. VAN ABEL: So, the k-effective is essentially predictive every time we start up. So, we have high flux trips that will trip and shut off the system if we get to too high of a k-effective.

So, the actual k-effective difference from a code prediction of the system would be to predict some k-effective. Then you go turn the reactor on, you find out the control rods need to be 30 steps out from what they are to actually get you

to criticality from what the code predicted.

In our system, you fill it up and you actually see where you are in multiplication factor as you start up every time and if you go too high in multiplication factor which is essentially k-effective, you would trip and shut down the system.

So, we've looked at -- we've done preliminary analysis on the uncertainty to ensure that we have enough -- we don't go into values here but we can talk about them later if you want -- to make sure we have enough and we'll do that during detail design once we have the exact, you know, pumps and flux detectors spec'd out so that we can ensure that we have enough margin and, if we need to, we'll adjust the k-effective to do such.

MEMBER POWERS: The nice thing about this reactor is if it's too high, it'll correct itself and avoid like crazy.

CONSULTANT SMITH: I would like to follow up that question.

As you approach your initial k-effective, at what rate are you adding reactivity from the solution being filled? I didn't see any real description of that.

MR. VAN ABEL: I don't have the rate off

hand. That will depend a lot on the final transient analysis. We plan to perform a transient analysis during detail design that'll show what our maximum allowable rates are so that if you have an uncontrolled fill event, that the fill pump goes at the maximum speed, the operators either do it accidentally or cannot control it, that the flux detectors will trip the system and initiate draining before you ever reach criticality with sufficient margin.

And, the one dump valve is more than enough and the flow rates through one of the two dump valves is more than enough to drain much faster than you can fill even if the filling continued in that scenario.

CONSULTANT SMITH: Yes, I was sort of looking for those curves and didn't find them.

The other question, I saw some timing on the dump valves that say something like one second assumed delay and five seconds to full opening of the valve, is that correct?

MR. VAN ABEL: Yes, correct for the -- we had I&C engineers look at the expected response time for the instruments we were thinking of and they came up with approximately 500 milliseconds for the

response time of the instrumentation system including the digital control system. And we moved that to one second.

And the valves are not chosen, as I think we discussed here before. We expect those to be solenoid valves. We expect them to be fairly fast opening but we used five seconds to bound that.

CONSULTANT SMITH: One other question on the calibration of the flux detectors. How do you go from a signal to what the absolute flux level is or even power level? Is there a heat balance done at some point here to establish the correlation between detector response and core power?

MR. VAN ABEL: Yes. Yes, we plan to do a thermal heat balance to ensure that we're below our licensed power limit and correlate that to a detector output signal.

CONSULTANT SMITH: So, is there also going to be a campaign upon -- preceding operations to go through and qualify, I assume? But I didn't see anything on that. I assume that's coming as part of the FSAR or the tech specs?

MR. VAN ABEL: I didn't fully catch that.

MEMBER REMPE: The word after qualify got lost. Could you repeat the question?

CONSULTANT SMITH: Well, at some point, you have to establish that your flux detectors and your power calibrations are really what they should be and you won't know until you actually start operation.

So, I assume the test procedure and tech specs at some point for how this is done. It's just not there until the FSAR comes out, is that right?

MR. VAN ABEL: Yes, we'll have the calibration requirements in the FSAR and the technical specifications for the flux detectors.

CONSULTANT SMITH: Okay, thank you.

MEMBER REMPE: So, before you leave this slide and before all the questions started, you started talking about this difference of 200 psi for the deflagration events versus the 50. And, could you say that again so I -- I think I missed a bit of that and I've been confused about what I've been reading.

MR. VAN ABEL: Yes, sure.

The calculation, we needed an assumption to do this calculation. And, without knowing the deflagration value at the time for sure, we just assumed 200 psi.

MEMBER REMPE: Okay.

MR. VAN ABEL: From preliminary analysis, we figured it was going to be less than a 100 and then we finally did it, then it was less than 50.

MEMBER REMPE: So, components are designed to withstand 50 because your calculations now have said it's only going to be 50?

MR. VAN ABEL: Yes, and this calculation just bounded the reactivity insertion by assuming a larger pressure.

MEMBER REMPE: Okay, thank you.

MR. VAN ABEL: Yes.

Okay, next slide?

Another event that can add reactivity is over cooling by the primary cooling system. That's a PCLS and LWPS systems.

Excessive cool down will drop the temperature in the target solution vessel and, because of the negative temperature coefficient, the temperature drop will add reactivity to the system.

Approximately five degree drop in temperature in the TSV will add around a 100 pcm of reactivity.

We have trip set points to trip the system if there's over cooling on both end low temperature in the primary cooling loop and on high flux in the

flux detectors because the increase in reactivity would also cause a corresponding increase in the flux and the high trip would catch it as well.

The next event is inadvertent target solution injection during start up and irradiation operations. And, you could either have target solution -- I've touched on this a little before -- you can either have target solution injected inadvertently during your normal controlled start up process or you could have it injected during irradiation when you plan not to be injecting target solution.

For the first scenario, the TSV reactivity protection system has trips on high flux to prevent criticality and that's what I was describing before. We'll do a transient analysis with the FSAR looking at the fill rate, the maximum possible fill rates we can add to the system, the trip activation times, deviations in uranium concentration, if the uranium is batched incorrectly as well and detector uncertainties.

And that trip prevents reaching criticality during the start up in Mode 1 operation.

During Mode 2 operation, we isolate that batch of uranium in the TSV. We isolate two series

fill valves and isolate power to the fill pump so you can't add uranium during irradiation.

CONSULTANT SMITH: Can I ask another question on your high flux trip?

MR. VAN ABEL: Yes.

CONSULTANT SMITH: Is there a different setting between Mode 1 and Mode 2 on what's going to initiate the shut down?

MR. VAN ABEL: Yes. Yes, the intent is that we'll switch modes and that'll switch the trip set points. It'll bypass the low range high flux trips and switch to Mode 2.

CONSULTANT SMITH: All right, thank you.

MR. VAN ABEL: Next slide?

MEMBER STETKAR: Before you get to the next one, on excess reactivity, a couple of questions.

In the PSAR, there's a statement that says excessive cool down and other reactivity insertion scenarios is only credible when the neutron driver is not operating. Why is it only credible when the neutron driver is not operating?

MR. VAN ABEL: The reactivity is so far suppressed during operation.

MEMBER STETKAR: So, you know you can't get it cold enough during operations?

MR. VAN ABEL: Yes, to have -- you would --

MEMBER STETKAR: No matter how cold I make the chilled water system?

MR. VAN ABEL: Yes, you'd have to make it negative 30 degrees.

MEMBER STETKAR: Okay, all right.

I didn't see any discussion in this section about reactivity addition about increases in tritium flow. Suppose they try to put a lot more tritium in there?

MR. VAN ABEL: Yes, the way the driver -- the neutron driver, the accelerator works, is that the beam fully stops in the target chamber. So, no matter the rate of tritium injection you add, if you just keep adding tritium, the pressure would go up in the target chamber and the beam would stop a little higher which would actually drop our power.

The beam would just stop shorter and produce the neutrons in a different place than being spread out where we want them kind of centered on the target solution vessel for the best yield in the system.

MEMBER STETKAR: Okay, I'll think about that. Thank you.

MR. VAN ABEL: Yes.

Reduction in cooling, as noted at the previous meeting, the active functions of the PCLS and LWPS cooling, the forced flow of the cooling loops are not safety functions.

Loss of reduction of the cooling through equipment failure such as loss of a pump in the system results in a shut down of the irradiation process.

The TRPS trips on loss of primary coolant flow or on high temperature in the primary cooling system.

The RPCS, that secondary cooling system, is not an engineered safety feature. If we lose that cooling system, the subcritical assembly trips on the same trips as we had before.

Loss of -- and there's no accidents we postulated where the RPCS is required during inoperable following an accident.

The loss of active TSV cooling is alleviated by the pool. So, after we have the event, the target solution is dumped from the trip, it's dumped into the dump tank which is submerged in the light water pool and that provides a cooling of the target solution for a decay heat removal. And there's no dose consequences due to the event.

Next slide?

Sampling or malfunction of target solution, this event looked at ways in which the target solution could be mishandled in the irradiation facility and the ISA and the Hazards Analysis identified several scenarios of concern that could cause target solution release and the most limiting one was found to be the rupture of the dump tank piping as the solution is being transferred out of the RPF -- out of the IU cell to the RPF. We assume that piping ruptures as the solution's being pumped to the RPF.

And, during preliminary design when the PSAR was being put together, it was assumed that that piping could potentially traverse above the pool surface. So, it could come out of the pool surface before it enters the wall and, therefore, you'd lose the scrubbing effects of the pool.

So, we made that assumption to the accident analysis that it's being sprayed directly into the room.

And so, on the next slide, the accident sequences describe the solution is released from the piping. As I mentioned before, the rate of pumping is low. We planned for this transfer to occur over

a period of two hours.

So, during the ten minute evacuation assumption, less than 25 percent of the material would be released from this rupture and we assumed it was 25 percent for the purposes of the analysis.

MEMBER REMPE: Is something like this with the pipe ruptures considered to be a scenario of more concern than multiple human actions, erroneous actions? I just am curious. I mean you looked at what is involved and this is considered to be more likely and --

MR. VAN ABEL: It's the worst consequences.

MEMBER REMPE: So, worst consequences?

MR. VAN ABEL: Yes.

MEMBER REMPE: If the worker's involved, the worker will be right there to get the dose, though.

MR. VAN ABEL: Yes, we don't plan to have people in this irradiation cell when we have target solution present. It's --

MEMBER REMPE: When they're loading it, are any actions --

MR. VAN ABEL: Or any target solution in the cell --

MEMBER REMPE: -- near there?

MR. VAN ABEL: -- when people are present.

MEMBER REMPE: Okay, okay. Okay.

MR. VAN ABEL: High radiation signals then are actuated due to the irradiation, the airborne radiation in the exhaust and that actuates the evacuation alarm and the ESFAS actuation which closes the bubble tight dampers.

The workers are assumed to evacuate within ten minutes, as previously described. One percent of the airborne material bypasses the dampers and ten percent leaks out through the penetrations in the IU cell similar to the MHA we described before.

The HEPA and charcoal filters in the exhaust duct work are accredited to reduce exposures to the public, as mentioned previously. And the dose to the workers calculated to be 1.5 rem TEDE and the dose on the public -- for the public at the site boundary which is sitting on the fence line is 2 millirem.

MEMBER STETKAR: Eric, I asked earlier about the irradiated target solution transfer pump capacity because I wanted to do a back of the envelope for this scenario. You honestly don't have that

capacity available or is it proprietary?

Or, I mean I don't want to -- some of the numbers I'm dealing with may be proprietary, so I don't want to blurt out guesses on flow rates and stuff like that.

MR. VAN ABEL: We have the design transfer time and idea of the pressures we're looking at but we don't have the pump selected or --

MEMBER STETKAR: Okay, okay, thanks.

MR. VAN ABEL: Next event?

Loss of offsite power, as we described in Chapter 8, the UPSS on an uninterruptible power supply provides power to the emergency equipment described in Chapter 8. And we plan to do a detailed evaluation of the emergency power requirements during detail design and provide that with the OL Application and that'll describe how long we require that power to be provided.

During a LOOP, the neutron drivers don't function. They require offsite power to operate, so they automatically shut down.

The target solution is automatically drained to the target solution dump tank on loss of power.

And, the primary cooling pump stops

function, they require lots of power.

You can see the target solution is drained by gravity into the dump tank and the heat removal is provided by the light water pool just by natural convection. There are no consequences due to the LOOP.

For external events --

ACTING CHAIRMAN BLEY: When you were looking at these, did you think of or look to see if there were any partial losses of AC power that could get you into worse trouble?

I mean your fail safe stuff here takes care of you, but if you lost, you know, part of a BUS or some of that, could you get into situations where, you know, you're not getting the dump out trip or the pumps to stop and it makes it a worse event than the complete loss of power one?

MR. VAN ABEL: Yes, we haven't looked at that yet. That is something that we are considering.

ACTING CHAIRMAN BLEY: So, that's not in the ISA? You didn't look for those kinds of scenarios?

MR. VAN ABEL: No, not partial loss of systems. But, there's nothing, you know, since our last meeting, there's nothing identified where that

would be an immediate cause for concern.

ACTING CHAIRMAN BLEY: No, but you really should have searched for that.

MR. VAN ABEL: For external events, the SHINE production facility building is designed to survive postulated wind loads, seismic loads, tornado loads and aircraft crash loads as described earlier today in Chapter 3.

The safety related SSCs that are required to function are analyzed under loading condition of the design based earthquake and ensure and ensure that they can perform the safety-related functions following the design basis earthquake. And there are no consequences due to external events.

MEMBER BALLINGER: I have a question.

MR. VAN ABEL: Yes?

MEMBER BALLINGER: And I was discussing with my colleagues just before lunch or whatever, you supply natural gas to the system for boilers and stuff?

MR. VAN ABEL: To the facility, yes.

MEMBER BALLINGER: To the facility? Have you thought about what happens if something driving -- if there's a failure of the gas line, not in the facility, but external to the facility in the

road or something which is actually fairly common?

What happens then is the gas that's released flows along the pipe which is into the facility into the house or something, and then what happens is the house explodes. There's no fire because the leak rate is low enough so that the source doesn't supply a lot of gas.

But, you can get a gas leak into the facility along the pipe outside of the pipe and it goes into the facility.

MR. VAN ABEL: Did you look at that?

MS. KOLB: As we covered in Chapter 2, we did look at pipeline leaks, but they were all assumed to leak into the atmosphere and that a cloud would flow over to the facility.

MEMBER BALLINGER: Yes, and that's the easy one to find.

MS. KOLB: That was what we looked at.

MEMBER STETKAR: And, you looked at it out on the highway? You didn't look at it at the facility?

MS. KOLB: No, we did look at pipelines. There is a section about pipelines in Chapter 2, not just trucks carrying propane.

MEMBER STETKAR: No, no, no, the pipeline

you looked at in Chapter 2 is the one that runs along the - I've forgotten the highway number, but the --

MS. KOLB: Highway 51.

MEMBER STETKAR: -- road out front.

MS. KOLB: I'm assuming so, but yes, it was the closest pipeline to the facility.

MEMBER STETKAR: Right.

MR. VAN ABEL: Next event category is just having a malfunction of equipment affecting the TSV. This category of accidents we looked at systems handling fission product gases from the irradiation process and that's principally the TSV off-gas system.

And the limiting event was a rupture of the TSV off-gas system and release into the TOGS shielded cell. And the maximum inventories were assumed in the TOGS, similar to the other events, ten percent over power occurred right at the end of the cycle right at the end of the irradiation cycle and it occurred while we're still irradiating.

And the bound to possible release inventories for this event, we take all the noble gases that are in the solution and we assume they're all available for release. We're assuming they're all moved to the gas base and are released when the

event occurs. So, it bounds any possible partitioning fraction between the liquid and the gas space for the, for the noble gas. And the noble gases are a large part of the dose which is why I mentioned that.

Okay, next slide?

MEMBER STETKAR: And, Eric, before you -- because I have to call myself as much as I call anybody else, you did look at breaks of the feeder line that do come into the facility at around the pressure regulator location that's some distance from the actual entrance to the facility? But, I was incorrect when I said you only looked at the big pipeline on the side of the highway.

MR. VAN ABEL: Okay.

MEMBER STETKAR: I just want to make -- for the record.

MR. VAN ABEL: Yes.

MEMBER STETKAR: You did look at some of the smaller line breaks.

MEMBER BALLINGER: But, again, it's not a line break, it's a leak.

MEMBER STETKAR: No, it's -- these are external to the facility.

MEMBER BALLINGER: Yes, yes.

MEMBER STETKAR: But they're in that line.

MR. VAN ABEL: The figure on the screen now in Slide 68 shows the arrangement of the major systems involved here.

The TSV off-gas system is in green and the shielded cell on the left.

The release of off-gas occurs from the TOGS equipment within the shielded cell. There's a silver zeolite bed within the TOGS system that is assumed to retain 95 percent of the iodine in the gas stream. And that's, just to follow up on previous points, that's the calculation at will be done in detail design, you know, based on reviewing literature, that seems to be an appropriate factor, but that is something that we will have to perform the calculation for detail design.

The release of material into the air is transported into the exhaust duct work and that actuates the alarm in the ESFAS actuation.

Twenty-five percent of the activity enters the shielded cell and ten percent is released through the penetrations for evacuation and the one percent of the material bypasses the bubble tight isolation dampers and is released into the exhaust

duct work on the way to the stack.

Charcoal absorbers in the exhaust duct work are credited for removing 95 percent of the halogens, similar to the previous accidents. And, the HEPA filters, of course, are present but they're not credited for any removal.

And the dose is calculated to the worker at 1.9 rem and the dose is calculated at the site boundary for the public are 16 millirem.

Next event is large undamped power oscillations. So, the TSV will experience power oscillations due to the activity variations in the system and variations in the neutron driver output.

The power oscillations are small and self-limiting and the enhanced nuclear design characteristics, the very loss of negative temperature and void coefficients ensures that inherent stability.

Also, aqueous reactor stability has been demonstrated at power densities of 1.87 kilowatts per liter. SHINE is significantly below this. We can discuss that in the closed session with questions on the actual numbers.

Also, we worked with Los Alamos National Lab and Los Alamos National Lab reviewed accelerator

driven fissile solution systems and did a linear stability analysis and found them to be unconditionally stable based on the analysis.

And, we estimated the oscillations in the system that could occur and provided those numbers to the staff and we plan to perform a detailed transient analysis with the transient analysis code with the FSAR.

The next event is deflagration or detonation in the primary system boundary. There's a potential for failures of the TOGS components, failures of the blowers, flood zeolite beds, partial failures due to partial blockages of pipes and loss of recombine or functionality.

Those events were conceptual. The most limiting event was found to be blockage and a complete blockage of the connection to the TSV. And the calculation of the hydrogen concentration from that event was approximately 6.7 percent hydrogen during that event and the maximum deflagration pressure was less than 50 psi, it was approximately 31 psi.

And, the design pressure of the components will be greater than the credible deflagration pressure. And, we're currently looking at a design pressure of approximately 100 psi.

MEMBER STETKAR: Eric, I'm not an expert on burning or detonating hydrogen, so I'll defer to other folks who know about that stuff.

But, it strikes me that you're very careful in the PSAR to make statements about does it line against maximum credible hydrogen deflagration pressure and not saying against the detonation pressure.

MR. VAN ABEL: Yes, that's correct. And, we have no scenarios that we analyzed and we're working on safety systems. I'm sure we don't get close to a detonation. There's a threshold for detonation that's higher that you can burn hydrogen at. It's usually in the teens, depending on your air and oxygen and we're significantly below that and we have no events where we --

MEMBER STETKAR: So, a detonation is not a credible event in your estimation?

MR. VAN ABEL: Correct.

MEMBER STETKAR: Anywhere in the facility?

MR. VAN ABEL: I mean -- yes, correct.

MEMBER STETKAR: Okay.

MEMBER POWERS: There is no threshold for detonation. Detonation depends on geometry as well

as concentration.

MR. VAN ABEL: Yes.

MEMBER POWERS: I tend to agree with you, I don't have a detonation threat here, but you can't do it based critically on concentration. You've got to look at what your capability is to get a deflagration to detonation transition.

MR. VAN ABEL: Yes, I mean geometry definitely plays a role and limits your capability to have any detonations in certain systems if you're smaller than the detonation cell sizes. You can't have any detonations.

I think there is -- and I don't want to go into too much details on that, I'm not a hydrogen expert and I rely on other people to provide that analysis. But, from -- well, we don't have that potential for detonation in our system.

MEMBER POWERS: Let's just say when you look at deflagrations, I have assumed, based on your pressure changes, that you're looking at something less than ten percent hydrogen in your detonation, more like eight percent or something like that.

MR. VAN ABEL: For detonation potential on hydrogen?

MEMBER POWERS: Deflagration --

MR. VAN ABEL: Deflagration?

MEMBER POWERS: -- pressurizations. I mean just the numbers you've been quoting suggest to me you're looking at burns of like eight percent hydrogen?

MR. VAN ABEL: Yes, 6.7 percent was calculated.

MEMBER POWERS: Seven percent? Okay.

MR. VAN ABEL: For this maximum event.

MEMBER POWERS: Yes.

MR. VAN ABEL: Yes, there's a pressurization that's a function of hydrogen concentration in the event.

Next slide?

The next accident category is unintended exothermic chemical reactions other than detonation. Other chemical reactions were looked at in the Integrated Safety Analysis.

There's no chemical processing that occurs within the primary system boundary. We moved this batch of target solution into the TSV. We irradiated it and then it's transferred out of the irradiation facility. So, we don't process it on this side of the facility.

The target solution is uranyl sulfate.

There's no potential for exothermic chemical reactions of the solution itself from irradiation.

There's, during start up on irradiation modes, and administrative controls prohibit storing or presence of chemicals in the irradiation facility, except in the IU cells, except those required for normal operation.

And, there is no credible path identified to have high temperature reactions between steam and Zircaloy in our system. As we all know, Zircaloy can react and product exothermic reactions in hydrogen in certain conditions.

MEMBER POWERS: Well, to be sure, we've had accidents in which we've had zirconium alloys both in the air. I don't think we have that problem here because you're low surface to volume ratio but you don't have to think about Zircaloy steam, you can think about strictly Zircaloy air.

MR. VAN ABEL: Was it chips or fines of some sort?

MEMBER POWERS: Typically high surface area and they have to be wet.

MR. VAN ABEL: Okay.

MEMBER POWERS: And things like that. I mean we've --

MR. VAN ABEL: Yes.

MEMBER POWERS: -- had those accidents. I've had one of those accidents.

MR. VAN ABEL: Okay.

MEMBER POWERS: So, clearly aware of that. But, I don't think it's -- I mean --

MR. VAN ABEL: An issue with this vessel, yes.

MEMBER POWERS: You're fairly low surface area to volume claims of Zircaloy.

MR. VAN ABEL: Yes.

Okay, on the next category of system interaction events, we looked at functional interactions, spatial interactions and human intervention interactions.

There's a number of shared systems, as we've mentioned. There's shared electrical power systems, cooling systems, ventilation systems, fire protection and noble gas storage and they were evaluated for interaction effects.

The system interaction events did not result in a safety system failing to perform its safety function or they were analyzed already by other DBAs. And, there were no radioactive releases that were a result of these private system boundary

interaction events.

MEMBER STETKAR: So, because we don't have access to the ISA which actually generated all of these things, I have to try to ask questions.

Of the systems like the target solution vessel process control system, TPCS, controls all operating modes for all of the irradiation units, single system. It's digital. It's in cabinets, all the cabinets are in the same room.

We talked this morning about failures of things like room cooling ventilation or faults even within that system. Did you examine that type of interaction? And, if so, is it documented? Obviously, we can't see it because we can't see the ISA, but I didn't see any evidence of it.

MR. VAN ABEL: Yes, I don't know for the control system how the analysis looked at that.

MEMBER STETKAR: Okay. And, the question extends to several of these things. The protection system itself --

MR. VAN ABEL: Yes, the --

MEMBER STETKAR: -- is integrated among all of the irradiation units and it's solid state digital protection system.

MR. VAN ABEL: Yes.

MEMBER STETKAR: Suppose it goes nuts? I'll use the technical term. Seriously, did you look at faulty faults within the integrated protection and control systems themselves in addition to these environmental factors like loss of all chilled water or loss of ventilation or fire effects in those rooms that I talked about earlier?

There doesn't seem to be any evidence of that in this discussion of system interaction events. They're not mentioned in the PSAR as a class. You mention loss of offsite power because, you know, everybody knows you have to look at loss of offsite power.

MR. VAN ABEL: Yes.

MEMBER STETKAR: You look at, you know --

MR. VAN ABEL: For the common systems --

MEMBER STETKAR: -- other cooling systems.

MR. VAN ABEL: Yes, for cooling systems.

If we lost cooling for the IU cells, they would shut down. They would all trip on their own trip signals --

MEMBER STETKAR: Yes.

MR. VAN ABEL: -- or --

MEMBER STETKAR: Suppose the loss of

chilled water to the whole plant, what happens to the whole plant?

MR. VAN ABEL: The -- well --

MEMBER STETKAR: The whole plant?

MR. VAN ABEL: Yes, the irradiation processes are all shut down. We haven't identified any other processes in the plant that require chilled water. They would be shut down --

MEMBER STETKAR: Oh, I'm sorry, the ventilation system requires chilled water.

MR. VAN ABEL: For safety functions.

I mean, I wasn't going to go into the ventilation system.

MEMBER STETKAR: Is the TOGS system operated from, for example, the integrated control system? Is that cooled by a ventilation system? It's cooled by chilled water. Does the TOGS system have to remain operating even after you shut down all of the irradiation units? Did you think about that?

MR. VAN ABEL: Yes. The flux for the control system design, we need to define the mission time first of all. We need to define, as part of what we discussed earlier, is we have to determine how long hydrogen recombination needs to occur by active means on the TSV off-gas system.

And then we'll have a requirement for the duration of that electronic PFC function.

MEMBER STETKAR: See, I'm not talking about a duration before the electronics goes dark as if I turn off the off button here. I'm talking about a situation where the electronics gets warm and starts to give you funny signals like your screen coming on and screen going off.

MR. VAN ABEL: And, the analysis that we plan to do during detail design is look at what the heat up will be in that room.

MEMBER STETKAR: Okay.

MR. VAN ABEL: Determine what we need for cooling in that room and we'll have some form of safety-related cooling, whether it be passive cooling -- you know, there's a huge concrete heat sink there, there's two feet of concrete everywhere. So, there's a huge passive heat sink there.

If we need to, we'll put in an active safety-related cooling system to provide cooling to those rooms and ensue that those systems can perform their safety function for the duration of the event.

MEMBER STETKAR: Okay, thank you.

MR. COSTEDIO: And, that was all documented in an RAI response. There was an RAI and

we documented all that.

MEMBER STETKAR: Yes, we have to apologize. You know, there are tons of RAIs.

MR. COSTEDIO: This is 3.5-7.

MEMBER STETKAR: 3.5-7, thanks.

ACTING CHAIRMAN BLEY: And now, it's on our transcript.

MR. VAN ABEL: Next slide, Jim?

We also looked at facility-specific events. We obviously have some unique systems in the SHINE facility. So, we looked at the unique events that could occur there during the ISA process.

One of the categories is inadvertent exposure to the accelerator of radiation fields. So, there's potential for someone getting into the IU cell inadvertently during operation or the accelerator being energized while someone is in there performing maintenance or other operations.

The significant shielding on the cell and the access door is interlocked so the accelerator cannot be energized should the door be opened. So, the accelerator can't be energized.

In addition --

MEMBER SKILLMAN: Excuse me. How is that protection provided, particularly during the set and

establishment of the proper geometry at the very outset of the, if you will, the configuration of the facility?

You're finding that all of your equipment and technicians are in there hooking this device up. They're hooking high tension wires. They're hooking switches and that type of thing. What prevents there from being an inadvertent energization that could then irradiate a man or woman who's working there?

MR. VAN ABEL: You have the work sequencing needs to be set so that the interlocks are present before you're applying high voltage to the system -- to the accelerator. I mean that would part of our commissioning process that we go through.

Do you have anything?

MR. HENNESSY: Well, in addition to that, we would have a clearance and tagging process so that people working on equipment would be protected by a clearance lock out, tag out.

MEMBER SKILLMAN: Okay, thank you.

MR. VAN ABEL: All right. There's also visual and audible warnings, pre-actuation warnings to indicate that the accelerator's coming on to alert personnel key switches that deactivate the accelerator and local shut off switches to shut off

the accelerator if need be.

And then, that further reduces the potential for inadvertent radiation exposure.

The irradiation facility fire event was evaluated and this could occur due to malfunction equipment, loss of combustible or ignition control, hydrogen release from the tritium purification system or spread of fire from the RPF spreading into the IF.

The facility fire detection and suppression system detects fires within the IF and initiates isolations of the fire area and then combustible loadings are limited throughout the IF to reduce consequences of a fire.

The tritium inventory in the tritium purification system is less than that. That would cause the LFL to be exceeded in the glovebox. In addition, the gloveboxes also inerted, so there is no oxygen available.

MEMBER SKILLMAN: Eric, talk a little bit about a fire outside the facility. You have your Zone 4 that's brining in air and pressurizing the facility for occupants use. What if you have an airplane crash in the dead of August when all of the grass around the facility is just dry as can be and you end up with a grass fire that's 10 or 15 acres

and it's really out of control and your facility is under a smoke cloud?

MR. VAN ABEL: We did look at external fires in Chapter 2, I believe. Do you remember?

MS. KOLB: We didn't analyze a smoke cloud coming into the facility. We analyzed a toxic gas release, as we talked about before, but not smoke. You know, an unlimited large amount of smoke, we didn't analyze that.

MEMBER SKILLMAN: There have been several incidents where that has occurred at nuclear power plants. And, the grass fire turned out to be the least of the concern. The greater concern was the conductivity of the combustion product of the high tension lines that caused arcing from the lines to the ground.

But, I would offer that a large grass fire might be something you may wish to consider. It is probably less a threat than gas release of some chemical. But, I would think you might want to look at it.

Thank you.

MS. KOLB: Thank you.

MR. VAN ABEL: Thanks.

All right, the IF boundary and

components, the doors, the penetration seals and dampers are fire rated as well and there are no unique -- no consequences identified from fire events.

The next slide?

And then, finally, the mishandling and malfunction of the equipment in the treating purification system was analyzed. And, that was looked at for potentials and failures of piping, processing equipment malfunctions, fire or human errors in the treating purification system.

The ~~treating~~ tritium supply and return lines are in double-walled pipe and those lines are all ~~soft-rated~~ sub-atmosphere so the tritium within them is sub-atmospheric, so if you have a leak you tend to have ingress rather than egress of tritium and they're in double-walled pipe.

The TPS glovebox and double-walled piping are inerted with nitrogen and there's automatic isolation valves that isolate the tritium supply should a leak be detected and loss of system integrity.

The limiting event was determined to be a loss of all the tritium from all the eight neutron drivers and the simultaneously and that tritium's

released into the IU cells. The high radiation or other actuation signal activates the bubble tight isolation dampers which seals the IU cell. And up to one percent of the released material bypasses isolation dampers to be released.

Alarms notify personnel and evacuation is assumed within ten minutes, as described before.

It should be noted on this event that there's no credit taken whatsoever for the IU cells and the fact that IU cells are there and they actually contain the tritium. It's assumed the workers are exposed to that tritium that's released from the IU cells, so the worker dose would be much lower.

The worker dose is calculated to be 2.4 rem and the dose at the site boundary was calculated to be less than 1 millirem from the event.

MEMBER SKILLMAN: Eric, I'd like to ask this. Right from the beginning of this presentation, the emphasis on the bubble tight isolation dampers has been prominent. It is identified in almost every scenario. Hence, the capability of this prospective equipment is a critical feature in the safety of this facility.

My question is this, is there hardware existing today that will meet the functional

performance requirements that you are anticipating that equipment will need to fulfill?

MR. VAN ABEL: We haven't selected bubble tight dampers from my knowledge. Yes, from talking to the HVAC engineers and looking for myself, these are off-the-shelf components.

MEMBER SKILLMAN: Well, I was looking for more than that. I would think that there would be great certainty within the SHINE organization that components of the quality requirements that are essential and the bubble tight capability that allows you to make the assumptions, particularly regarding the public exposure, that you know that hardware is available right now and it's mighty good hardware. It's from a vendor that is known to be able to supply, I don't know whether it's a hospital type or a nuclear grade facility or, you know.

But, when you're talking about bubble tight of any diameter, ensuring no flow leakage becomes a real challenge. It has to do with the seals. It has to do with the way in which the valves -- the dampers are closed, how they are mounted, what their operators are designed to do, what the time function is.

So, it is not an easy task to get very,

very low leakage HVAC dampers. So, I'm curious who's on your list? That's for a different discussion, but tracking this hardware down is a major task.

Thank you.

MR. VAN ABEL: Thanks.

MEMBER BALLINGER: We tend to focus on the irradiation issues related to the tritium. Tritium being hydrogen, in effect, or like hydrogen.

The fact that you have a low pressure on the inside and a high pressure on the outside has nothing to do the diffusion rate of tritium which goes from high concentration to low concentration.

MR. VAN ABEL: Yes.

MEMBER BALLINGER: And so, and I'm assuming the piping and stuff is, you say, double-walled, but also austenitic? Stainless steel?

MR. VAN ABEL: Yes, it's not selected yet.

MEMBER BALLINGER: Well, the diffusivity in austenitic stainless steel is 10 to the third lower than a ferritic material. So, I would be a little bit careful about tritium release in the long-term, small as it is, just by literally migration through the system.

MR. VAN ABEL: Yes.

MEMBER BALLINGER: Because tritium replaces hydrogen in water. Water gets absorbed by humans and cells that have tritium instead of hydrogen don't work.

So, it's an MSTD for D2 deuterium says there's no issue except if it's ingested or if it's combined in, you know, with oxygen.

So, I don't know how the tritium concentrations will be over the long-term, but sooner or later, if you're not careful and you have ferritic materials or other kinds of materials that are not austenitic, then that tritium will diffuse.

MR. VAN ABEL: Yes.

MEMBER BALLINGER: Yes.

MR. VAN ABEL: I'll just make a couple points. The low pressure there is a safety feature for detecting releases and preventing --

MEMBER BALLINGER: Okay.

MR. VAN ABEL: -- a large egress of tritium, not to prevent diffusion.

The lines are double-jacket and those space between the jacket goes back to the glovebox and it's swept so that the tritium that diffuses out of that inner pipe will be swept in the glovebox and captured by the glovebox cleanup system.

And, we're working with Savannah River National Lab is doing a lot of our work on the tritium purification system.

MEMBER BALLINGER: They're the right people, yes.

MR. VAN ABEL: All right, that's all I have.

ACTING CHAIRMAN BLEY: You're probably going to be half an hour, forty-five minutes?

Why don't we take a break now? We'll take a break now, come back at 3:15 and we'll continue on.

(Whereupon, the above-entitled matter went off the record at 3:00 p.m. and resumed at 3:18 p.m.)

ACTING CHAIRMAN BLEY: We'll come to order.

All right, I think we're ready to go to the irradiation facility accident analysis that the NRC performed. And our friend will address that.

MR. LYNCH: All right, thank you. I'm Joe Staudenmeier. Also present today is Mike Salay with -- Is that better? Okay.

I'm Joe Staudenmeier. I work in the Office of Research. I also have some people that did

part of the review with me. Mike Salay is here to answer some source term questions, if any come up. And Sami Sherbini did the dose calculation review. He's not here but one of his colleagues, Tony Huffert, is with us here if any questions come up about that.

The accident analysis, what I see the purpose of that: identify and analyze postulated accident scenarios that are representative of the range of events that are possible in an operating facility for the purpose of a construction permit;

Identify and analyze challenges to the safety systems and the defense-in-depth features of the design of the accident scenarios;

Identify design features and procedures needed for prevention and mitigation of potential accidents;

And establish safety limits for facility operations and a technical basis for control of those limits through technical specifications.

Regulatory basis and acceptance criteria, regulatory requirements 10 CFR 50.34, for PSAR, 10 CFR 50.35 for issuance of construction permits, acceptance criteria, NUREG-1537, and the ISG Part 2, that was the

build we were using.

The ISG wasn't specifically developed for the SHINE facility. What we had in mind when we were developing that was actually a critical solution reactor vendor that was going to come in with that. Decided not to. But it was somewhat applicable since they were both aqueous systems that we were using that as guidance. There are some unique features of SHINE that are not part of the critical reactor and would be separate, like the accelerator.

There was a review, identification and analysis of possible accident scenarios, identification of source term and calculation of doses.

We tried to do a thorough complete section-by-section evaluation of the material presented in the PSAR and tried to compare that to things in other chapters of the PSAR, like definitions of system structures and components. For instance, the ventilation system was part, has connections to this review of the accident analysis. Answered RAIs where things were not clear to try to get additional information.

This 13a is for the irradiation facility. The irradiation unit configuration, the SHINE IUs are accelerator-driven and sub-critical. The target

solution vessel is submerged in a fairly deep light water pool and located directly beneath the neutron driver assembly.

The off-gas treatment system was in a separate concrete chamber that's within the main assembly of this Irradiation Facility.

MEMBER STETKAR: I don't think it makes any difference to mention anything, but in the SER you state that the off-gas ~~solution~~ system circulates nitrogen gas through the TSV. I don't think that's true.

MR. STAUDENMEIER: No, it isn't. It's an error I saw in the last ACRS meeting. I think I had some earlier discussions. I think we talked about inert atmospheres and it wasn't specifically stated in the --

MEMBER STETKAR: I don't think it affects any of the accident analysis or your conclusions.

MR. STAUDENMEIER: So I mean it's a little more inert without the oxygen in there, if it's pure nitrogen.

MEMBER STETKAR: That's what I was concerned about.

MR. STAUDENMEIER: -- are there. I don't think it will affect any -- the accident analysis.

Places where there are significant radioactive inventories: the neutron driver and tritium purification system. There's tritium. The target solution vessel and dump tank contain the irradiated target solution. The gas management system can contain noble gases and iodine, and the zeolite ~~observer~~ adsorber in there can also have iodine inventory in that.

Reviewing accident scenarios. SHINE had a comprehensive set of generic and facility-specific events that they considered. And then proposed an MHA that bounds all accidents. MHA, as described by SHINE, it's an instantaneous dump of target solution into the pool but no credit is given for the pool being there and retaining any fission products or storing the release of any fission products.

MEMBER STETKAR: We've kind of danced around this issue, and I wanted to wait until you came up because the Staff in the SER makes a very definitive statement. You state that "The Applicant has considered the consequences to the public of all critical accidents at the reactor facility." Now that's, that's off accident because it says "all" and it's all critical.

So I'd like you to explain a little bit

more so that we understand how they considered all accidents that are critical. Because Staff has asserted this. They didn't assert that. The Staff in the SER, which is a public document that the public's going to read. And the Staff is saying that they've done a complete assessment. It's critical. So what's critical? And how are you assured that they evaluated them all because the Staff has made that statement?

MR. STAUDENMEIER: Okay, that's maybe a statement that is saying more than it should. That's why I would change it to maybe representative set.

MEMBER STETKAR: I don't know what you'd change it to but if I'm a member of the public and I read an NRC Staff safety evaluation that uses this very definitive term on what is a very high confidence level in the completeness of you review, and I don't see that myself.

MR. STAUDENMEIER: Okay. I mean you can always come up with something more severe than the accident they evaluated. You could say, oh, there's some big explosion that disperses up, TSV's full material up into the atmosphere at once.

MEMBER STETKAR: But you've characterized it as credible. I'm questioning whether they've

evaluated all things that are even credible.

MR. STAUDENMEIER: Well, there's an infinite number of sequences that are credible. I think you kept all categories that seem to be possible events in the facility, so. Is there some specific thing that you think --

MEMBER STETKAR: Yeah.

MR. STAUDENMEIER: -- hasn't been analyzed as credible.

MEMBER STETKAR: What's a chilled water resulting in loss of ventilation causing all of the control and protection cabinets to overheat, causing unidentified spurious signals that I don't know what will happen because I haven't seen anybody analyze it? That's one.

MR. STAUDENMEIER: Okay.

MEMBER STETKAR: Factors in one of the rooms causing high temperature and smoke problems in said cabinets. That's another. I mean I can, you know, I can list a bunch off the top of my head. And I don't even know much about the facility.

MR. STAUDENMEIER: Yeah. I guess the question is are the consequences of that bounded by the MHA or not?

MEMBER STETKAR: Frequency and

consequences if we're talking about risk, which is ultimately what we're talking about.

MR. STAUDENMEIER: Yeah. But I mean to get consequences you have to disperse the radioactive fluid. I don't think those things that you mentioned are going to cause breach of boundary and loss of radioactive fluid. But maybe there's some way to do that, if you go down there eventually and see what happens.

ACTING CHAIRMAN BLEY: It's really hard to say unless you look.

MR. STAUDENMEIER: Yeah.

ACTING CHAIRMAN BLEY: It is. And the ones John mentioned, when you get control systems that might do anything, open valves, close valves, start things, stop things, you know, what's the answer --

~~MEMBER~~ Mr. ADAMS: I think you've given us a lot of food for thought here and we're going to go back and think about that. My whole point is that this is a construction permit. And Staff already has said that they need to beef up some stuff in the final, in the FSAR.

On the other hand, making a safety conclusion at this stage that they've evaluated

everything, and the Staff agrees with it, is a very, very strong regulatory statement, statement to the public.

MEMBER STETKAR: Agreed.

~~MEMBER~~ Mr. ADAMS: And that's the only thing I'm challenging. I'm not trying to identify specific scenarios that may or may not have been evaluated, and the frequency, all the consequences of those scenarios. I guarantee you some things haven't been evaluated.

MR. LYNCH: I agree with you. That one would need to be adjusted to more appropriately reflect the --

MEMBER STETKAR: Because it is, they are pretty careful in the PSAR is looking for those sweeping statements about all and everything, and they're pretty careful in the PSAR. It's the only place that I could find that that absolutely inclusive statement is made.

MEMBER SCHULTZ: Sets a precedent for what you are going to do next. And you don't, you don't want to do that. It's best to describe what you in fact have done and what you have to do.

MR. LYNCH: Understood, yes.

MEMBER REMPE: So as a matter of process

we have a couple more meetings and then we'll have a full committee meeting and we'll write a letter. Will we have something that reflects what I think you said, "I think I might change this," or something like that, or just the PSAR that we should reflect our thoughts on for the letter?

MR. LYNCH: We are working on updating the SER right now.

MEMBER REMPE: Oh, the SER.

MR. LYNCH: Yes. You will have an updated version in September.

MEMBER REMPE: Okay, thank you.

MR. STAUDENMEIER: Yeah, there's actually some updates for this chapter that need to be done based on responses.

MEMBER REMPE: Thank you.

DR. GAVRILAS: This is Mirela Gavrilas of the Staff. We owe the committee I think 31 days before the full committee meeting the documentation that supports that meeting. That's when you'll have --

MEMBER REMPE: Okay.

DR. GAVRILAS: -- a final draft.

MEMBER REMPE: Thank you.

MR. STAUDENMEIER: Design

characteristics ~~of~~ that impact accidents. Facility has low power density, low total power and low pressure.

There's a large passive heat sink to store decay heat. And no large thermodynamic to drive the type of large energetic release that could occur in a power reactor.

Release pathways. It's a fairly simple system. Releases to liquid and gas spaces in the irradiation unit were considered. Once you dump it into the irradiation unit there's pathways to RVZ1 through both a filtered ventilation system and leakage paths.

Isolation dampers close the regular ventilation system pathway after a high radiation signal, leaving only leakage pathways.

There are filters in that ventilation system pathway that no credit has been given for in the dose calculations. No credit for iodine retention in the pool. And release to the environment from RVZ1 is through a filtered ventilation system. And there's no filter on the project for noble gases or tritium.

Dose calculations for workers in the facility. There's a worker evacuation time that was

assumed that will have to be verified with the final design and procedures for evacuation and pathways evaluated.

I think SHINE mentioned that there's, they think there's quite a bit of conservatism built into that assumed evacuation time.

There's doses for members of the public at the site boundary and members of the public at the closest residence. It uses 10 CFR Part 20 for dose limits: 5 rems for workers and 0.1 rem for off-site doses.

And some of the worker doses for the accidents I mean are a considerable fraction of 5, but the public doses are way below the off-site dose limits.

The review areas deferred to the Operating FSAR. Some other analyses that are going to need to be done: the licensee in the PSAR having demonstrated primary pressure system boundary integrity after a hydrogen deflagration or detonation. And due to failure of keeping the TOGS below the lower flammability limit.

There is another thing, the TOGS I think was discussed before, that radioisotope processing cooling system cools all the TOG systems. We had a

concern about if you lose that will the TOG system integrity survive or will after some time if you lose off-site power will it cause a release, turning one type of event into another event where you have the release. We have to come back with an analysis or demonstration that the TOG system could survive loss of this cooling system for the operating license.

And for the doses, SHINE has committed to coming back with age-dependent doses and pathways for doses to the public.

Findings and conclusions. Believe the applicant has proposed and analyzed a set of accidents that should be representative of the possible range of events that may happen in an operating facility.

The analyzed set of accidents provides insights into the challenges to the safety system and defense in depth features of the facility. And as they've identified, there are mitigation features, procedures, trained personnel actions that can help mitigate accidents.

The proposed features of design, including the engineered safety features, keep the radiation doses below acceptable limits and adequately protect the workers and public for all proposed accidents.

One thing to keep in mind here, a lot of the dose calculations are based on specifications of leakages and penetrations and filtering efficiencies and release fractions. And one thing we've discussed with them that these are really specifications that the final design is going to have to meet. I think someone brought up before you're going to have to procure parts that meet these release fractions like these ~~bubble-type~~ bubble-tight dampers or filters, either HEPA filters or charcoal filters that can actually meet the assumed specifications for the safety analysis.

So based on all of that we conclude that the proposed preliminary accident analysis and engineered calculated -- the calculated consequences show that the design, including the engineering safety features, adequately protect workers and the public. And accordingly, they've met the requirements of -- for construction permits that they've proposed and analyzed of set of representative accidents.

They're allowed to not have final design for all the parts but they do have to consider that they can procure parts that meet some of these assumptions or else they're going to have to change

the design and analysis. This is similar to Part 52 requirements for standardized designs. Not all the parts are designed when you give final design approval for power reactors under Part 52. So it's similar to that. I'm sure you're familiar with that since with all the design approvals. It's actually less prescriptive than Part 52 is in terms of that because they can still be doing research on systems and don't have to -- just that they have to have an idea to go forward with that and do additional research.

And as they said, they are doing, there is research being done in some of the areas by some of the national labs. And that's still ongoing.

They have identified to use safety features or things that are still ongoing in research. And we think the proposed facility can be constructed without undue risk to the health and safety of the public.

Any questions?

~~MEMBER~~ Mr. ADAMS: I'd like to add just one thing. We talk about the does limits. And in Part 20 there is the public dose limit of 100. But there's also in Part 20 under certain circumstances a 500 limit, which was the old Part 20 limit. And we've used that before for accident analysis on

research reactors when we were over 100.

So, you know, if at the end of the day when we, you know, analyze everything, if the 17 millirem number from the MHA does hold there is some, you know, considerable margin between where the design is at and where the 500 limit is at. So there is, there is some, you know, there is some margin available there as the design moves forward and gets finalized.

ACTING CHAIRMAN BLEY: Anything from the members?

MEMBER REMPE: Yeah. Again a lot of this is just educating me. But I mean John pointed out the pretty strong statement or a strong statement at the beginning, but at the end of this graphic the staff concludes that the potential specifications that they're proposed to be adequate for operation of the features.

And so what I want to know, did you actually go through their calculations on certain cases and you spot checked it? Did you do independent analyses? Have you looked at the many stuff going on at Oak Ridge and Argonne, even though the final reports aren't up, aren't available, but you've concluded, yeah, the approaches that they've taken is

the appropriate scale and duration and things like that? How much, how deep in the weeds are you and then do you plan to get deeper in the weeds of independent methods for evaluations of the work when they come in for the FSAR?

MR. STAUDENMEIER: We're going to do some independent evaluations when they come in for the operating license, yes.

MEMBER REMPE: So basically you've not validated, or verified I should use, the separate steps or the functions to say those are adequate even at this point?

MR. STAUDENMEIER: I mean in terms of some things that they've done, we've looked at what they're using for like gas generation assumptions. There's some Argonne tests going on looking at that. I've reviewed some of the papers that they've published and had on conferences.

The Oak Ridge work I haven't looked at all. I'm not a materials person.

MEMBER REMPE: But other staff has?

MR. STAUDENMEIER: That would be under the structures and components people. I'm reactor design. I don't think anybody though has looked at the Oak Ridge stuff, but.

MR. LYNCH: Maybe your colleagues can speak to this, but I did know that when we were working, we did work with some of our reviewers that were looking at effluent releases. And we did ask SHINE to submit calcula -- their calculations --

MR. STAUDENMEIER: Yes.

MR. LYNCH: -- for those effluent releases and Chapter 13. So we did look at those calculations.

MR. STAUDENMEIER: Yes. Sami Sherbini looked at some of the dose calculations, so.

MR. HUFFERT: Hi. I'm Tony Huffert. I work with Sami Sherbini in the Office of Research. Yes, not only the NRC but also those seasoned contractors took a look at the output from the SHINE calculations. We saw that there's a 10-page output with nothing but numbers to make sure that what the values were by column made sense.

And what we've asked for SHINE to do for the final calculations is to sharpen the pencil when it comes to some of the radiation dosimetry calculations. Specifically, updating to ICRP-72 dose coefficients, making sure that some of the parameter values that they selected for the calculations are defensible, the respirable fraction in particular we

asked about. And there's a list of other things related to chi over q, d over q, some of the partitioning of different iodine issues that would be important for those calculations.

And SHINE has agreed that they will come back to us with a laundry list of changes. And we consider it acceptable for the construction permit at this time, what they've done so far.

MEMBER REMPE: So then to kind of summarize then, basically you believe the Staff has looked at what they've done for the cases they've analyzed, and if they can verify that the filters work efficiently and everything like that, and that the new dose ICRP accepts, you'd feel happy with the requirements and assumptions they've made if they can validated it?

MR. HUFFERT: I can only speak to the radiation dosimetry calculations because that's my expertise. What leads up to that as far as the source term generation assumptions, that's another part that we -- I was not involved in.

MEMBER REMPE: Right. Well, I realize Staff reported with a little pause, but again, the SE has to, somebody has to say, yes, the Staff has looked at this and they feel comfortable with it. Again,

you may pick a different scenario or something like that, you know, --

MR. LYNCH: Yes.

MEMBER REMPE: -- from what I've listened to today. But for the MHA that they've picked you feel comfortable with it?

MR. LYNCH: Yes. Some of that's based on, as I was saying, the margin that we have with what they're saying their release here is marginable but looking for release on spec. That's where some of our comfort comes from.

MR. STAUDENMEIER: Yeah, there's also an accident similar to the MHA where they did take into account more realistic assumptions and mitigative actions and the doses are significantly below what the MHA accident lists.

MEMBER REMPE: Again, some of the RAI exchanges give me some comfort level. But what I read in the SE didn't really get into that level of how much review was really done by the Staff. And maybe it's just I didn't read it carefully enough or something, but I just didn't get that impression.

MR. LYNCH: We can make sure to clarify.

MR. STAUDENMEIER: Yeah, and source term, I mean Mike Salay is over here if he wants to say

anything.

MR. SALAY: Hi. This is Mike Salay. Yeah, we did look over the source term calculations. And mostly they are specifications for filters. Yes, so if you start with the release calculations from the water, okay, in solution then if their filters work as specified and everything, yes, then you've been through the calc, yes, it comes out with a release that they accept.

MEMBER REMPE: Okay. Thank you.

MR. STAUDENMEIER: Yeah, and for that --

MEMBER POWERS: Where are the accidents we're going to be doing?

MR. STAUDENMEIER: We started looking at our own reactor because it's the type of calculations we're looking at, the activity insertions, things like that, for independent analysis.

MEMBER POWERS: Where are they getting their release of the noble gases that are not retained, and by assumption they don't retain iodine, is that correct?

MR. STAUDENMEIER: Yes.

MEMBER POWERS: What else do they release?

MR. STAUDENMEIER: There's a list of all the source term. Yeah, I couldn't --

MEMBER POWERS: But the mechanism for that release, is that primarily, what, a droplet entrainment or is it just imagined because it's a release?

MR. STAUDENMEIER: It's, yeah, just a contrived release, non-mechanism specific.

MEMBER POWERS: So non-physical source term. Makes it awful hard to design if it's a non-physical source term.

MR. STAUDENMEIER: I mean we're going to look at some more physical release, release mechanisms. And I think when we do that we're going to find that there's significant conservatism in what they're seeing.

MEMBER POWERS: It's a HEPA filter protected system. And so your focus then depends on the care and feeding of HEPAs.

~~MEMBER~~ Mr. ADAMS: And design features like that become many tech specs on the care and feeding of the filters.

MEMBER POWERS: Yes. I mean that's all it is, do they have leakage --

~~MEMBER~~ Mr. ADAMS: Leakage is, you know, is the charcoals can still absorb iodine. You know, testing on that on a regular basis.

MEMBER POWERS: Right.

~~MEMBER~~ Mr. ADAMS: Yeah, those filters play a big role in the assumptions that go into the analysis.

MEMBER POWERS: Right. And the loading is never going to be very big here. More problematic to work on the process facility. Because you get obnoxious things coming out.

MR. STAUDENMEIER: Yes, and I guess, yeah, one thing the doses from the process, the accidents are bigger than the radiation facility accidents.

MEMBER POWERS: Right.

ACTING CHAIRMAN BLEY: Anything else from the committee?

(No response.)

ACTING CHAIRMAN BLEY: I guess we're ready for the next topic.

MR. HENNESSY: Next up is technical specifications. I'm Bill Hennessy and I will be discussing that.

In accordance with 10 CFR 50.34, SHINE has identified the variables and conditions that will likely be the subjects of our tech specs. In accordance with NUREG-1537, our tech specs will be written using the guidance of the ANSI Standard 15.1,

development of tech specs for research reactors.

Our tech specs will meet the regulatory requirements specified in 10 CFR 50.36, and the complete set will be submitted with the operating license application.

Within our tech specs we will specify safety limits. The variables and conditions that are likely subjects of our safety limits right now are TSD power, uranium concentration and enrichment, and quantities of radioactive materials, and limiting safety system settings which right now we've identified TSD covered gas and concentration and neutron flux high both in the source range and the high range.

MEMBER STETKAR: How did you settle on the three, and only three, limiting safety system settings? Because there are many other inputs to the protection systems, for example. Why those three and only those three?

MR. HENNESSY: The ANSI standards gives examples of the types of things that would be included in limiting safety system settings. And you're right, there are many protective systems which will have set points and so forth. So we tried to choose those that were similar to those that were provided

in the ANSI standard as examples.

MEMBER STETKAR: Okay, I'm not familiar with the ANSI standard, so.

MR. HENNESSY: The same is try with the safety limits as well. We tried, you know, we have a unique system and we tried to fit that into the examples given in the standard.

MEMBER STETKAR: So, for example, I don't have a limiting safety system setting for any protection system input parameters such as PCLS temperatures or levels or.

MR. HENNESSY: No. But we will have LCOs on there.

MEMBER STETKAR: You have LCOs. But, but how do I know that the setpoints are that, that they have the requirement for a setting? I mean I can have an LCO if it's inoperable but how do I know if it's inoperable?

MR. HENNESSY: Well, these are the ones that were selected right now. And we will be continuing to evaluate those and refine the set as we go on.

MEMBER STETKAR: Because I had a few, you know, as I was going through the lists in the tech specs, why aren't these things in here? Your LCOs

seem more comprehensive because also bouncing back and forth along the LCOs. But I would want to make sure that indeed the parameter that's supposed to provide the safety function is verified to be within some range.

MR. HENNESSY: Was there other questions?

MEMBER STETKAR: Yeah. I might as well ask it now while I'm on a roll. Also statements in -- not to get into this 14a versus 14b stuff, are you going to talk about -- I haven't looked in your presentation -- you're not talking about the stuff that was 14.a.

14b in your PSAR talks about things in particular, it says for irradiated special nuclear material outside of the product solution vessel, safety limits are provided for criticality accident prevention based on the Nuclear Criticality Safety Program and also from the Integrated Safety Analysis also. Similarly for LCOs for stuff out in the Radioisotope Production Facility it says going to use the ISA to derive LCOs for things out there.

For the irradiation facility there's no mention of using the ISA for either limiting safety system parameters or LCOs. So I'm curious about why, why the difference? Why are you using the ISA out

in the Radioisotope Production Facility for things out there that are related to safety and not in the ~~Radioisotope Production~~ Irradiation Facility?

And secondly, because the ISAs are typically not quantitative, how do you use them to derive things like LCOs which typically are, are risk confirmed? You know, the duration that I can have something out of service depends on the incremental risk likelihood of an accident that requires that while it's out of service.

That's a long question. But basically what I'm trying to get at is why is the ISA being used in part of the tech -- to support part of the technical specifications, and only part of it, and how are you actually going to use it?

MR. HENNESSY: I think that that might be misstated a little bit. We used the -- it was one safety analysis and it's the ISA. So the ISA derives all the variables that are proposed for the tech specs, including the IF.

MEMBER STETKAR: Okay.

MR. HENNESSY: And with regard to -- what was the second part?

MEMBER STETKAR: The second part is how are you actually going to use it? I can understand

how you might identify parameters that are employed. But in the sense of completeness of the limiting safety system setting or parameters that are in that list. The second, the second part is though, you're deriving LCOs, in other words limiting conditions for operation, allowed outage times and things like that. How do you use the ISA to do that if it's not quantitative?

MR. HENNESSY: Well, the ISA provides the -- well, the originally the IROFS then converting to the safety related. So it provides those things that are necessary to perform the safety function. And those are the variables and conditions and so forth, equipment that ended up in the tech specs. So the result of the ISA reflects directly on the tech specs.

MEMBER STETKAR: That's okay for getting a list. I don't understand how you -- how long can I have a TOGS blower out of service?

MR. HENNESSY: For action conditions, action statements, surveillances and that sort of thing, we'll have to develop that as we go through. Looking at each, each of the, yeah, for the requirements of emission time or whatever, for each of those variables and make a determination about

allowed out-of-service time. It may be that we may not be able to proceed with the process if a component like the TOGS blower is out of service. We don't know that yet but I suspect that will be the case.

MEMBER STETKAR: Okay. I guess we'll just have to see in the final version how you actually work through this.

MR. HENNESSY: Right.

MEMBER STETKAR: Okay.

MR. HENNESSY: Right now, you're right, we have a list.

MEMBER STETKAR: Okay. Okay. But you say the ISA has in fact, information from the ISA has been used to calculate tech spec list --

MR. HENNESSY: Yes.

MEMBER STETKAR: -- and all of that for the Irradiation Facility.

MR. HENNESSY: That's correct.

MEMBER STETKAR: I was just curious because when I looked in 14a there was no mention of the ISA there. And suddenly in 14b it starts to pop up in different places.

MR. HENNESSY: It actually references you to the accident analysis in Chapter 13.

MEMBER STETKAR: It does.

MR. HENNESSY: Which is based on --

MEMBER STETKAR: The ISA.

MR. HENNESSY: -- the ISA.

MEMBER STETKAR: Okay. Okay. All right, thank you.

MEMBER REMPE: I think John asked this, but I just want to make sure. Why are -- why is there no mention about what we talked about earlier with the red oil event and those parameters being monitored? Aren't there going to be some sort of requirements about temperatures and pressures and concentrations and things like that in there for that consideration? Am I missing that?

It's the 14b situation. But 14b kind of points you back to a list in 14a.

MR. COSTEDIO: WE don't have red oil identified as an accident.

MR. HENNESSY: No, but it's, it's possible that we may end up with some of those controls as tech specs.

MEMBER REMPE: I would think you'd want to if you want to maintain margin. Like we're going to get that list next time we meet and stuff. And seems like it would be something that should be added to that table.

ACTING CHAIRMAN BLEY: Jim, from what you said it's not that you don't have red oil, you don't think you'll have these conditions, so if you don't think that there ought to be something to make sure we don't get into conditions for that maybe. That would be worse than these other things we're looking at, events.

MR. HENNESSY: Okay, the next, the next several slides are just examples of LCOs that have been provided. The complete table is provided in the PSAR. For example, part of the solution parameters would be looking at these different values to define them. They'd have LCOs on for the various systems that we'd have.

Ventilation systems, safety related ones including the dampers and the filters. And you'd have LCOs on emergency power, system operable, we'd have LCOs on.

We included design features. Design features are features of the facility describing materials and construction and arrangements which if altered or modified would significantly affect safety and are not included in the other sections. An example of that is site and facility description where we talk about fire-resistant construction of the

supercells and so forth, and the production facility biological shield and the arrangement of the facility's biological shield.

MEMBER STETKAR: Your -- before we get to the -- well, I'll let you finish. I'll be back.

MR. HENNESSY: Administrative controls required by the ANSI standard which includes organization review and audit, radiation safety required actions, reports and records.

We also have requirements and procedures written for certain programs. There is a list in the ANSI standard but we've also included some facility-specific ones such as criticality safety, ALARA, procurement needs, transport and waste containers, fire protection, solvent control. Solvent control is one related to red oil. Tritium control, light water coolant activity monitoring and chemical control.

MEMBER STETKAR: A couple things. And this also, I know it's a work in progress so we'll see the final thing when we see the final thing. And I agree that tech specs are a work in progress. So in terms of construction permit we're not talking about things that are going to affect concrete or barriers or some metal designs of systems. These are

administrative controls.

There's nothing in there that has any limits on what I'll call environmental control requirements. You mentioned ventilation, so RVZ1, RVZ2 which are directly associated with ventilation systems that are radioactive connected to systems that contain potential high radiation areas. But, but I'm talking about environmental controls, some mentioned earlier. Nothing on the main control room environment, nothing on room cooling requirements or anything.

There's nothing on the standby diesel generator, and I know you, you say that it's non-safety related. But in principle I guess according to the textbooks I can have it out of service infinitely and it doesn't make any difference. On the other hand, if I get a loss of offset power with duration of longer than two hours I lose everything in the plant right now.

So I'm curious why the diesel isn't in there to some extent. Nor do you mention anything about operability of fire protection, water supply system, fire detectors, facility fire pumps, which again are non-safety related but in many other facilities those types of things are controlled,

reliability is controlled. So, as I said, it's a work in progress.

MR. HENNESSY: It's a work in progress.

MEMBER STETKAR: It's a work in progress. So those things just sort of jumped out at me that they aren't addressed and.

MR. COSTEDIO: We'll benchmark other facilities to see how they've incorporated them.

ACTING CHAIRMAN BLEY: I'm almost curious as to why since this is unique you wouldn't have started some -- started from the ANSI standard examples, wouldn't have started from something like the list of what makes them safety-related and then backed up and said what are all the things that need to support these functions, and make that the set that you're looking at. And it doesn't have to be every parameter. You have to have enough things so that you can support all of these safety functions. And some structured way to go at it would seem -- or it's the way I would have approached it.

MR. HENNESSY: Well, that is how we did it. And I didn't mean to imply that the only parameters or variables that we've included were those that were provided as examples in the standard. The standard uses content and format. We used the

results of our integrated safety assessment to lay down those examples in here. That's where these come from.

ACTING CHAIRMAN BLEY: Okay. It is from the ANSI standard.

MR. HENNESSY: We did, I'm sorry, all we did with the ANSI standard was try to put them into the right bin within the tech specs.

MEMBER SCHULTZ: But the approach you're taking so far would in fact identify then those things that are safety related?

MR. HENNESSY: That's correct.

MEMBER SCHULTZ: And sometimes there's a tendency to try to minimize what's in the technical specification. And yet, for a new and different facility which has got somewhat different bases, for our purposes you may want to take advantage of the specifications to capture more information about what's important to the facility, important to safety, important to operation, important to all of which is important to the safety and operation of the facility. Take advantage of that to document it for the future and it would become important in operation.

CHAPTER 14 STAFF PRESENTATION

MR. LYNCH: All right. Technical

specifications.

So what we're -- so with technical specifications, as we've identified, we're not really evaluating those right now. What is required by the regulations is the SHINE has gone through their chapters and identified those topics that are probable subjects of what will be those technical specifications. So we've taken a look at that.

And one thing I wanted to highlight also in terms of when we're actually reviewing their technical specifications for the production facility, as is written into our guidance, we will likely be referring to those, the technical specifications for fuel reprocessing facilities that are included 50.36 as guidance for what those need to look like.

And then I'd just mention these, ANSI 15.1 and NUREG-1537.

All right. Steve.

MR. MARSCHKE: Based on the NUREG-1537 -- based on 1537, the area that was used for the SHINE technical specifications included the following. It conforms to the ANSI Standard format and content guide. And the technical specifications conform to the NUREG-1537 format and content guide, including the ISG.

The review procedure was comparing the technical specifications with the ANSI Standard, as supplemented in the format and content guide, operating characteristics, site environmental, and use, with the PSAR.

The technical specifications and basis should be determined from the analysis in the PSAR. I think that SHINE has done that or explained that they did that in their presentation. They used the ISA.

Confirm that the technical specifications are complete and follow the correct format. So they follow the correct format, that's for sure. What was pointed out by John in the SHINE presentation that there are certain parameters that may be necessary to be added to the technical specification list that is currently in the PSAR. So whether or not it's complete is still a question which is open.

The evaluation findings, usually as we point out that there is a list of proposed parameters for technical specifications provided in the PSAR, Table 14a2-1. And while that gives us some preliminary information on the technical specifications, we felt that it was really insufficient for the Staff to perform a review at

this particular point in time.

So and that's really the gist of the conclusion. There are no RAIs on the technical specifications at this time. And the technical specification review has really been deferred to the FSAR.

MR. LYNCH: And I guess one point of clarification I want to make there on slide 6 is when we are saying that that table is insufficient for the Staff report to perform a review. What we mean there is that insufficient to perform a review saying these are the technical specifications that we would limit the facility to. Yes, we looked and said, okay, SHINE, you've identified the areas that you think will be the subjects of technical specifications. Yes, but to really validate whether those are correct or not we're going to hold off, we're going to defer that to the FSAR.

~~MEMBER~~ Mr. ADAMS: And if I can add something. We do have some historical documents we can go back and look at. The irradiation facilities have a lot of similarities with liquid homogeneous reactors. And we've licensed over a dozen of those over the years, including their technical specifications. So process here, we will go back and

see what, you know, what was considered important for safety limit LSSSs, LCOs for those facilities. And that, you know, that gives us some clues as if we're heading in the right direction. And also the translation of the IROFs into technical specifications is, you know, one of the challenges we have here.

But I think we're at the beginning of a long journey here on these but we do have some historical documents to look at that will help us.

ACTING CHAIRMAN BLEY: Very good. Anything from the committee?

I've got a couple housekeeping things to do first and then we'll be going into a closed session. But before that, if there's anything that ought to come forward in the public session from things earlier today, either from the committee or from Staff or from the applicant, this would be the time to get them on the record.

MS. BANERJEE: There is one question. Trying to get SHINE's response to the TSV

ACTING CHAIRMAN BLEY: Yes, do we do those?

MS. BANERJEE: From our point of view.

ACTING CHAIRMAN BLEY: Okay, let's do that

at this time.

And while they're getting ready, when they're finished we'll open up for public comment. And I think just leave it on the public record. We'll go around to subcommittee at that time for comments on the day. We might do a brief one at the end after the closed session to see if there's other things from the committee members at that time.

Okay, who's up? Steve?

MEMBER SCHULTZ: Actually, Eric wants to clarify something.

ACTING CHAIRMAN BLEY: Okay.

MR. VAN ABEL: Hi. This is Eric Van Abel with SHINE. I just want to add some more clarification. There was a question asked earlier about do we consider partial failures at all in the facility.

And one thing I should have added in that discussion is we did the HAZOPS analysis in both the RPF and the IF. And in the HAZOPS process you look at things that are not absolute. You look at more for less, more composition, less composition. So that analysis was performed.

ACTING CHAIRMAN BLEY: Did you extend the HAZOPS to look at electrical and control systems at

all?

MR. VAN ABEL: Not in the preliminary phase. Looking at the --

ACTING CHAIRMAN BLEY: Just fluid systems.

MR. VAN ABEL: We were looking at the PFD, the process flow diagram, because that's what we had available at the time.

MEMBER SCHULTZ: Okay.

MS. KOLB: I'm Catherine Kolb. I'll be addressing some of the comments that we had in the previous ACRS meeting. The first four slides are related to a chemical hazard analysis in Chapter 2. We had a discussion on the forklifts and propane-powered forklifts. And SHINE will use electric forklifts in lieu of propane-powered forklifts to eliminate the administrative burden with keeping them away from the facility, and how many hours per year they can be in the facility. And that we are going to revise the PSAR to reflect the use of electric forklifts.

We also had a question about chlorine releases from railcars specifically. A chlorine release from a railcar was not considered because chlorine was not included in the list of chemicals transported on railways in Rock County provided to

SHINE by the Rock County Emergency Management Organization. They are part of the Emergency Planning and Community Right to Know Act.

They are given information from businesses and facilities and they did not -- they included a list of other very hazardous materials that they addressed, but chlorine was not one of them. And per Reg Guide 1.78 we only consider materials that are transported frequently.

MEMBER BALLINGER: What if they change their minds?

MS. KOLB: We will have to go back and look at it and reassess our current corrective action program.

ACTING CHAIRMAN BLEY: I don't remember from last time, did you look at other hazardous chemicals?

MS. KOLB: Yes.

MEMBER STETKAR: They did. They looked at truck transport.

MS. KOLB: We looked at truck transport.

MEMBER STETKAR: Local limited amounts and then larger amounts out on the interstate.

MS. KOLB: I-90, yeah.

MEMBER STETKAR: Yes. But the question

came up of why didn't you look at -- they looked at a bunch of stuff but not chlorine. It's interesting.

MS. KOLB: Yes, a list of eight or ten different really hazardous chemicals. And we had evaluated those but chlorine wasn't one of them.

We also had a question about ammonium nitrate specifically. According to the local Tier II reports from the facilities in the area, ammonium nitrate was only present as part of a solution of urea ammonium nitrate, UAN. No one reported quantities of solid ammonium nitrate. And because they didn't report quantities, we assumed that the transportation of ammonium nitrate on nearby roads would also be in solution form.

UAN is non-flammable and --

MEMBER POWERS: Do you have a Home Depot?

MS. KOLB: Pardon?

MEMBER POWERS: Do you have a Home Depot in that area?

MS. KOLB: The closest Home Depot is on the north side of Janesville and so is the Menards.

MEMBER POWERS: Go there and ask them in their garden to show you the ammonium nitrate stocks they've got.

(Laughter.)

MS. KOLB: They didn't report it. And there is a quantum, there is a threshold -- that's the word, thank you -- for when they need to report it. They might fall below that threshold. I don't know.

MEMBER POWERS: An agricultural area without ammonium nitrate. That, that will --

MS. KOLB: I mean there are very large quantities of UAN. Over 10 million pounds reported at a facility in Janesville and another one in Beloit. Yeah, a crop services facility. So they use it but in another form. And since it's not flammable we didn't consider an explosion permit.

Next slide.

We also had a discussion about a margin related to standoff which includes some explosion. The regulatory guides apparently have margin built into them. The acceptance criteria from Reg Guide 1.91 is based on a Department of Defense reports which they came to the conclusion that 1 psi was conservative.

A separate different Department of Defense and Electric Power Research or Energy Research and Development Administration reports found that 1 psi was the pressure, all the pressure at which

glass windows shattered. And that non-reinforced concrete walls failed at approximately 1.5 to 5.5 psi but that stronger structures were the heavily framed and reinforced concrete buildings which surpassed those pressures.

So because these safety-related areas of the SHINE facility will be made of reinforced concrete and seismically designed, we readily expect them to withstand pressures in excess of 1 psi, which provides margins. And in all the calculations those standoff distances, even when the apparent margin is, you know, a fraction of a mile or, you know, dozen feet, that there is additional margin built into that.

The next five slides are considering our aircraft hazard analysis. This is a updated version of PSAR Figure 2.2-2. We used low and high altitude charts from the FAA to construct this because the airways, the low altitude airways converge on the radio beacon, a navigational aid which is offset several miles from the airport. So there is one airway that is almost directly over our site.

And this figure will be included in the PSAR rule updates to revise the figure.

Next slide.

In our aircraft hazard analysis in the

PSAR SHINE combined methodology aspects of NUREG-0800 and DOE Standard 3014-96. To address the discussion we had on airway density we performed a confirmatory analysis using this same methodology, but we for the non-airport operations we used the highest crash rates that were included in the standard. These are the crash rates for Brookhaven, Long Island, for commercial and large military. For Argonne for the general aviation which is, as you know, in the Chicago metro area. And the Nevada Test Site for small military planes.

And could you show the next slide please.

You can see that we're still within the acceptance criteria of 1~~e~~E-6. And if we replace our non-airports operation with the maximum average -- not average -- the maximum that is in the standard for DOE sites.

And that's, and then the last one is the air show impact. There are no air shows currently planned at the Southern Wisconsin Regional Airports. Increases in the number of operations for military craft, which is one to be concerned about because they are not bounded by our Challenger 605 limiting small aircraft, those are, the calculation was done using a historical average which would include, which

does include past air shows at the site.

To conduct an air show at the airport an FAA review and regulatory waiver is required because of the air space that we are in. The ingress and egress routes to a confined aerobatic box are also clearly defined. And an aerobatic box is required to be sterile per the regulations.

We discussed this issue of a hypothetical air show with the FAA National Aviation Events specialists. And they would consider the safety of the SHINE site when granting waivers for future air shows.

Next slide.

In the --

MEMBER SKILLMAN: Catherine, on that slide, how is that agreement codified? Is that a written agreement? Is that just a verbal agreement? Or is it in the regulation or?

MR. COSTEDIO: You're talking about the waiver?

MEMBER SKILLMAN: Yes.

MR. COSTEDIO: It's in 14 CFR.

MS. KOLB: They do need to have a waiver and they need to consider the safety of the air show when they grant the waiver. And --

MR. COSTEDIO: Do you have the RAI number that we could --

MEMBER SKILLMAN: That's fine. Thank you.

MR. COSTEDIO: We did respond to it and listed how it's codified in the RAIs.

MEMBER SKILLMAN: Thank you.

MR. COSTEDIO: Yes.

MS. KOLB: And I guess, and this is our last slide, in the opinion of the aviation event specialists if the SHINE facility were not in the aerobatic box or within the -- near the ingress or egress routes defined for the military planes, for plane performing aerobatics risk to the facility would be reduced similar to the risk due to normal flight operations in the vicinity.

And that is the end of our update.

MS. KOLB: Thank you.

ACTING CHAIRMAN BLEY: Anything from the committee?

MEMBER STETKAR: Yeah. This is for the Staff. I asked a question of what's the basis for the 10 to the minus 6 per year screening criterion that's been applied for this site. And I was sent a memorandum and order CLI 06-19, In the Matter of Private Fuel Storage, LLC, Independent Spent Fuel

Storage Installation, from the Commission, docketed September 9, 2005, that was apparently the basis for that.

And I've read through that. I've studied it. I will read you a quote. "The Commission's ruling compared the one-in-a-million threshold standard established for a GROA," which I've forgotten what the acronym, it's basically an underground, oh, so-called geologic repository operations area, "a temporary storage area to be used in conjunction with a permanent repository for disposing of spent nuclear fuel, to the one-in-ten-million threshold standard established for nuclear power reactors. The decision noted that in terms of both every day operation and potential accident consequences, PFS's proposed ISFSI resembles a GROA more than a nuclear power reactor."

And I'll grant you that dry cask storage stuff sitting on a pad in an underground spent fuel storage facility looks a lot different from a nuclear reactor. To me SHINE looks a lot more like a nuclear reactor than a concrete thing with some spent fuel in it.

So I'm curious why this particular ruling has any relevance to screening out aircraft passes

into SHINE at less than 10 to the minus 6 rather than 10 to the minus 7?

MR. LYNCH: I think that is -- all right, and maybe Steve could -- or I'll try if you want me to.

MR. MARSCHKE: This is Steve Marschke. I was the one that pointed you to the really historic area. And basically we were looking for non-reactor -- I mean initially SHINE was proposing to use 10 to the minus 6 as based upon a IAEA limit for non-power reactors. And we were looking for a non-reactor to count that facility and what the limit was that a non-power reactor facility. And the fuel storage facility was the most recent non-power reactor facility that we could identify which had the aircraft accident capability or possibility documented.

So that's really the reason why we selected that.

MEMBER STETKAR: Okay. I guess this is a subcommittee meeting so I can personally disagree completely with that rationale. So I will do that on the record.

MR. MARSCHKE: Well, if the, well the --

MEMBER STETKAR: No, my point is, and if

you read in particular on that Commission ruling, Commissioner Jaczko dissented to that ruling. And if you read his dissension it's a very, very clear discussion of this issue. And his discussion of the issue is framed in the terms of risk.

He says that, in a sense he says that these are not absolute numerical thresholds so that if you're 9.997 times 10 to the minus 7 you succeed, and if you're 1.0006 times 10 to the minus 6 you fail, because there are very large uncertainties. And if you're within the range of that guidance you ought to look more carefully. In fact, you ought to look at both frequency, and more importantly, consequences.

The majority of the Commission in their ruling also refers to consequences. And they say, well gee, the consequences from aircraft crash hitting an ISFSI are much lower than the consequences of an aircraft hitting a nuclear power facility, which is the comparison that they were making, a nuclear power reactor.

So if you were actually invoking both frequency and consequences, which is the type of argument that I'm trying to push people to here, that if the frequency of a large aircraft crash into this facility, for which it's not designed, is on the order

of something 10 to the minus 7th-ish, and I don't care whether it's 1.03 or whether it's 6.4 or whether it's 5 or whatever, then we ought to look at the consequences of that.

One ought to turn up the microscope a bit rather than just saying, well, I've done a calculation and by something that I can point to written by the Commission they cited a number of 10 to the minus 6 for something that's not called a reactor is acceptable on a frequency basis, without considering the consequences, so the Staff is saying everything is fine. That, that seems not only contrary to the intent of the Commission's ruling on that particular issue but it's certainly contrary to the what I think is a very good argument laid out by Commission Jaczko.

So I, you know, as I said, my opinion is as a subcommittee member I guess I'm sending you back to the drawing board to see why that magic 1.00 times 10 to the minus 6 frequency is good enough. For this particular facility with its particular location and the mix of aircraft that one would expect from both overflights and take-offs and landings, because there are some take-offs and landings at that airport of larger aircraft.

~~MEMBER~~ Mr. ADAMS: I guess there's one

thing that I can add. There is historical precedence for the 10 to the minus 6. And that's basically what we've used in the past for the licensing of research reactors.

The Court's example is the research reactor at the University of California, Davis, which when we took over licensing from the Department of the Air Force, that reactor, the back fence of that reactor was on an active Air Force Base. And basically the NRC accepted the siting criteria that came from the Air Force that it was within 10, less than 10 to the minus 6. And that was the licensing base that we used for licensing that facility as it sits there today.

MEMBER STETKAR: If I took the entire inventory of that reactor and released it directly to the environment what would be the risk to the health and safety of the public?

~~MEMBER~~ Mr. ADAMS: I don't, I don't know the answer to that sitting here. I'd have to go and look what the entire inventory would be. My gut feeling is that it would -- is that the consequences would be similar to one of the irradiation facilities. That's my gut feeling.

MEMBER STETKAR: One-eighth. Okay,

one-eighth of this facility.

~~MEMBER~~ Mr. ADAMS: And, you know, my reasoning is very crude. I know I'm dealing with a power level of 1 megawatt -- well, actually it's 2 megawatts, 2 megawatts at Davis. And I know that the definition of test reactor talks about 10 megawatts for what I would call solid homogeneous reactors versus liquid homogeneous reactors. You become a test reactor at 1 megawatt.

So there's both a risk inference of a factor of ten. So you can go from there. So, you know, given that it is actually a 2.3 megawatt licensed reactor, the risk is probably equal to several irradiation facilities. Again, that's the top of my head sitting here.

ACTING CHAIRMAN BLEY: I'd just mention from the committee's point of view -- we're not the whole committee -- we not too long ago looked at another test reactor. And I think, to take John's point, one of the things that finally convinced the committee to submit its letter in favor was the level of consequences were quite low no matter what kind of accident was proposed there. So that we really can't decouple the two completely.

Anything else at this point from members

or from Staff for the applicant? At this time, Maitri, let's open.

MS. BANERJEE: Well, you have another presentation from the Staff.

MR. LYNCH: Yeah, we have that. It's a very short presentation. Essentially what that's part of, we were going to get up in front of you for just 5 to 7 minutes to just go over some of the topics like SHINE did.

ACTING CHAIRMAN BLEY: Right. Let's do that.

MR. LYNCH: That's all right?

ACTING CHAIRMAN BLEY: I missed that on the agenda. Yes.

(Brief pause.)

ACTING CHAIRMAN BLEY: Okay, Staff's back on.

MR. LYNCH: If I can find our presentation. Maitri, did the rest of our presentations get added?

MS. BANERJEE: It's in most of the packets.

MR. LYNCH: Ah, got it.

Okay, there were a few topics. And I'll go over the overview right after this. But one of

the topics that we had a question on from the members last time was a query on how we selected some of the procedures we gotten into using a construction inspection program for these facilities.

So I'll ask Carl Weber to talk about that for a few minutes on some NRO. He's been one of the leads on developing a construction inspection program for SHINE and similar facilities.

MR. WEBER: Okay. On the next page I have a little bit of background that might help you understand how we came to progress the way we decided to up to this point. And I do want to point out that right now we are -- it's not complete, the construction inspection program. We're working on it. We have reached the point where it's in the final concurrence review and we're working on resolving comments.

And I will point out that while I did take a lead role in this it was done as a working group so it was a joint effort. We had NMSS. We had NRR and we had regional people assist with developing the program.

So the first item is that NRO was tasked by NRR to come up with the construction inspection program which we had some expertise in developing a

construction inspection program for new reactors. First thing we decided was that the existing CIPs weren't appropriate either to use as is or to try and revise them into something that would cover this.

ACTING CHAIRMAN BLEY: The first thing is our -- I guess just for the record give us the acronyms. Inspection --

MR. WEBER: Yeah, I'll go -- yeah, I should address that now.

We were not expecting to see RPF, but the idea was that we wanted to try and do this as a generic program that would cover all of the molybdenum-99 production facilities. So we wouldn't have to develop an individual one for each different facility that eventually comes in for a CP.

And then it was suggested to us that if we made it even more generic it could be used for any, any work done on a research and test reactor. So we wanted to come up with something that would cover all of those areas. And so we came up with NPUF which is the -- which is what we have. Okay.

So, first of all, the NRO program that we have now clearly is based on Part 52 and the SHINE was based, is going to be licensed under Part 50. The issue there is that under Part 52 the inspection

focuses on ITAAC. We use ITAAC to define our inspection sample. We use it as input to our assessment, so it really wasn't a good fit.

NRR does have a 10 CFR 50 program. It's currently in use for Watts Bar 2. We really can't change it at this point until they're complete with it. Plus, it's focused on the large light water reactors. One of the, one of the major differences, of course, is quality assurance. Anything in the program that addresses quality assurance under Part 50 for NRR addresses or references Appendix B and 18.7, while here we're working with the 15.8.

So there are quite a few differences. And we decided it was better just to start from scratch and come up with something that we could really focus on and give our inspectors a clear idea of what they were working in.

So on the next page we give a little bit of a very quick overview. We have one inspection manual chapter that basically covers everything. We wanted to make it compact. Normally you would see for three or four different IMCs. We did it with one, including assessment. We eventually expect to address the transition to operations once we get a little more information about how that works. It's

not there yet.

And we're incorporating qualification and training into our existing IMC for inspectors 1245.

We have three inspection procedures. And I wanted to call out under the second bullet quality of construction because I know there were some questions earlier about looking at quality assurance. We have a lot of focus on quality assurance. As soon as the construction permit is issued we're looking not just at implementation, we're looking at programs. Do they have the program in place and procedures? Then we're looking at the actual implementation later on.

And obviously we're going to look at SSCs and then do a final sort of a wrap-up inspection for just to make an indication of -- get an indication of whether they're ready for an operating license, which will come much later in the process.

So that's my overview. I know it was pretty quick.

MEMBER SKILLMAN: Carl, if I could ask?

MR. WEBER: Yes.

MEMBER SKILLMAN: Normally the fuel cycle plants are inspected out of Region II. Is the design of what you've described intended to be inspected out

of Region II?

MR. WEBER: Yes. That's where we have basically all of our construction inspection expertise is located in Region II. So they will be doing the inspections from the issuance of the construction permit to, at some point, we don't know the exact transition at this time, but somewhere around the issuance of the operating license it would transition to the headquarters group that has their own group of inspectors who currently inspect research and test reactors.

MEMBER SKILLMAN: That's reassuring because the Region II inspectors who have been doing this work know what to look and for what reason, particularly the Q/A for the construction.

MR. WEBER: Yes. And like we said, we made sure that we had Region II representation from day one. We had them looking at it, giving us feedback and making sure it was the way we want it to look.

MEMBER SKILLMAN: Thank you, Carl.

MEMBER SCHULTZ: So pretty quick, Carl, but just you went by the qualification and training chapter to indicate that that was applicable. And I presume that review has been done sufficiently. It's

general enough so that there is -- there isn't a need for any changes to that?

MR. WEBER: Actually there is. I'm sorry.

MEMBER SCHULTZ: Oh, there are? Okay.

MR. WEBER: Qualification and training, and if you're familiar with it there are several appendices, we're actually going to -- the plan right now is we're going to add an appendix --

MEMBER SCHULTZ: Okay.

MR. WEBER: -- that talks about specifically construction inspection at these types of facilities.

MEMBER SCHULTZ: So it will be addressed there.

MR. WEBER: Right.

MEMBER SCHULTZ: But as a separate section in the appendix. The main body stands. The appendix will provide special guidance.

MR. WEBER: Yes.

MEMBER SCHULTZ: Thank you.

Any other questions?

(No response.)

ACTING CHAIRMAN BLEY: I notice we have another little package. This was one of the things on it. Is there anything else from the Staff?

MR. LYNCH: Yes. I'm just going to quick, I just have one slide here that I'm going --

ACTING CHAIRMAN BLEY: Some of that I think we've already talked about.

MR. LYNCH: Yeah, and that's some of what I want to highlight it. You know, we did talk about construction inspection. I just want to be sure that we have a list of what we thought were the big issues from last time I want to tough briefly on.

We talked about implementing digital I&C at the SHINE facility. We've got our, with research reactors we do have a subject matter expert on digital I&Cs at research reactors. We have specific guidance developed for implementing digital I&C at non-power facilities. We've got and signed that guidance. And they know who our expert is in that. And as they start designing their digital system we've got an agreement that we're going to immediately set up a meeting and start discussing that.

ACTING CHAIRMAN BLEY: By any chance does that look anything like the DSRS that were done for the SMRs recently?

MR. LYNCH: I think --

ACTING CHAIRMAN BLEY: Or is it something independent?

MR. LYNCH: It's scaled back. I know that we used the power reactor guidance and scaled it back. I would have to ask Rand.

ACTING CHAIRMAN BLEY: That's okay.

~~MEMBER~~ Mr. ADAMS: Yes, I mean we, we took what we contracted with the Oak Ridge National Lab, the I&C folks there. We have our NRR I&C folks involved. And what we try to do is go through the existing IEEE guidance in that and point the applicants at those aspects of the systems that made sense for a research reactor.

ACTING CHAIRMAN BLEY: There's just been a whole lot of work centered in NRO and revamping the SRP guidance and looking at digital I&C in particular. And so I hope you picked up some of that because that's got some crucial new structural ideas in how to look at these systems.

I mean if you didn't, I hope you'd dig back quickly and look at that.

~~MEMBER~~ Mr. ADAMS: I'll take that message back. For the reviews we're doing we are using the NRR I&C experts, are looking at some reviews. The research reactors sort of still have some aspects of the systems are still analog to try to avoid, I think you know, all the miscellaneous bad, hard-to-predict

things that can happen, so.

ACTING CHAIRMAN BLEY: So do the new reactors though, and the review standard covers that issue also.

MR. HARDESTY: Al, I'm actually online. If you want me to address that.

~~MEMBER~~ Mr. ADAMS: Oh. Oh, sure.

MR. LYNCH: This is Duane Hardesty who is actually our digital I&C expert.

MR. HARDESTY: So I'm part of several working groups that are with NRO and NRR. And I keep track of all of the issues and I participate in all of the specific issues like, for example, the embedded digital devices. And we are bringing that all into our guidance. It hasn't gone out for public comment, the last version yet. It will very shortly. And it recently just incorporated some cyber security issues that we have a contractor for that also was working with the power reactor side.

So we are keeping very much in pace with what they're doing on the new reactor side as well as the research and the NRR side in the power reactor community. And then, as Steve said, we're scaling that to be what is appropriate for the research -- or the non-power production utilization facility.

ACTING CHAIRMAN BLEY: Okay, I understand that, Duane. I'm glad you came up. I hope the set of things you're looking at includes the new Chapter 7 DSRSs that were put together for a couple of plants. But really they're the same thing. And they're a general extension of what had been in the old SRP, existing SRP but really specializing it based on a lot of lessons learned over the last five, six years.

MR. HARDESTY: When you say SRP you mean NUREG-0800?

ACTING CHAIRMAN BLEY: Yes.

MR. HARDESTY: Yes. So we are, we are doing that. My reps, the representatives I have on from EICB and NRR are feeding me all that information. Norbert Carte is actually my principal contact.

MEMBER STETKAR: But I think one of our cautions is that we have seen different staff review I'll call it philosophies, for lack of a better term, being applied for digital retrofits to new reactor -- to existing reactors versus new reactors versus, you know, the design-specific review standard that's being developed for the small modular reactors. And at least the design-specific review standard to my understanding seems to be focusing all those efforts together into kind of a cohesive staff

approach to reviewing digital systems.

And I think the concern that you may be hearing from us is that it -- I know I wouldn't like to see suddenly an offshoot of that process become specialized to things that are called non-power utilization facilities or something, simply because somebody wants to carve out a different, yet a different philosophy. Because the digital systems don't care.

MR. LYNCH: Understood.

So one other thing I wanted to add on here with the aircraft impact analysis. So one of the challenges we have with research reactors I was doing, as one of my many research projects I was kind of going through what aircraft impact analysis have we done for our existing research reactors? If you look at NUREG-1537 basically it says you should think about aircraft hitting a facility.

So I looked at what have facilities actually submitted to us in their SARs and what have we done in our analysis of that? For the most part we did a paragraph on the facility that says, we understand that if an aircraft is going to crash, generally it's going to land short of the runway or go long. And you know what? The runway's not

pointed at the facility, so we're good to go. That's for the vast majority of research reactors, that's as far as the analysis goes.

What I looked at then was, okay, what's the most rigorous analysis we've done a research reactor? And that was at U.C. Davis where the reactor sits 500 meters from the runway at the Air Force Base. And in that analysis performed by General Atomics they used the same DOE standard that SHINE is using. And the NRC Staff used that standard to conform a confirmatory analysis setting 10 to the minus 6 as an appropriate threshold for what aircraft impacts needed to be considered.

So to me, as far as Our review goes, that was the precedent that we're going off of in setting that threshold. And that's kind of where we're going. It's using the DOE standard and the precedent set at U.C. Davis for the most rigorous aircraft analysis that's been performed at a research reactor.

As far as the impact of the RPCS failure, we talked about that in Chapter 13. We're going to look for them to justify how that could impact the TOG system that the FSAR hydrogen deflagration and detonation accident, you know, we're at the FSAR we're going to look at that again as far as how could it

impact the primary system boundary integrity.

And then last thing on here, I talked about updating you on some of the analysis we did on Part 50. I know we're short on time so I will just kind of do a highlight of some of the things that we're looking at with that.

First of all, we don't see any impact on the regulations as far as construction goes. That we can go forward with. The regulations are good for construction. But we are looking at what needs to change for the operating license.

Some things we're looking at I mentioned earlier. We're looking at those technical specification requirements. For example, right now those call out this applies to fuel and processing facilities. We're looking at those. And in our guidance we say those might be a good idea to follow. Maybe we need to come up with a mechanism. May not be a rule change. Maybe some other regulatory mechanisms, impose those regulations that we think are appropriate on the facilities. That's one example.

We're looking at, you know, fire protection regulations. While Appendix R doesn't apply, there are some fire protection regulations in

Part 50 that we're making sure adequately apply to SHINE.

We are looking closely outside of Part 50 at some of the Part 73 material categorization rulemaking. That's something that's in process right now to make sure that SHINE is in compliance with regulations that are in development by the staff to make sure that what we want to avoid is they get licensed and then the next day we have a new regulations that they didn't design their facility to. So we're working closely with NSIR to make sure that they are up with that. And SHINE's been involved in that process as well.

And the last couple things here. We had three other issues that I really want to address. But they're going to work naturally into our presentations in September. We're going to go into a lot of detail on quality assurance.

Radiological release limits we're going to talk all about that in September with our Chapter 11 presentation. And then when Mary comes back to talk about Chapter 13b we'll get more into some of our red oil considerations.

MEMBER POWERS: Will you be talking also not just about the red oil but the difficulties of

storage of acetyl hydroxylamine?

MR. LYNCH: Mary? I will make a note of that and we can follow up with that.

MEMBER POWERS: You're using, I believe you're using TRUEX; right?

MR. LYNCH: TRUEX? Mary might know that.

Oh, as far as the process for the separation? It's the UREX process.

MEMBER POWERS: UREX. All right.

MR. LYNCH: Yes.

MEMBER POWERS: And your reductant there instead of being hydroxylamine is acetyl hydroxylamine. And whereas I know a lot about hazards of storage of hydroxylamine, I know zip about acetyl hydroxylamine. I mean there have been some classic explosions with hydroxylamine that's been stored on a facility.

MR. LYNCH: Okay. I understand.

MEMBER POWERS: They happen about every five years, somebody blows half a train or something like that. That, the acetyl hydroxylamine I have zero experience with it. I've just never used it. So I don't know how sensitive it is to iron contamination and things like that.

MR. LYNCH: Understood. Are you looking

at that? I guess that's in your chemical hazard analysis?

MS. ADAMS: Our chemical engineer was in the front row for most of the afternoon but he's gone now.

MEMBER POWERS: I waited till he left before I brought it up.

(Laughter.)

MR. LYNCH: I've got it now. I do understand now what you're talking about. And we'll make sure, yes, as far as our analysis of that, that will be covered in our next presentation in the accident analysis in September.

MEMBER STETKAR: Steve, just out of curiosity, this is strictly curiosity, is that U.C. Davis research reaction aircraft crash analysis available somewhere?

MS. ADAMS: Yes.

MR. LYNCH: I can provide that to you.

MEMBER STETKAR: Thank you.

MR. LYNCH: Yep.

MEMBER STETKAR: I'd like to take a look at it. Thank you.

MEMBER POWERS: You'd think that he has no life and he likes to study hazard analyses.

ACTING CHAIRMAN BLEY: Any more comments, questions?

(No response.)

Maitri, what other surprises do you have for me?

MS. BANERJEE: I think that's it. We can open up for the public comment.

ACTING CHAIRMAN BLEY: Okay. Go get the line opened up.

Is there anyone in the room who would care to make a comment to the committee at this time? Come to the microphone if you'd like.

ACTING CHAIRMAN BLEY: Just so that we're going to go around the committee and we'll ask you for anything when we do it.

If anyone is on the public line and has not been able to talk till now, would you just please say hello so we know the public line is operable. If there is anybody on the public line that would like to make a comment, please state your name and we will be glad to hear you comment.

(No response.)

ACTING CHAIRMAN BLEY: Going, going, gone.

I think at this time we will close, no, we will close the public line. We're going into

closed session.

MEMBER STETKAR: Well, we're going to make our comments.

SUBCOMMITTEE DISCUSSION AND COMMENTS

ACTING CHAIRMAN BLEY: Oh, I'm sorry. Thank you for the reminder. Yes, we'll mute the public line. Doesn't sound like anybody's there. And we'll go around the let the members of the committee speak. I think I will start with Dr. Dana Powers.

MEMBER POWERS: Well, the issues John phrased about how you define this need to rely on safety and the like I'm sure you'll explore further. I am at this stage of the construction permit it's always like a kiss your sister sort of thing. It's okay, it's just not the real thing, you know.

(Laughter.)

ACTING CHAIRMAN BLEY: You continue to astound me.

MEMBER POWERS: I really don't know what to say here. But the one area that if I were the applicant here that I would really give some thought to is that do you have design considerations that need to be made if you have a long-term lay-up of this facility? That is, something causes you to shut

down in not necessary for years but six months and you have all these solutions running around where -- and lying in various places, and you've got to clean them out to lay the facility up for a protracted period of time. Are there design considerations you need to do for that eventuality?

Because if this facility operates for some protracted period of time, I guarantee you there's going to be an occasion where you're going to have to lay it up for some period of time. And at least in the MOX facility that we reviewed, could be a week here, that was a very substantial fraction of the design consideration was how to lay the facility up. In that case because they wouldn't get feed or they wouldn't be able to dispose of waste for some reason.

But here you may have other considerations that cause you to lay up. And that may introduce additional piping, additional cells, additional kinds of designs, design consideration for an intermediate term lay-up.

My two cents worth.

ACTING CHAIRMAN BLEY: And that's a great one.

Dick?

MEMBER SKILLMAN: Yes, two quick items.

The importance of the shock team talking where these bubble tight isolation dampers are that will meet the specifications to ensure that the analysis that they are depending upon will be fulfilled.

The second thing is because they are in the design stage, construction stage, ensuring that the filters are located in locations that will not prevent workers from being prevented from exiting this facility. That's a very specific item. But if the filters are normally -- if they're placed, if you will, in the overheads of the passageways then it can be that the workers receive doses they would not receive if the filters are placed in a more secure and shielded location.

Thank you.

MEMBER POWERS: In addition then you need to make sure that those filters are located in such a way that's really easy to assure that they've not become dislodged or dislocated or have leakage inside the plant. I mean we've had more than our share of mistakes, as you say, in putting them in congested, bad places where there's low visibility and you can't see how to get them. And we paid the price terribly.

ACTING CHAIRMAN BLEY: Joy.

MEMBER REMPE: I want to thank the folks from SHINE as well as the Staff. I recognize that you both are trying to be very responsive to the questions we raise. I guess again I'm not as experienced as Dana so I can't have the same analogy he had, but I can't help but wonder why when you have a lot of uncertainty at this stage and, yeah, a ~~point~~ pouring in concrete out in Wisconsin doesn't really harm the public, but it's in the longer term that there's some changes as we get to the operating license and how to mitigate some of the changes that will inevitably occur and the impact of those changes.

But that's probably beyond the scope of what we're supposed to be doing.

ACTING CHAIRMAN BLEY: Thank you.

MEMBER BALLINGER: I'm very much impressed by the competency of the review that's going on on the nuclear side. I think the last couple of times on construction, structure, this facility is going to be built -- this facility is going to be built to nuclear standards in effect by people who essentially have no, likely will have no experience of that kind of construction, of that kind of quality control and that kind of -- I mean the people you hire to do the

pouring of the concrete and the hammer and nail stuff. So I think there's probably going to be some tension there between the quality control that you're going to insist upon, which may not be what people are used to in the non-nuclear construction side.

So anyway, but other than that, thank you.

MEMBER SCHULTZ: I also appreciate the presentations that were made today by both the applicant and the Staff. And it did demonstrate there's still a lot of thinking ongoing here related to the process that's moving forward on the construction current stage.

My comment is related to the particular examples that Dick Skillman and Dana Powers mentioned but it's more general. And that is especially given that we're going through this process relatively rapidly, we tend to, I think there's a tendency, not that we all are doing it, but there's a tendency to try to determine what is the minimum that we need to do in order to set aside a construction permit approval and to leave behind thinking not only in terms of inside the box but outside the box what really can be and should be done with regard to construction of the facility.

And I think that the examples that Dick and Dana have raised, I think it's really important not to be constrained or put into a particular frame of mind because of what we need to do, but rather expand that and think of what the requirements are for construction and operation. And try to take as much from that as possible to assure that the construction of a facility is going to be right the first time and we won't have to go through retrofits down the road.

And even pertains to Ron's comments, to make sure that the overall process -- in the overall process we're taking the best of why the regulations have been established as we go forward with the project.

Thank you.

ACTING CHAIRMAN BLEY: As it goes past me I'm going to go a little further with Steve's comment because I am personally aware of two major chemical processing facilities that were built related to nuclear that didn't pay attention to the kind of things Steve just talked about. And one was only used for a short time. The other one was abandoned in place because they couldn't solve the problems they didn't consider before they poured all the

concrete and put stuff in place. And that's a massive loss.

Mr. Stetkar.

MEMBER STETKAR: Yes. I won't -- I've made a lot of detailed comments. I like the analogy of inside the box and outside the box because one of the comments that I wanted to make is what I've seen and what I think I hear is there's attention to things that can affect the irradiation facility and there's attention to things that can affect the radioisotope production facility. Those are two boxes. And they're literally boxes on the frame.

There's not much attention to things outside the boxes. Now, an important set of things that are outside the boxes are in the bottom part of that drawing are all of the rooms that contain all of those cabinets: the control room, power supplies, things that I've been stressing along that have an integrated effect on the whole facility.

And I don't, the message I want to leave is I don't see the attention being paid to that integrated effect on those common whether you want to call them support systems, protection systems, control systems, you name it, because there's too much thinking about what can affect the radiation

facility and what requirements do I need to have for that versus what can affect the production facility and what kind of requirements do I need for that because that's more like a process plant. And I see it on both sides.

So and why stress that right now? Well, it can affect construction because if you have to somehow reconfigure that part of outside those boxes because you need to move around where things are located because you didn't have enough compartments or you didn't have enough spacing or you needed to provide a different type of ventilation system, you don't want to go back and do that after the fact. You run into what Dennis is saying is you get the facility built and find out that it costs too much to fix it.

So it's worth thinking about that kind of stuff now in a little bit more detail. You don't need the final sizes of the blowers. You don't need the final specifications on temperatures. You just to make sure somebody's asked those questions.

ACTING CHAIRMAN BLEY: Kord Smith, we have your preliminary comments and I expect we'll get further written comments. But if you have anything at this time you'd like to add that we especially

ought to be paying attention to or the Staff or the applicant could benefit from the comments now, please go ahead.

MR. SMITH: Okay, thank you very much.

I guess the one area that I keep coming back to in my analysis, and it's a pretty limited scope that I have here, is that I essentially look at this facility as operating so close to critical that we might as well consider it to be a critical reactor. And that's why on your FSAR and your tech specs and commissioning tests that you'll have laid out then, I'm going to be looking very carefully at the reactivity addition rates when you first fill the TSVs. Just make sure that your dump valve actuation time and the negative reactivity you're going to get from that is sufficient to keep you away from trouble.

Also, a little concern that of course there's no diversity in your ultimate shutdown mechanism. If you do go critical you have dump valves and once they dump obviously it will be subcritical. But there's no diversity in that system, although there is redundancy.

So I think I will be looking very carefully at those reactivity addition rates.

And I think from the Staff's point of

view I think it's very important that you make the statement that even if there is a criticality we are confident that it can be shut down through these dump valves and the storage. But that has to come across plainly.

ACTING CHAIRMAN BLEY: Kord, thank you.

Let me say one more thing. Maitri has been asking me if one more meeting is going to be enough for us. I was very pessimistic. I thought this meeting we couldn't possibly get through all the topics. It looks like we're going to.

So we don't know the answer to that for sure. I'm hopeful that we can do it. And today is a good sign I think.

At this time we want to close the public phone line and we want to have both SHINE and the Staff check people who are in the room and make sure they are either your, one of your people and they have right to be here and need to know for what we're going to look at met.

And we can take a 2-minute break while we do that if anybody needs to run out in the hall, or just do anything you'd like. But be back in 2 or 3 minutes, 5 minutes.

(Whereupon, at 5:10 p.m., the

above-entitled matter was went off the record in PUBLIC SESSION and went back on the record at 5:15 p.m. in CLOSED SESSION.)

SHINE™ Medical Technologies

Advisory Committee on Reactor Safeguards Radiation Protection & Nuclear Materials Subcommittee Meeting on the SHINE Construction Permit Application

August 19, 2015

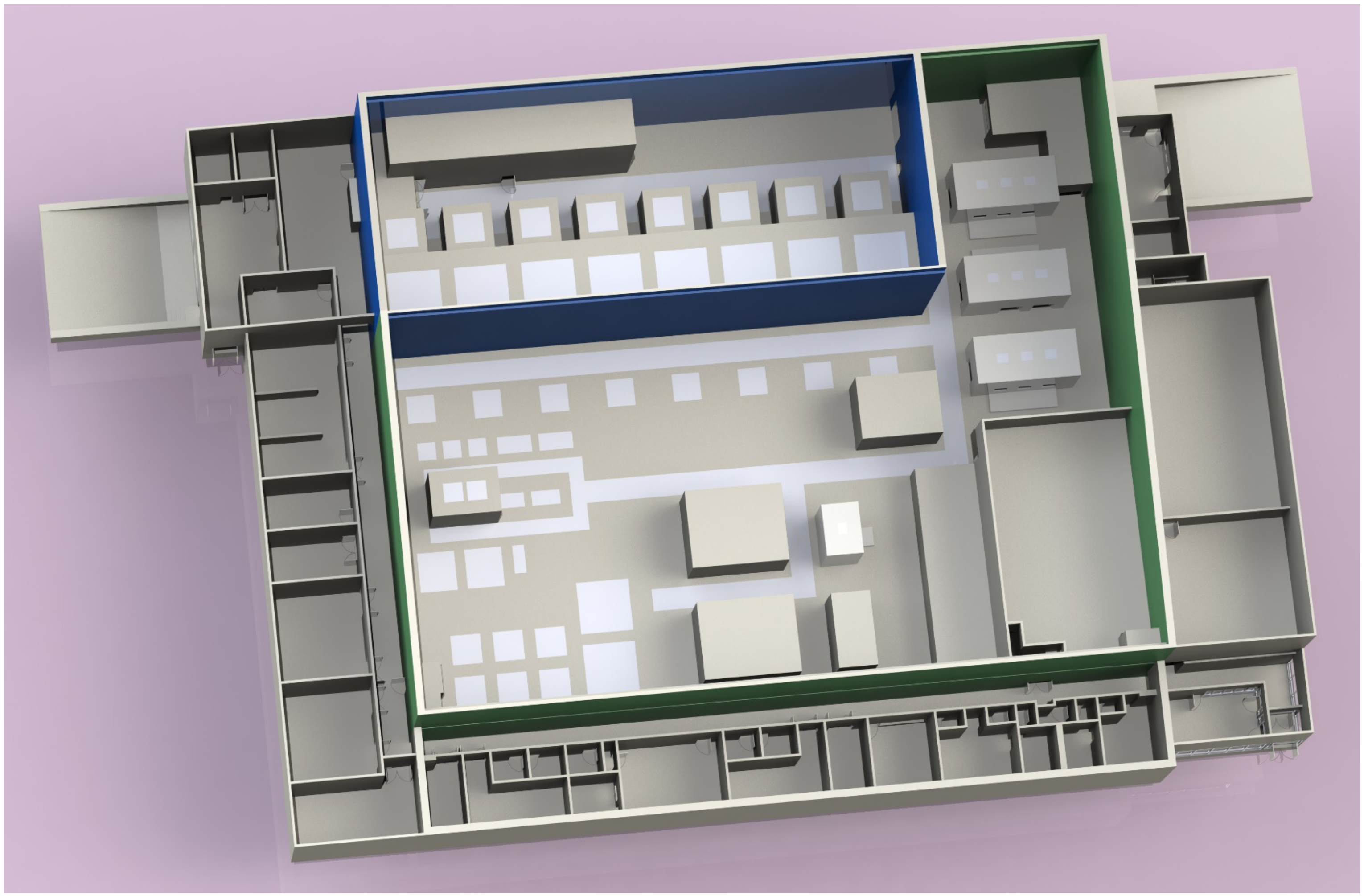
Chapter 3 – Design of Structures, Systems, and Components

John McLean, Sargent & Lundy
Eric Van Abel, SHINE
August 19, 2015

Facility Preliminary Arrangement

- SHINE Main Production Facility:
  - Essentially one story building at grade
  - Tank vaults and trenches below grade
  - Safety-Related areas protected by thick concrete walls and roof
- Seismic Boundary:
  - Concrete shear wall substructure
    - Subgrade walls are a minimum of 3 ft. thick
  - Concrete shear wall superstructure
    - Shear walls and roof diaphragm are a minimum of 2 ft. thick
- Adjacent Seismic II/I Areas:
  - Concrete mat foundation
    - Mat separated from seismic boundary by seismic gap
  - Steel and/or concrete wall superstructure
    - Designed to ensure seismic II/I protection of safety-related envelope

Facility Preliminary Arrangement



Meteorological Damage

- Wind Loading
  - Basic wind speed (50-year recurrence interval) of 90 mph (ASCE 7-05), converted to 96.3 mph (100-year)
- Tornado Loading
  - Maximum wind speed of 230 mph converted to velocity pressure (ASCE 7-05)
  - Differential pressure of 1.2 psi (Regulatory Guide 1.76) applied as outward pressure to exterior walls and roof
  - Missile spectrum per Regulatory Guide 1.76
  - Missile impacts converted to equivalent static load (NUREG-0800)
  - Load combinations evaluated per NUREG-0800, Section 3.3.2
- Snow, Ice and Rain Loading
  - 30 psf (50-year recurrence interval) snow load, converted to 36.6 psf (100-year), calculated per ASCE 7-05
  - Rain loading not considered due to sloped roofs; ice load enveloped by design snow load

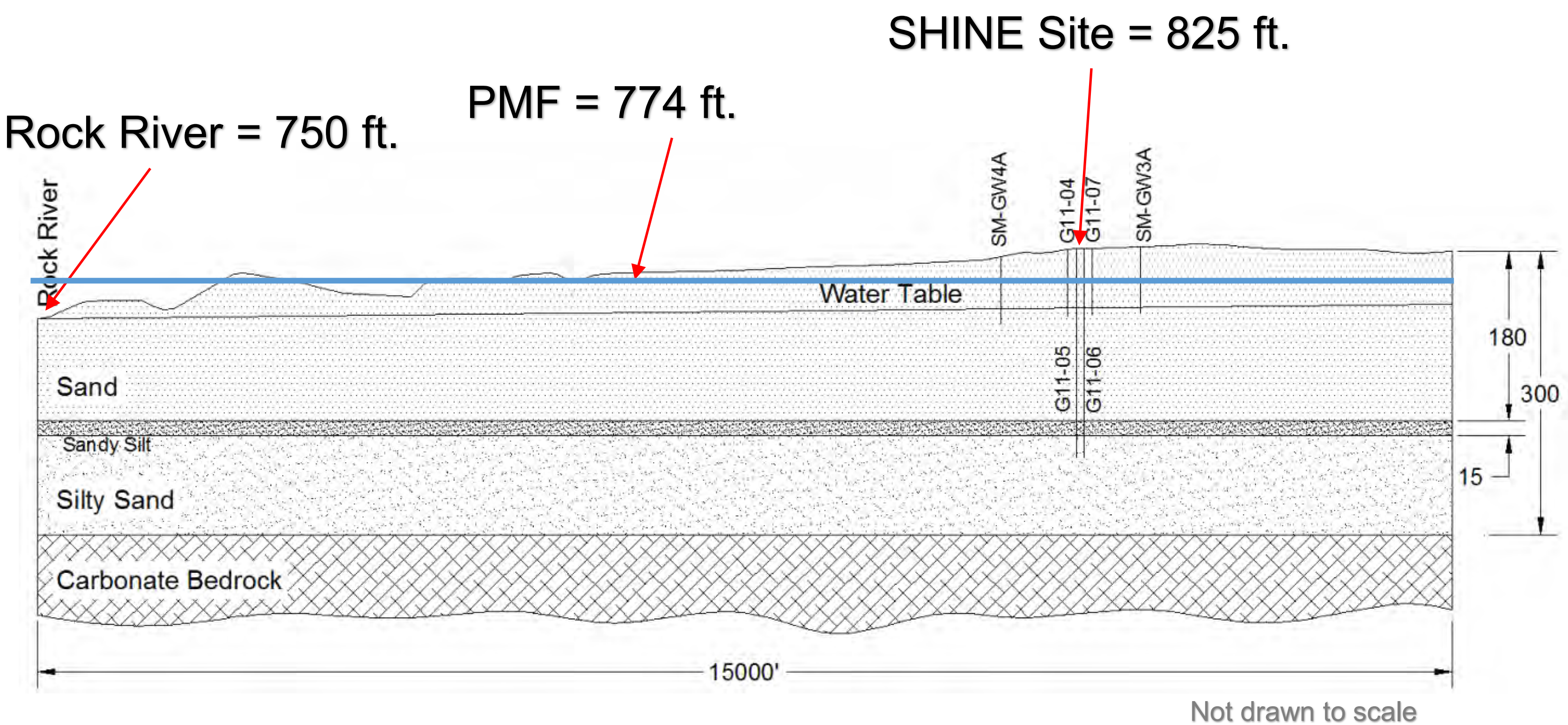
Design Temperatures

- Winter (minimum) temperatures
  - Minimum temperature on surface of siding or concrete = -35°F
- Summer (maximum) temperatures
  - Maximum temperature on surface of siding or concrete = 105°F
- Temperature-induced loads
  - Thermal gradients expected to be less than approximately 100°F (indoor to outdoor)
  - Uniform temperature changes expected to be less than approximately 50°F (original poured temperature to design temperatures)
  - Loading effects can therefore be neglected per ACI 349.1R-07

Water Damage

- Design basis flood level: 774 ft. (caused by PMF)
  - SHINE site is 825 ft. (grade)
  - Lowest point of building is 29 ft. below grade (approx. 796 ft.)
  - No dynamic force due to flooding
- Design basis precipitation level: at grade (caused by PMP)
  - Main floor of building is 4 in. above grade
  - Exterior walls below grade are not less than 3 ft. thick.
  - Water stops are provided in all construction joints below grade.
  - Waterproof coating is applied to external surfaces below grade.
  - Roofs are designed to prevent pooling of large amounts of water in accordance with Regulatory Guide 1.102.

Water Damage



Water Damage

- Internal flooding
  - Water collection system accommodates firefighting water volume
    - 30 minutes (per NFPA 801) at 550 gpm total flowrate
  - Safety-Related equipment is protected from water damage
    - Flood protective compartments, or
    - Raised to 8 in. or 12 in. above grade (at least 50% higher than calculated water depth)
  - Potential failure resulting in a total loss of the light water pool is not considered due to robust safety-related design
    - Approximately 6 ft. thick reinforced concrete
    - Stainless steel liner
    - Pool is below grade

Seismic Analysis Methodology

- Analysis methodology conforms to NUREG-1537 and IAEA-TECDOC-1347, supplemented with NRC guidance from SRP and Regulatory Guides
- 3-D Soil-Structure Interaction (SSI) analysis is performed
- SSI Analysis is performed in two steps:
  - Step 1: Free field site response analysis to determine strain-dependent soil properties, using SHAKE2000 program
  - Step 2: SSI Analysis Using Combined soil-structure model, with Soil Properties from Step 1, using SASSI2010 program

Seismic Input Motion

- Site Peak Ground Acceleration (PGA) determined based on seismic hazard assessment for Janesville site, using 2008 USGS National Seismic Hazard Maps
- PGA of 0.20g is used for both horizontal and vertical directions, which equates to low hazard with return period of 20,000 Years (probability of annual exceedance = 5×10^{-5})
- Ground motion response spectra based on Regulatory Guide 1.60 with PGA of 0.20g; acceleration time history meeting SRP 3.7.1 requirements

Seismic Analysis Model

- 3-D Structural Model consists of shell and beam elements (Based on SAP2000 Model used for structural design)
- Structural damping based on OBE damping values in NRC Regulatory Guide 1.61
- Layered soil properties (strain dependent shear modulus and damping, unit weight, and Poisson's Ratio) from site soil boring results

Seismic Analysis Results

- Seismic analysis produced the following seismic design responses:
  - In-structure seismic response spectra for various damping values (horizontal and vertical directions) at critical locations of the building.

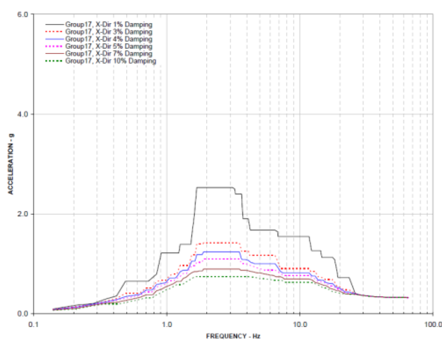


Figure 52. Enveloped Response Spectra - Center of Upper (RCA) Roof (EL ~58ft), X Direction (±30% widening)

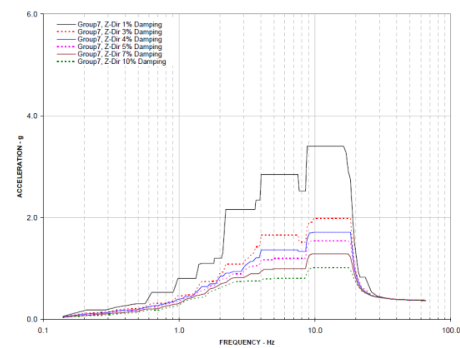


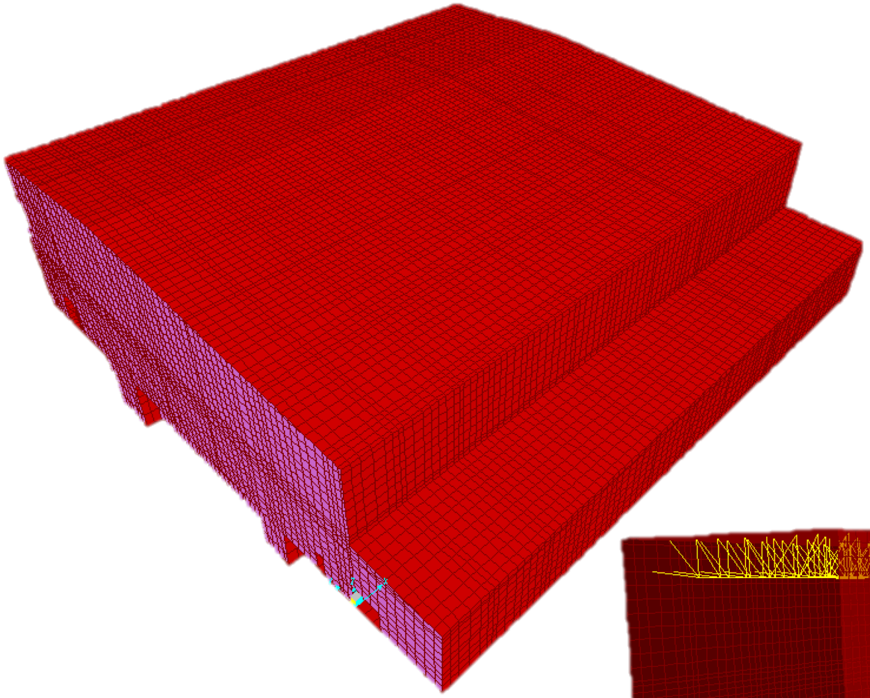
Figure 24. Enveloped Response Spectra - Center of Shear Wall (EL Varies), Z Direction (±30% widening)

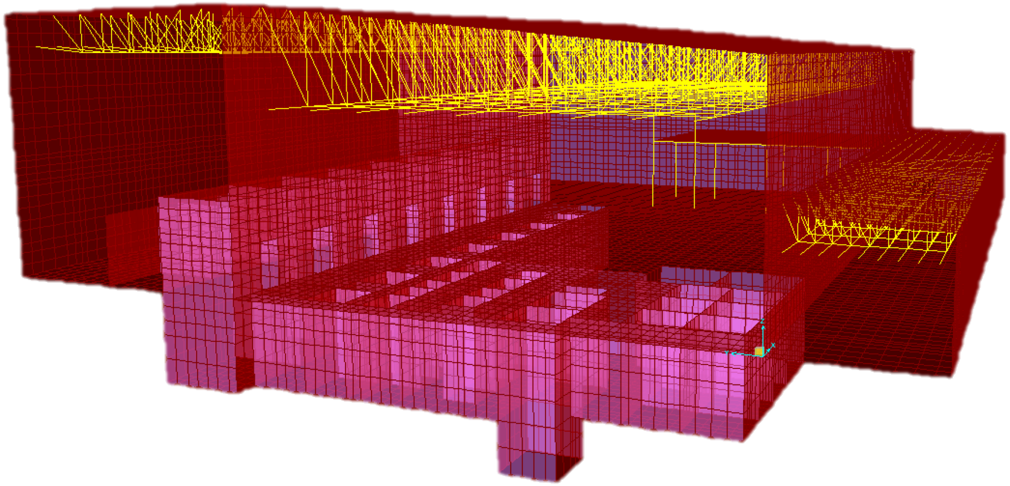
  - Maximum seismic accelerations at critical locations of the building
    - Center of Upper Roof (0.31 g horizontal, 0.90 g vertical)
    - Center of Shear Walls (0.41 g horizontal, 0.31 g vertical)

Structural Analysis Model

- Structural analysis determines adequacy for seismic (and other) hazards
  - A 3-D finite element model of the SHINE facility structure was created using the computer program SAP2000.
  - Required concrete reinforcement ratio calculated from SAP2000 force and moment outputs.
- Model consists of all safety-related areas
  - Wall heights are modeled to actual height dimensions to adequately capture wind and tornado loading.
  - Mesh aspect ratio is most commonly 1 ½ :1 (average element size is 3 ft. x 3 ft. for 2 ft. thick concrete), and is limited to a 4:1 ratio

Structural Analysis Model





Structural Analysis Results

- Structural Analysis Results
  - Concrete walls and slabs in the SHINE facility are designed for axial, flexural, and shear loads per provisions of ACI 349-06 .
  - Walls and slabs are modeled in SAP2000 using groups of shell elements. Using resultant loads obtained from SAP2000 model data, an element is designed as a reinforced concrete section per ACI 349-06.
  - Using these results, required reinforcement is specified in PSAR Table 3.4-1 for representative elements.
- Aircraft Impact Results
  - Global and local aircraft impact analysis performed using methods consistent with DOE-STD-3014-2006.
  - Structure shown to resist scabbing and perforation
    - Scabbing thickness = 1.612 ft.
    - Perforation thickness = 0.827 ft.
  - Concrete reinforcement specified to withstand impact
  - Building trusses shown to resist buckling

Design of Systems and Components

- Certain systems and components are considered important to safety because they perform safety functions during normal operations or as required to prevent or mitigate accidents.
  - SSCs must be capable of performing their design basis functions under the bounding conditions of normal operation or any accident or event that they are required to function.
- SSCs that are determined to have safety significance are designed, fabricated, and tested commensurate with the criteria set forth in ANSI/ANS-15.8 ("Quality Assurance Program Requirements for Research Reactors").
  - Implemented by Quality Assurance Program Description (QAPD).
  - Records determined to have safety significance are maintained throughout plant life.

Design of Systems and Components

- I&C systems are provided that can monitor variables over anticipated ranges for normal operation, accident conditions, and safe shutdown.
- SHINE system designs based on defense-in-depth practices, with preference for engineered and passive controls over administrative controls.
- Single failure criterion is applied to safety systems
  - Sufficient redundancy and independence that a single failure of an active component does not result in loss of capability to perform its safety function.
  - A single failure, in conjunction with initiating event, does not result in the loss of the systems ability to perform its safety function.

Safety-Related SSC Definition

- Safety-related SSCs are those SSCs that are relied upon to remain functional during normal conditions and during and following design basis events to assure:
  1. The integrity of the primary system boundary;
  2. The capability to shutdown the target solution vessel (TSV) and maintain the target solution in a safe shutdown (SSD) condition;
  3. The capability to prevent or mitigate the consequences of accidents which could result in potential exposures comparable to the applicable guideline exposures set forth in 10 CFR 20;
  4. That all nuclear processes are subcritical, including use of an approved margin of subcriticality;
  5. That acute chemical exposures to an individual from licensed material or hazardous chemicals produced from licensed material could not lead to irreversible or other serious, long-lasting health effects to a worker or cause mild transient health effects to any individual located outside the owner controlled area; or
  6. That an intake of 30 mg or greater of uranium in soluble form by any individual located outside the owner controlled area does not occur.

Design of Systems and Components

- Plant SSCs are designed to withstand the effects of the design basis earthquake (DBE) if they perform a safety-related function or if necessary to ensure they do not degrade the function and performance of any safety-related SSC.
- Safety-related SSCs are designated as Quality Level 1 (QL-1) in the QAPD, and the full measure of the QAPD is applied to these SSCs.
- Selected SSCs that support or protect the safety function of safety related equipment are designated QL-2, and quality elements are applied commensurate with the importance to safety.
- QL-3 is applied to nonsafety SSCs that do not support or protect the safety function of safety-related SSCs.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Advisory Committee on Reactor Safeguards
Radiation Protection & Nuclear Materials Subcommittee
Meeting on SHINE Construction Permit Application

Chapter 3
Design of Structures, Systems, and Components

August 19, 2015

Design Criteria

- Licensing Basis
  - The SHINE facility is being licensed under 10 CFR Part 50
  - However, because of the unique design considerations of the facility, the design is evaluated against both the criteria of 10 CFR Part 50 and the 10 CFR 70.64, “Baseline Design Criteria,” as described in the interim staff guidance (ISG) to NUREG-1537.
  - As required by 10 CFR 50.34(a)(3)(i), SHINE must describe the principal design criteria for its facility in the PSAR; however, SHINE is not required to follow 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” as this appendix only applies to nuclear power reactors. Nonetheless, SHINE has applied several of the GDCs to the preliminary design of its facility.
  - “Although compliance with 10 CFR 70.64 is not specifically required for a radioisotopes production facility licensed under 10 CFR 50, a license application that adequately addresses the baseline design criteria listed in 10 CFR 70.64 would be found acceptable by staff.”

Meteorological Damage and Water Damage

- Meteorological Damage:
  - The Facility is designed to withstand wind, tornado, snow, ice, and rain loadings postulated for the site location.

- Water Damage:
  - The Facility is designed to withstand flood, precipitation, and ground water levels postulated for the site location.
  - The Facility is designed to protect internal structures, systems, and components from the effects of postulated internal flood.

Seismic Damage

- Safe Shutdown Earthquake (SSE):
  - The Facility is designed to withstand the SSE postulated for the site location.
    - The Facility is designed to withstand the SSE ground accelerations and be maintained in a safe shutdown condition.
    - The Facility internal structures, systems, and equipment are SSE qualified to ensure functional reliability.
- Aircraft Impact:
  - The Facility is designed to withstand the effects of an accidental crash by an aircraft operating through the Southern Wisconsin Regional Airport (SWRA).
- External Explosions:
  - The Facility is designed to be robust enough to withstand credible external explosions.

Safety Related Structures, Systems, and Components

- In developing the Facility definition for Safety Related Structures, Systems, and Components (SSCs), the applicant reviewed the following safety criteria:
  - 10 CFR 50.2 definition for Safety Related (SR)
  - 10 CFR 70.4 definition for Items Relied on for Safety

Safety Related Structures, Systems, and Components (Continued)

- The applicant provided a preliminary definition based on the SR and IROFS definitions. After staff review and RAI responses, the following SR definition is being used:
  Safety-Related SSCs: Those SSCs that are relied upon to remain functional during normal conditions and during and following design basis events to assure:
  1. *The integrity of the primary system boundary;*
  2. *The capability to shutdown the target solution vessel (TSV) and maintain the target solution in a safe shutdown (SSD) condition;*
  3. *The capability to prevent or mitigate the consequences of accidents which could result in potential exposures comparable to the applicable guideline exposures set forth in 10 CFR 20;*
  4. *That all nuclear processes are subcritical, including use of an approved margin of subcriticality;*
  5. *That acute chemical exposures to an individual from licensed material or hazardous chemicals produced from licensed material could not lead to irreversible or other serious, long-lasting health effects to a worker or cause mild transient health effects to any individual located outside the owner controlled area; or*
  6. *That an intake of 30 mg or greater of uranium in soluble form by any individual located outside the owner controlled area does not occur.*

Safety Related Structures, Systems, and Components (Continued)

- There two items, while not necessary for the issuance of a CP, the applicant will need to address in the FSAR:
  - Control Room Habitability – While the Control Room is considered SR, many of the support systems (i.e., HVAC, lighting, breathing air, communications, etc.) are not. In response to an RAI, the applicant provided information on how these issues will be addressed. This information should be part of the FSAR.
  - RVZ3 Safety Classification – The applicant has stated that RVZ3 in non safety. However, in responses to Chapter 9 RAIs the applicant has stated that RVZ3 areas are the airlocks between the RCA and the outside world. In addition, the applicant has stated that RVZ3 is the tertiary confinement zone for the RCA and that ventilation for RVZ3 is supplied via safety related RCA air handling units. Thus, during the OL review, the applicant will need to clarify why RVZ3 should not be SR.

Unique Considerations for SHINE Radioisotope Production Facility

- Summary of the SHINE PSAR:
  - Section 3.1-1 provides a list of 65 systems
  - Section 3.1-2 provides 11 pages of codes and standards used to guide the design of the SHINE facility
  - Section 3.1-3 discusses the use of 26 regulatory guides used to guide the design of the SHINE facility
  - Section 3.5b-1 provides the baseline and general design criterial for the SHINE Radioisotope Production Facility

Unique Considerations for SHINE Radioisotope Production Facility

- Application of Defense-in-Depth
- Single Failure Considerations
- Modifications to the definition of "safety-related structures, systems, and components"

Areas of Review

- Sufficiency of principle design criteria
- Design bases
- Information on types of equipment, functional requirements, and general arrangement, sufficient to provide reasonable assurance that final design will conform with design basis

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements:
  - 10 CFR 50.34, "Contents of applications System technical information," paragraph (a), "Preliminary safety analysis report."
  - 10 CFR 50.35, "Issuance of Construction Permits."
- Acceptance Criteria
  - NUREG-1537 and ISG, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria."
  - Referenced/invoked codes and standards

Review Procedures and Technical Evaluation

- Section-by-section evaluation of the technical information presented in Chapter 3 of the SHINE PSAR
- Supplemented by responses to RAIs
- Assessed sufficiency of preliminary design and expected performance of these SSCs in support of CP issuance

Evaluation Findings and Conclusions

- PSAR Chapter 3 meet the following requirements of 10 CFR 50.35 for issuance of a construction permit:

1) Auxiliary systems have been described, including the principal architectural and engineering criteria

2) Further technical or design information may be reasonably left for later consideration in the FSAR

1) The proposed facility can be constructed without undue risk to the health and safety of the public

FSAR Follow-Up Items

- Snow Load – Section 3.2
- SSC Protection From FP Suppression Discharge – Section 3.3
- SHAKE2000 Version Reference – Section 3.4
- Seismic Instrumentation – Section 3.4
- Facility Egress/Access Post-DBE – Section 3.5
- Safety Classification of RVZ3 – Section 3.5
- Control Room Seismic Classification – Section 3.5
- Control Room Habitability & Support Systems Issues – Section 3.5
- 10 CFR 70.64, Criterion 7 Revision – Section 3.5b

Discussion

Chapter 9 – Auxiliary Systems

Catherine Kolb, SHINE
Rico Ricohermoso, Sargent and Lundy
Joseph Aldiere, Sargent and Lundy

August 19, 2015

Heating, Ventilation, and Air Conditioning Systems

- The SHINE production facility is designed with four ventilation zones.
  - Radiologically Controlled Area (RCA) Ventilation Zone 1 (RVZ1)
  - RCA Ventilation Zone 2 (RVZ2)
  - RCA Ventilation Zone 3 (RVZ3)
  - Facility Ventilation Zone 4 (FVZ4)
- A negative pressure differential is maintained between the confinement zones, ensuring airflow travels in the direction from zones of lower potential for contamination to zones of higher potential for contamination

$$P_{RVZ1} < P_{RVZ2} < P_{RVZ3} < P_{Ambient}$$

- FVZ4, outside of the RCA, is slightly positively pressurized with respect to the atmosphere

$$P_{Ambient} < P_{FVZ4}$$

RCA Ventilation Zone 1 (RVZ1)

- Areas where high levels of airborne contamination are anticipated during normal operations
- Ambient supply air from adjacent RVZ2 spaces
- Air inlets are equipped with automatic isolation dampers (fail closed), manual isolation dampers, and non-credited HEPA filters
- Air exhausts include automatic isolation dampers to enable confinement of the specific RVZ1 area and local HEPA filters

RCA Ventilation Zone 1 (RVZ1)

- Automatic isolation dampers on the supply and exhaust
  - Safety-related
  - Isolate upon a signal from the Engineered Safety Features Actuation System (ESFAS) or the Radiological Integrated Control System (RICS)
  - Additional safety-related isolation dampers located downstream of the final filters

RCA Ventilation Zone 2 (RVZ2)

- Areas where airborne contamination could be present during normal operations (but is not routinely), or as a result of a breach of an RVZ1 confinement area
- Direct supplied air via the RCA supply air handling units (AHUs), which contain filters, pre-heat and cooling coils, and supply fans
- Additional air cascaded into RVZ2 areas from RVZ3 areas via engineered airlock door leakage pathways due to a negative pressure differential
- Exhaust through general room exhausts and fume hood enclosures (where present)
- A portion of RVZ2 air is also transferred to RVZ1 areas through RVZ1 area air inlets

RCA Ventilation Zone 2 (RVZ2)

- Supply and exhaust systems have airflow control valves, reacting to maintain the design differential pressure and ensuring the zone pressures are negative with respect to atmosphere and RVZ3
- Safety-related automatic isolation dampers
  - In supply duct at the RCA boundary
  - In exhaust duct system downstream of the final filters
  - Controlled by RICS to provide confinement

RCA Ventilation Zone 3 (RVZ3) and Facility Ventilation Zone 4 (FVZ4)

- RVZ3
  - Areas where airborne contamination is not expected during normal facility operations
  - Consists of RCA airlocks
- FVZ4
  - Areas outside the RCA, but within the production facility building
  - Supplied by independent AHUs
  - Controlled by FICS

Fire Protection Systems and Programs

- The SHINE Facility Fire Protection System (FFPS) meets the design criteria of NFPA 801, “Standard for Standard for Fire Protection for Facilities Handling Radioactive Materials.”
  - Fire water is normally supplied from two separate fresh water storage tanks, backup supply from city water main.
  - There are two 100 percent capacity fire pumps; the lead pump is electric motor-driven and the secondary pump is diesel engine-driven.
- The SHINE Fire Protection Program will comply with ANSI/ANS 15.17, “Standard for Fire Protection Program Criteria for Research Reactors.”

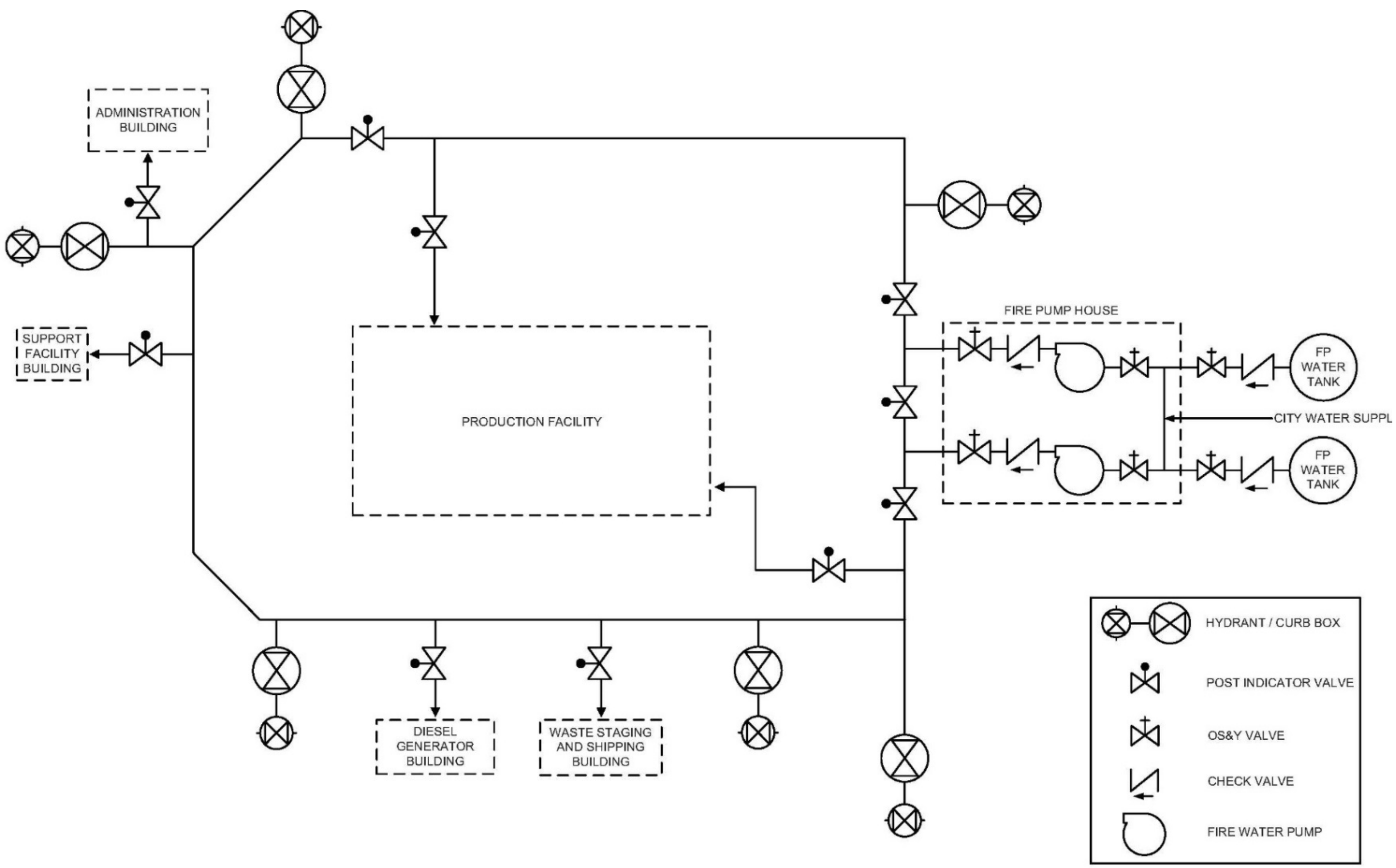
Fire Hazards Analysis (FHA)

- Evaluates the potential for occurrence of fires within the SHINE facility
- Documents the capabilities of the fire protection system
- Provides reasonable assurance of the capability achieve safe shutdown
- Ensures that fire protection requirements established in NUREG-1537 have been applied to the SHINE facility and are sufficient in:
  - Preventing fires, including limiting combustible materials
  - Detecting, controlling, and extinguishing fires to limit consequences
  - Protecting systems required for safe shutdown

Fire Hazards Analysis (FHA)

- The SHINE facility is divided into 21 fire areas.
  - Each fire area is separated from other areas by fire barriers, such as walls, floors, ceilings, penetration seals, fire doors, and dampers
  - 3-hour fire resistive rating where required by high combustible loading or where adjacent rooms contain SSCs from a different safety train
- FHA identifies fire protection system design features necessary to minimize both the occurrence and the consequences of fire for the SHINE facility as well as Life Safety considerations:
  - Fire detection
  - Fire suppression
  - Passive protection (i.e., fire barriers)

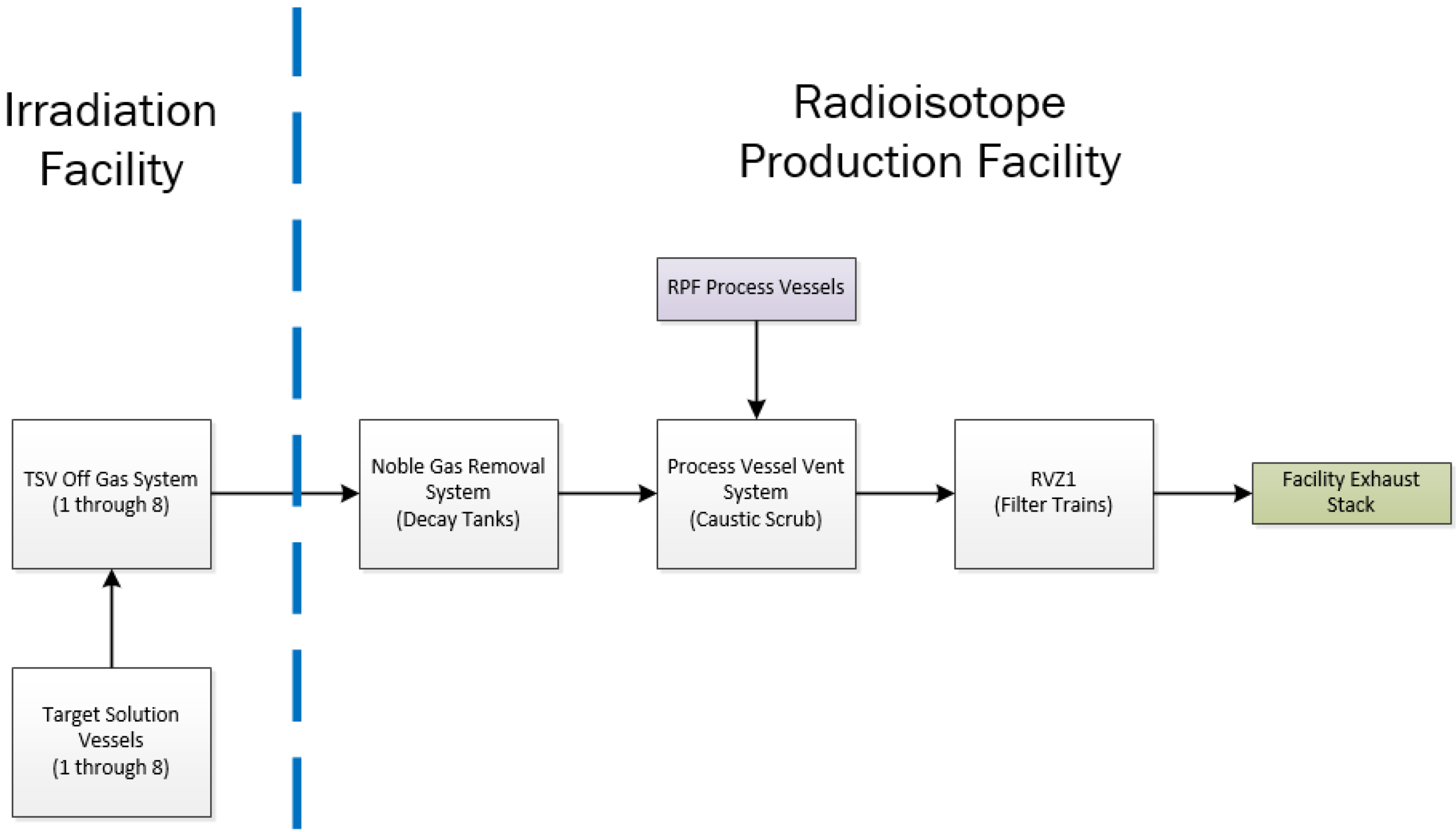
Fire Protection Process Flow Diagram



Tritium Purification System (TPS)

- Process function to provide high-purity tritium to the neutron driver (NDAS):
  - Two TPS gloveboxes with separate trains
  - TPS receives mixed tritium/deuterium gas from driver, removes impurities, separates hydrogen isotopes, and buffers supplies
  - Monitors gaseous effluents and scrubs glovebox atmosphere for tritium that may escape from the purification processes
- Safety-related function to minimize tritium releases:
  - Confinement system boundaries
    - Gloveboxes, including the pressure protection bubbler and glovebox airlock
    - Outer jacket of double-walled piping that transfers tritium outside of gloveboxes
    - Confinement isolation valves that isolate portions of the tritium system upon loss of integrity to limit tritium releases
  - Cell volume sized to maintain tritium concentration below the lower flammability limit in the event of a leak into the glovebox

Gas Handling Systems



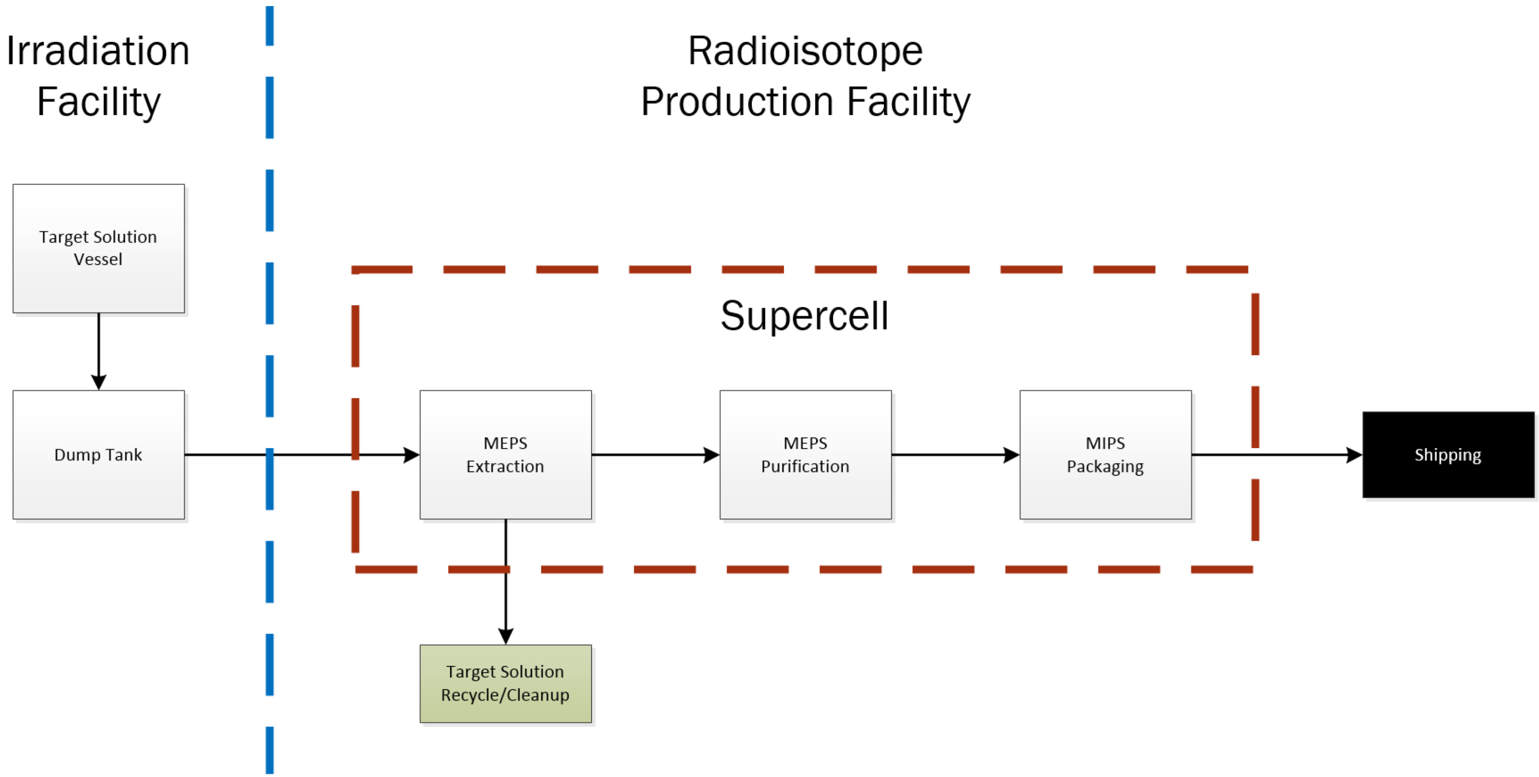
Noble Gas Removal System (NGRS)

- Safety-related system
- Stores fission product gases, i.e., radioactive isotopes of iodine and noble gases (primarily krypton and xenon), generated in the TSV during an irradiation cycle
- Stores gases for at least 40 days of decay prior to sampling for release
- Decayed off-gas released to the Process Vessel Vent System (PVVS)
- Off-gas releases monitored to ensure radioactivity levels are below regulatory limits for discharge to the environment.

Process Vessel Vent System (PVVS)

- Process function to collect and treat the off-gases from process vessels and NGRS:
  - Receive off-gas from the process systems within the RPF
  - Treat off-gas to remove excess acids
  - Transfer treated off-gas to the RVZ1 exhaust system
  - Maintain process vessels at a negative pressure for contamination control
- Safety-related functions of the PVVS include:
  - Prevent detonation or deflagration of radiolytic hydrogen gas by maintaining the hydrogen concentration below the LFL by diluting the evolved gases
  - Capture noble gases from process vessel vents

Mo-99 Processing Systems



Molybdenum Isotope Product Packaging System (MIPS)

- Receives the Mo-99 product collection bottle from the Molybdenum Extraction and Purification System (MEPS)
- Once in the MIPS area of the supercell, the product goes through an assay and quality control procedure
- The Mo-99 product is then removed from the Mo-99 product collection bottle and placed in an inner Mo-99 product shipping container
- The inner shipping container is loaded inside an outer shipping cask

Radioactive Liquid Waste Systems

- Aqueous Radioactive Liquid Waste Storage System (RLWS)
  - Two liquid waste storage tanks, each provide around 40 days of buffer storage capacity of radioactive liquid wastes produced by normal facility operations
  - Liquid waste is primarily routine effluents, but also includes liquid wastes generated by non-routine operations such as maintenance activities
  - Waste is sampled to verify the chemical and radiological composition prior to entering the RLWS tanks or feeding the RLWE liquid waste evaporator
- Radioactive Liquid Waste Evaporation and Immobilization System (RLWE)
  - Evaporation system reduces the liquid waste volume
  - Immobilization system mixes the bottoms product from the evaporator with a cement formula to produce a monolithic solid waste form for shipping and disposal as radioactive waste

Radioactive Drain System (RDS)

- Receives radioactive liquids from various systems, collecting spills and leaks of radioactive liquids from processing areas
- Drain lines are sloped to the criticality-safe sump catch tank, which is sized to contain a potential leak from the largest tank with radioactive liquids
  - Once the liquid is received in the criticality-safe sump catch tank, it can be sampled and characterized, if needed
  - The liquid may be treated with caustic or nitric acid, depending on the pH

Red Oil Event Prevention Features

- DNFSB/TECH-33 recommends the following controls where organics have the potential to come in contact with nitric acid
  - Temperature: maintain at less than 130°C
  - Pressure: provide a sufficient vent for the process to keep a potential pressure increase from destroying the process vessel and to prevent the red oil reaction from becoming autocatalytic
  - Mass: remove organics from the process
  - Concentration: maintain nitric acid less than 10 M
- SHINE uses these recommended controls in addition to organic impurity monitoring and residence time controls to prevent red oil events
- SHINE will continue to evaluate industry experience and review the available literature regarding red oil events and will apply this information during detailed design as appropriate

Red Oil Event Prevention Features

Process	Temp	Organic Controls	Vent	Nitric Acid Conc
Uranium metal dissolution	✓	✓	✓	
Uranyl nitrate preparation	✓	✓	✓	✓
UNCS evaporation	✓	✓	✓	
UNCS denitration		✓	✓	
UREX	✓	✓ **(TBP degradation products)**	✓ **(hold and collection tanks)**	✓
Liquid waste evaporation	✓	✓	✓	

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Chapter 9
Auxiliary Systems

August 19, 2015

Listing of Sections/Systems in Chapter 9

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Section 9a2	Irradiation Facility Auxiliary Systems
Section 9b	Radioisotope Production Facility Auxiliary Systems

Systems Common to Both Facilities

Sections 9a2.1 & 9b.1	Heating, Ventilation, and Air Conditioning Systems
Sections 9a2.3 & 9b.3	Fire Protection Systems and Programs
Sections 9a2.4 & 9b.4	Communication Systems

Systems Unique to Each Facility

Section 9a2.2	Handling & Storage of Target Solution
Section 9a2.5	Possession and Use of Byproduct, Source and Special Nuclear Material
Section 9a2.6	Cover Gas Control in Closed Primary Coolant Systems – *(to be provided in the FSAR)*
Section 9b.2	Handling & Storage of Target Solution
Section 9b.5	Possession and Use of Byproduct, Source and Special Nuclear Material
Section 9b.6	Cover Gas Control in Closed Primary Coolant Systems

Listing of Sections/Systems in Chapter 9
(Continued)

Other Auxiliary Systems

Section 9b.7.1	Molybdenum Isotope Product Packaging System
Section 9b.7.2	RCA Material Handling
Section 9b.7.3	Radioactive Liquid Waste Evaporation and Immobilization System
Section 9b.7.4	Aqueous Radioactive Liquid Waste Storage System
Section 9b.7.5	Solid Radioactive Waste Packaging System
Section 9b.7.6	Radioactive Drain System
Section 9b.7.7	Material Handling
Section 9b.7.8	Facility Potable Water System
Section 9b.7.9	Facility Instrument Air System
Section 9b.7.10	Facility Compressed Air System
Section 9b.7.11	Facility Breathing Air System
Section 9b.7.12	Facility Inert Gas System
Section 9b.7.13	Facility Roof Drains System
Section 9b.7.14	Facility Sanitary Drains System
Section 9b.7.15	Facility Acid Reagent Storage and Distribution System
Section 9b.7.16	Facility Alkaline Reagent Storage and Distribution System
Section 9b.7.17	Facility Salt Reagent Storage and Distribution System
Section 9b.7.18	Facility Organic Reagent Storage and Distribution System
Section 9b.7.19	Organic Liquid Waste Storage and Export
Section 9b.7.20	Off-Normal and Accident Scenarios

Select Systems Discussion

In the next slides, those auxiliary systems which generated RAIs are discussed.

Heating, Ventilation, and Air Conditioning System

- Single system serves:
  - Irradiation Facility and the Radioisotope Production Facility
  - The system is divided into 4 subsystems. Of which three serve the RCA (RVZ1, RVZ2, RVZ3) and one serves the remainder of the facility (FVZ4)
- Provides:
  - Normal Service
  - Emergency Service (prevent/minimize offsite releases)
- While the PSAR descriptions coupled with the RAI responses is sufficient for the CP review, that information on the 4 subsystems (including figures) needs to be incorporated into the FSAR for the OL review.

Fire Protection System and Programs

- Single system serves:
  - Irradiation Facility and the Radioisotope Production Facility
- Provides:
  - Protects the facility from fire damage
  - Provides fire detection and suppression
  - Provides the means to safely shut down in case of a fire
  - Includes a Fire Hazards Analysis to provide assurance that the combustible loads and fire barriers are sufficient to mitigate the spread of a fire
- While the PSAR descriptions coupled with the RAI responses is sufficient for the CP review, additional detail will be needed in the FSAR for the OL review. Also, at the OL stage, the effects of the pipeline gas combustible load (until the pipeline can be shut off outside the boiler room) on the boiler room and adjacent fire areas.

RCA Material Handling

- System serves the entire radiological controlled area
- Provides:
  - Overhead cranes and other heavy lift equipment for the removal/placement of shielding
  - Equipment to move/manipulate radioactive material
  - Where required, equipment is designed to prevent inadvertent criticality
- While the PSAR descriptions coupled with the RAI responses is sufficient for the CP review, additional detail will be needed in the FSAR for the OL review. Also, at the OL stage, depending on the final design, it may be necessary to have some of the material handling requirements incorporated into the Technical Specifications

Unique Considerations for SHINE Radioisotope Production Facility

- RPF Auxiliary Systems:
  1. Heating, ventilating, and air conditioning
  2. Handling and storage of target solution
  3. Fire protection systems and programs
  4. Communications systems
  5. Possession and use of byproduct, source, and special nuclear material
  6. Cover gas control (PVVS and NGRS)
  7. Other auxiliary systems

Unique Considerations for SHINE Radioisotope Production Facility

- 8 Auxiliary Systems that process byproduct material in the RPF:
  - Target Solution Preparation System (TSPS).
  - Radioactive Drain System (RDS).
  - Aqueous Radioactive Liquid Waste Storage System
  - Radioactive Liquid Waste Immobilization System
  - Process Vessel Vent System (PVVS).
  - Molybdenum Isotope Product Packaging System (MIPS).
  - Solid Radioactive Waste Packaging (SRWP).
  - Noble Gas Removal System (NGRS).

Unique Considerations for SHINE Radioisotope Production Facility

- 19 other Auxiliary Systems in the RPF.

1. Molybdenum Isotope Product Packaging System
2. Radioactive Controlled Area Material Handling
3. Radioactive Liquid Waste Evaporation and Immobilization System
4. Aqueous Radioactive Liquid Waste Storage System
5. Solid Radioactive Waste Packaging System
6. Radioactive Drain system
7. Material Handling
8. Facility Potable Water System
9. Facility Instrument Air System
10. Facility Compressed Air System

Unique Considerations for SHINE Radioisotope Production Facility

- 19 other Auxiliary Systems in the RPF (continued)

11. Facility Breathing Air System
12. Facility Inert Gas System
13. Facility Roof Drains System
14. Facility Sanitary Drains System
15. Facility Acid Reagent Storage and Distribution System
16. Facility Alkaline Reagent Storage and Distribution System
17. Facility Salt Reagent Storage and Distribution System
18. Facility Organic Reagent Storage and Distribution System
19. Organic Liquid Waste Storage and Export

Areas of Review

- Normal and Emergency Conditions
- Sufficiency of principle design criteria
- Design bases
- Information on types of equipment, functional requirements, and general arrangement, sufficient to provide reasonable assurance that final design will conform with design basis

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements:
  - 10 CFR 50.34, “Contents of applications System technical information,” paragraph (a), “Preliminary safety analysis report.”
  - 10 CFR 50.35, “Issuance of Construction Permits.”
- Acceptance Criteria
  - NUREG-1537 and ISG, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria.”
  - Referenced/invoked codes and standards

Review Procedures and Technical Evaluation

- Section-by-section evaluation of the technical information presented in Chapter 9 of the SHINE PSAR
- Supplemented by responses to RAIs
- Assessed sufficiency of preliminary design and expected performance of these auxiliary systems in support of CP issuance

Evaluation Findings and Conclusions

The design bases and functional characteristics of the auxiliary systems will provide reasonable assurance that:

- Systems will support all required applications
- Facility can be safely shut down and maintained in a safe shutdown condition

Evaluation Findings and Conclusions

Level of detail provided on SHINE’s auxiliary systems is suitable to determine that:

1) Functional characteristics commensurate with design bases of supported systems and equipment

2) System design ensures and maintains safe facility shutdown and prevents uncontrolled release of radioactive material

Evaluation Findings and Conclusions

- PSAR Chapter 9 meet the following requirements of 10 CFR 50.35 for issuance of a construction permit:

    1) Auxiliary systems have been described, including the principal architectural and engineering criteria

    2) Further technical or design information may be reasonably left for later consideration in the FSAR

    3) Safety features or components requiring research and development have been identified

    4) The proposed facility can be constructed without undue risk to the health and safety of the public

FSAR Follow-Up Items

- HVAC Systems Description – Section 9a2.2.1
- FP Design And Administrative Details – Section 9a2.2.4
- Natural Gas Pipeline Combustible Load – Section 9a2.2.4
- Closed PCS Cover Gas Control – Section 9a2.2.6
- RCA Material Handling Issues – Section 9b.4.7.2

Discussion

Chapter 12 – Conduct of Operations

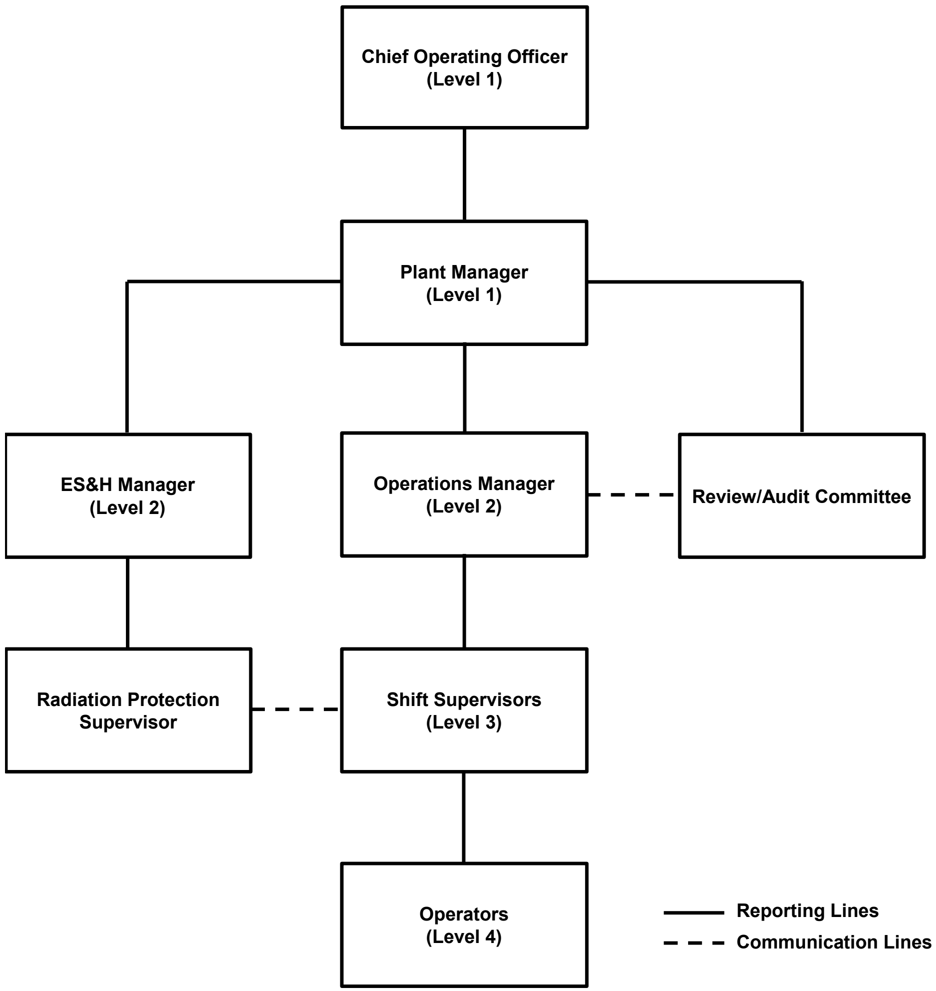
Jim Costedio, SHINE

August 19, 2015

Operational Structure

- ANSI/ANS-15.1-2007 (The development of technical specifications for research reactors) used as guidance
- The functional levels and assignments of the operating organization are described as follows:
  - Level 1: Responsible for the medical isotope facility license
  - Level 2: Responsible for the facility operation
  - Level 3: Responsible for day-to-day operation or shift
  - Level 4: Operating staff

Operational Structure



Responsibilities

- SHINE Medical Technologies, Inc. is the entity with legal responsibility for holding the Construction Permit (CP) and the facility Operating License (OL).
- The Chief Executive Officer (CEO) is responsible for the overall management and leadership of the company. The CEO provides direction to the Chief Operating Officer (COO) and reports to the Board of Directors.
- The COO reports to the CEO and is responsible for operational aspects of the company including operations, safety, quality, environmental (including RP), regulatory affairs, and security.

Responsibilities

- The Plant Manager (PM) is responsible for site operation.
- The Operations Manager (OM) reports to the PM and is responsible for day-to-day operational activities.
- The Shift Supervisor (SS) responsibilities include the safe operation of the site and authorizing day-to-day site activities.
- Senior Operators and Operators responsibilities include conforming to applicable rules, regulations, and procedures for operation of the facility.

Responsibilities

- The Quality Manager (QM) reports to the COO and responsibilities include overseeing review and audit of plant operations by review and audit teams.
- The Environmental, Safety, and Health (ES&H) Manager reports to the COO and responsibilities include managing matters regarding environment, safety, and health, including RP.
- The Radiation Protection Supervisor reports to the ES&H Manager and responsibilities include establishing and implementing the RP Program.

Staffing

- SHINE provides sufficient resources in personnel and materials to safely operate the facility.
- Facility staffing considerations, including minimum staffing levels, allocation of control functions, overtime restrictions, facility status updates during turnover between shifts, procedures, and training will be defined in the FSAR.

Selection and Training of Personnel

- SHINE establishes and maintains training programs for personnel performing, verifying, or managing facility operation activities to ensure that suitable proficiency is achieved and maintained.
- ANSI/ANS-15.4-2007 (American National Standard for the Selection and Training of Personnel for Research Reactors) is used.

Selection and Training of Personnel

- Records of personnel training and qualification are maintained.
- Required minimum qualifications for facility staff will be provided in the FSAR.
- The licensed operator training program, including the requalification training program, will be developed and implemented in accordance with 10 CFR 55 as it pertains to non-power facilities (e.g., 10 CFR 55.40(d)).

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Chapter 12
Conduct of Operations

Steve Lynch, Project Manager, USNRC
Diane Mlynarczyk, Technical Reviewer, ISL

August 19, 2015

Conduct of Operations

- Conduct of Operations (ConOps) is a philosophy of working in a formalized, disciplined manner to achieve operational excellence.

- The ConOps program emphasizes safety in every aspect of plant operations.

Conduct of Operations

- Addresses organization, review and audit activities, procedures, required actions, reports, records, emergency planning, security planning, quality assurance, operator training and requalification, startup plan, and material control and accountability program.

- SHINE has stated that some of these sections will be differed to be addressed in the FSAR.

Regulatory Basis and Acceptance Criteria

- Regulatory Requirements:
  - 10 CFR 50.54 (l)-(m)(l), "Conditions of licenses"
  - ANSI/ANS 15.4-2007, "Selection and Training of Personnel for Research Reactors"
  - 10 CFR Part 55, "Conditions of construction permits, early site permits, combined licenses, and manufacturing licenses"
  - 10 CFR Part 19, "Notices, instructions and reports to workers: inspection and investigations"
  - 10 CFR 50.34, "Contents of applications; technical information," paragraph (a), "Preliminary safety analysis report."

Regulatory Basis and Acceptance Criteria

- 10 CFR 50.35, “Issuance of Construction Permits.”
- ANSI/ANS 15.1-1990, “The Development of Technical Specifications for Research Reactors”
- 10 CFR 50.59, Changes, tests and experiments”

- Acceptance Criteria
  - NUREG-1537 and ISG, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria.”

Staff Review

- The staff performed a thorough and complete section-by-section evaluation of the technical information presented in Chapter 12 of the SHINE PSAR, as supplemented by responses to RAIs, to assess the sufficiency of the preliminary design and performance of SHINE's conduct of operations in support of the issuance of a construction permit.

- Staff considered design criteria, design bases, and relevant design information to provide reasonable assurance that the final design will conform to the design basis.

Section 12.1
Conduct of Operations - Organization

- Areas of review:
  - organization and its structure,
  - responsibilities of individuals and groups,
  - selection and training of personnel, and
  - organizational aspects of the radiation protection program.
- To be detailed in the FSAR:
  - staffing considerations for reactor operations and
  - production facility safety program.

Review of SHINE Organization

- The staff determined that additional information was needed concerning the SHINE functional organization.

- In RAI 12.1-1, staff asked the applicant to include the review and audit committee and the radiation safety function in the organization chart and describe the responsibilities of both the committee and the radiation safety function.

Review of SHINE Organization - 2

- In response to RAI 12.1-1, the applicant stated that the Review and Audit Committee will report to the Plant Manager and the Radiation Protection Supervisor will report to the Environmental Safety and Health Manager.

- Applicant also provided an updated Operational Organization Chart showing the reporting and communication lines of the Review and Audit Committee and the Radiation Protection Supervisor.

Review of SHINE Organization - 3

- The SHINE PSAR did not include a reference to the operator requalification program or a review of compliance with 10CFR55.

- In RAI 12.1-2, the staff requested SHINE:
  - include a reference to the operator training and requalification programs,
  - provide a review of compliance with 10CFR55, and
  - indicate is minimum requirements exist for facility staff.

Review of SHINE Organization - 4

- In response to RAI 12.1-2, the applicant stated the FSAR will:
  - provide the required minimum qualifications for facility staff,
  - state that the operator programs will be developed and implemented in accordance with 10CFR55, and
  - state that SHINE will comply with the requirements of 10CFR55 as it pertains to non-power facilities.

- The staff reviewed the RAI responses for Section 12.1 and found them to be satisfactory.

Conduct of Operations
Section 12.2 - Review and Audit Activities

- Review and audit committees are established by the Project Manager.
- Review and audit activities are summarized and reported to Executive Management.
- Independent audits of the SHINE facility are conducted periodically.

Review of SHINE Review and Audit Activities

- Additional information was needed:
  - who holds approval authority, and
  - how the review and audit committees communicate and interact with facility management and corporate management.

- In RAI 12.2-1, staff asked the applicant to state who holds approval authority and provide additional detail on how the review and audit committees interact with management.

Review of SHINE Review and Audit Activities - 2

- In response to RAI 12.2-1, the applicant responded that the Plant Manager holds approval authority for review and audit activities, and detailed the review and audit committee interaction with facility management.

Review of SHINE Review and Audit Activities - 3

- In RAI 12.2-2, staff asked the applicant to add 10 CFR 50.59 safety reviews to the list of items to be reviewed.

- In response to RAI 12.2-2, the applicant responded that the FSAR will be updated to include 10 CFR 50.59 safety reviews to its list of items requiring review by the Review and Audit Committee.

Review of SHINE Review and Audit Activities - 4

- In RAI 12.2-3, staff asked the applicant include a minimum list of items which should be audited and details of the audit function.

- In response to RAI 12.2-3, the applicant responded that they will expand the description of the audit function in the FSAR.

- The staff reviewed the RAI responses for Section 12.2 and found them to be satisfactory.

Conduct of Operations
Section 12.3 - Procedures

- Operating procedures are written, reviewed, approved, controlled and monitored.

- SHINE procedures are prepared, approved, revised, canceled and implemented in accordance with the procedure program. Document Control (DC) controls the procedures in accordance with this program.

- SHINE policy on use of procedures is documented and clearly understood by all applicable SHINE personnel. Activities and tasks are performed in accordance with approved implementing procedures.

Review of SHINE Procedures

- Some clarification was needed in the descriptions of the SHINE procedure activities.

- In RAI 12.3-1, staff asked the applicant to discuss
  a) basic topics the procedures currently address or will cover,
  b) method for the review and approval, and
  c) process required to make changes, noting that 10CFR 50.59 may apply.

Review of SHINE Procedures - 2

- In response to RAI 12.3-1, the applicant responded with:
  a) List of basic topics SHINE procedures will cover
  b) Description of method for initial review and approval of procedures listed in part a), and descriptions for review and approval of minor modifications and temporary deviations, and
  c) Discussion of the process required to make changes.

- The staff reviewed the RAI response for Section 12.3 and found it to be satisfactory.

Conduct of Operations

- The following sections have been deferred to the FSAR:
  - Section 12.4 - Required Actions
  - Section 12.5 - Reports
  - Section 12.6 - Records

Evaluation Findings and Conclusions

- The staff finds that the Conduct of Operations sections meet the applicable guidelines as follows:
  (1) SHINE has presented a complete facility organization and described the responsibilities of persons in that structure.
  (2) SHINE has described facility staffing requirements that demonstrate ability to safely operate the facility and protect the health and safety of the staff and public. Staff will meet requirements acceptable for non-power reactors.
  (3) SHINE has described an acceptable radiation safety organization with the authority to interdict or terminate activities to ensure safety.

Evaluation Findings and Conclusions - 2

(4) SHINE has proposed acceptable review and audit committee membership, charter and rules for that committee, and a complete and acceptable list of items for the committee to consider.

(5) SHINE has proposed an acceptable set of required procedures appropriate to operation of the facility and has described the review and approval process for those procedures and for making changes or temporary deviations to existing procedures.

Evaluation Findings and Conclusions - 2

- Accordingly, SHINE has met the appropriate regulatory requirements and acceptance criteria. Specifically, it meets 10 CFR 50.35 for issuance of a construction permit:
  1) Facility systems have been described, including the principal architectural and engineering criteria
  2) Further technical or design information may be reasonably left for later consideration in the FSAR
  3) Safety features or components requiring research and development have been identified
  4) The proposed facility can be constructed without undue risk to the health and safety of the public

Discussion

Chapter 13a2 – Irradiation Facility Accident Analysis

Eric Van Abel, SHINE

August 19, 2015

Accident Initiating Events and Scenarios

- Bases for identification of Design Basis Accidents (DBAs) and their Initiating Events (IEs) are:
  - Hazard and Operability Study (HAZOPS) and preliminary design hazard analysis (PHA) within the Integrated Safety Analysis (ISA)
  - List of IEs and accidents in the Final ISG Augmenting NUREG-1537
- ISA performed with experienced team members in a range of disciplines
- Based on current preliminary design information, will be re-evaluated with detailed design
- Qualitative evaluations performed within categories of accidents to identify bounding or limiting accidents and scenarios
- Quantitative evaluations performed for those DBAs with consequences

Accident Categories

- Irradiation facility (IF) Postulated Maximum Hypothetical Accident (MHA) (Subsection 13a2.1.1)
- Insertion of excess reactivity and inadvertent criticality (Subsection 13a2.1.2)
- Reduction in cooling (Subsection 13a2.1.3)
- Mishandling or malfunction of target solution (Subsection 13a2.1.4)
- Loss of off-site power (Subsection 13a2.1.5)
- External events (Subsection 13a2.1.6)
- Mishandling or malfunction of equipment affecting the primary system boundary (PSB) (Subsection 13a2.1.7)
- Large undamped power oscillations (Subsection 13a2.1.8)

Accident Categories (cont.)

- Detonation and deflagration in the PSB (Subsection 13a2.1.9)
- Unintended exothermic chemical reactions other than detonation (Subsection 13a2.1.10)
- PSB system interaction events (Subsection 13a2.1.11)
- Facility specific events:
  - Inadvertent exposure to neutrons from the neutron driver (Subsection 13a2.1.12.1)
  - Irradiation facility cell fire (Subsection 13a2.1.12.2)
  - Tritium purification system design basis accident (Subsection 13a2.1.12.3)

IF Postulated Maximum Hypothetical Accident

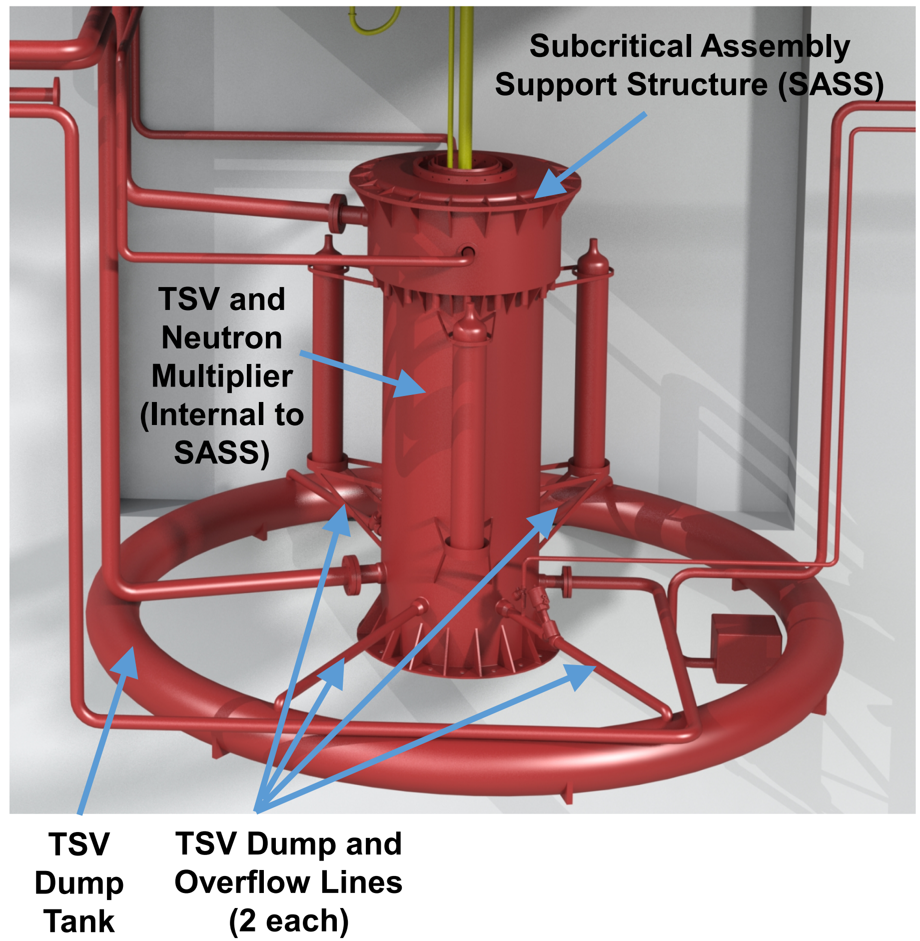
- MHA was postulated for both the IF and radioisotope production facility (RPF)
- IF-postulated MHA evaluated for:
  - Target Solution Vessels (TSVs)
  - TSV off-gas system (TOGS)
  - Light water pools (LWPs)
  - Accelerators
  - Tritium purification system
  - Primary cooling systems
- MHA is not required to be a credible event
  - ISG Augmenting NUREG-1537: "… MHA may be a non-mechanistic failure assumed to establish an outer limit consequence, the scenario need not be entirely credible."
- Most limiting MHA was in the RPF ("Facility MHA")

IF Postulated Maximum Hypothetical Accident

- The postulated MHA in the IF is a release of irradiated target solution to the IU cell as a result of a loss of TSV integrity
  - PSB is TSV, dump tank, TOGS, and associated components
  - Assumed that both the PSB and the subcritical assembly support structure (SASS) have breached (non-mechanistic)
  - Maximum inventories assumed in TSV (110% power, maximum fission product carryover, end of cycle, no decay before event)
  - Robust design of each irradiation unit (IU) cell provides isolation between IUs, therefore it is assumed that only one IU is affected by the event
  - Radiologically Controlled Area (RCA) Ventilation Zone 1 (RVZ1) is operating normally at time of event
  - No credit is taken for the presence of the light water pool
  - Target solution batch is assumed to “spill” into IU cell, generating motive force for dispersal

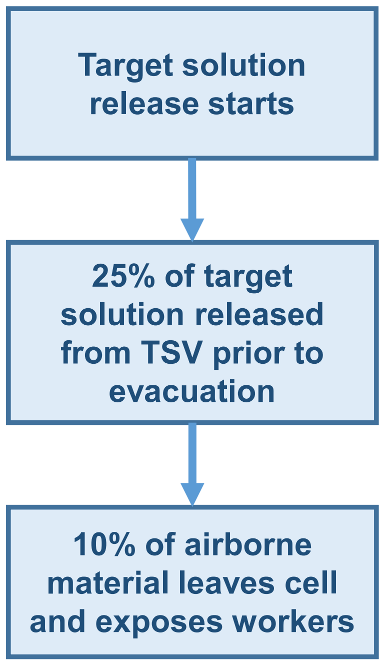
IF Postulated Maximum Hypothetical Accident

- Target solution is released from subcritical assembly
- Pool presence ignored
- Radionuclides drawn into HVAC system
- High radiation detected by RAMS in exhaust ductwork, initiates alarms
- ESFAS actuates confinement isolation of IU cell
- Release fractions:
  - 25% of target solution released from subcritical assembly prior to evacuation
  - 1% of airborne material released into cell assumed to bypass dampers before and after closure
  - 10% of material within cell assumed to leak through confinement barrier, expose workers

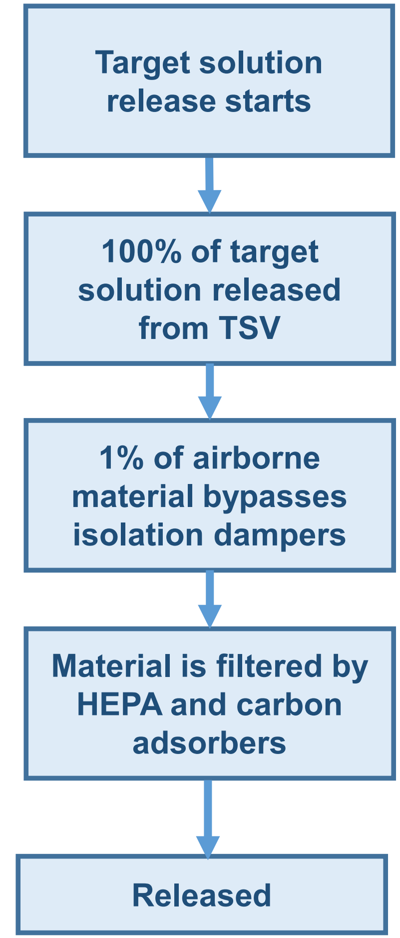


IF Postulated Maximum Hypothetical Accident

Worker Dose Assumptions

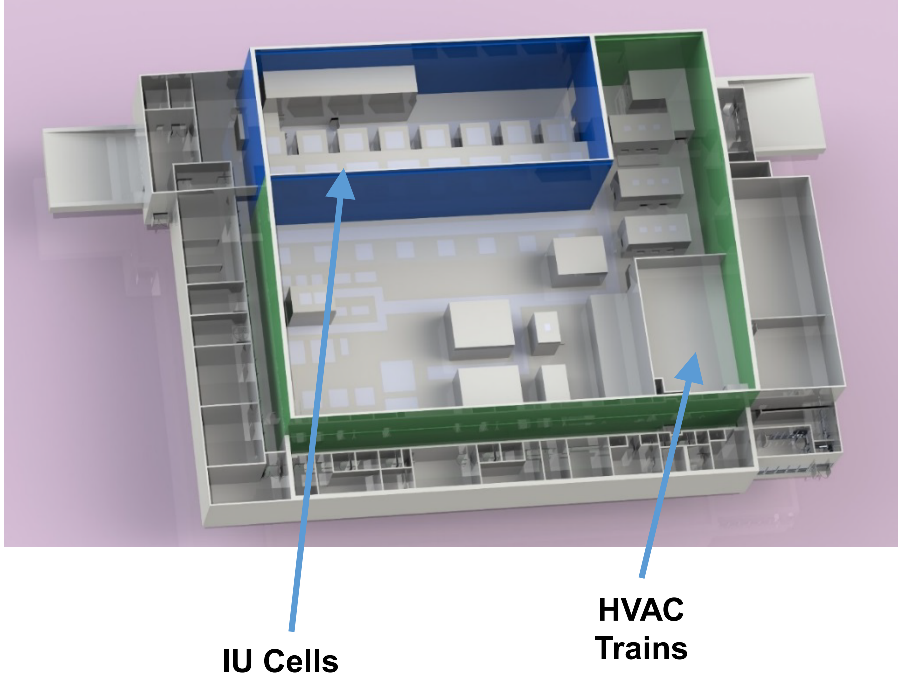


Off-site Release Assumptions



IF Postulated Maximum Hypothetical Accident

- HEPA filters assumed to remove 99% of particulate
- Carbon adsorbers assumed to remove 95% of iodine
- Dose conversion factors used:
  - ICRP-30, Federal Guidance Report 12
- Worker evacuation from RCA within 10 minutes
  - Material instantaneously leaves IU cell after release
  - Conservative as time for leakage of radionuclides from IU cell is neglected

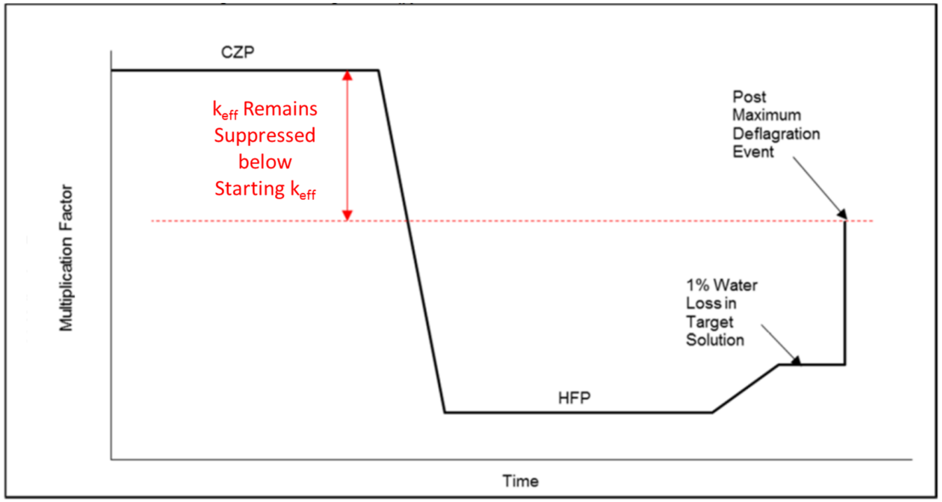


IF Postulated Maximum Hypothetical Accident

- Dose consequences
  - Worker: 3.1 rem TEDE
  - On-site doses below 5 rem regulatory limit specified in 10 CFR 20.1201
  - Public: 0.017 rem TEDE (site boundary)
  - Public doses below 0.1 rem regulatory limit specified in 10 CFR 20.1301
- Calculations contain significant conservatisms
  - TSV normally at or below ambient pressure, however large leak assumed capable of releasing all contents without driving force
  - Pool will normally prevent direct dispersal of aerosols and volatile fission products should a breach in the TSV or TSV dump tank occur
  - Pool will dilute target solution, reducing releases
  - Noble gases assumed to immediately evolve from solution as it is released and also immediately disperse

Excess Reactivity Insertion Accident

- Insertion of excess reactivity identified as requiring quantitative analysis due to potential elevated doses
- Potential chemical changes in the target solution were analyzed and no consequences were identified
  - Target solution is prepared and parameters are verified in RPF, no adjustments are made in IF
  - Precipitation of uranyl peroxide has been evaluated by Argonne National Laboratory, addition of metal sulfate expected to prevent precipitation
- Positive reactivity can be added to the TSV through void collapse scenario
  - Increase in reactivity due to pressurization of headspace of TSV, such as due to deflagration
  - Reduction in void fraction leads to positive reactivity insertion
  - Temperature of TSV would remain steady or increase due to heat production
  - Reactivity stays below initial reactivity, which is below criticality



Excess Reactivity Insertion Accident

- Reactivity can be added by over-cooling by primary cooling systems (PCLS and LWPS)
  - Excessive cooldown that drops the target solution temperature to a value 5°C (9°F) below the initial fill temperature would add approximately 100 pcm reactivity
  - Trip setpoints for low temperature and high flux result in draining target solution to criticality-safe dump tank
  - Would not cause criticality
- Inadvertent target solution injection during startup and irradiation operations can add reactivity
  - TRPS design will ensure trips on high flux prevent criticality during startup, considering fill rate, trip actuation time, uranium concentration errors, and detector uncertainties
  - Redundant (series) fill valves and fill pump interlocked during Mode 2, preventing solution addition during irradiation
  - Would not cause criticality
- Event does not challenge integrity of PSB, no releases

Reduction in Cooling Accident

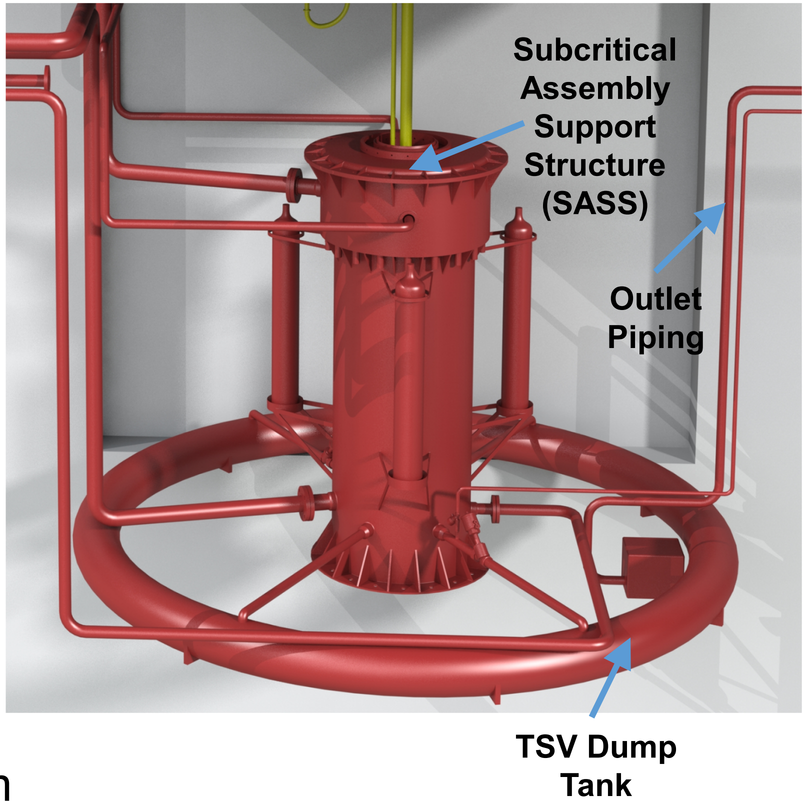
- Active functions of PCLS and LWPS cooling (i.e., forced coolant flow) are not safety functions
- Loss or reduction of cooling of the TSV through equipment failures results in a shutdown of the irradiation process.
  - TSV Reactivity Protection System (TRPS) trips the IU on loss of cooling
- RPCS is not an ESF, it is not expected to remain operable following any postulated accident
- Loss of active TSV cooling is alleviated by the passive cooling provided by the volume of water contained in the light water pool
  - Passive cooling of the TSV and TSV dump tank contents occurs from the pool water
  - Analyzed in Subsection 13a2.1.3
- No dose consequences to workers or public

Mishandling or Malfunction of Target Solution

- Target solution in the IF contained within TSV, TSV dump tank, and associated connecting piping and components
- ISA and associated hazards analyses identified scenarios of concern with regards to target solution transfer and handling in IF
- Dump tank leak into the IU cell was found to be most limiting
  - Rupture of piping downstream of dump tank
  - Assumed that piping may traverse above the pool surface, preventing scrubbing from the pool

Mishandling or Malfunction of Target Solution

- Release of solution occurs from piping
- Rate of pumping is low, limiting release of material to 25% prior to evacuation
- High radiation signals in exhaust ventilation cause alarm and ESFAS actuation
  - Workers assumed to evacuate within 10 minutes
- 1% of airborne material bypasses dampers, 10% released from IU cell into IF
- HEPA and charcoal filters in exhaust ductwork reduce releases to the public
- Worker calculated TEDE: 1.50 rem
- Public site boundary TEDE: 0.002 rem



Loss of Off-Site Power and External Events

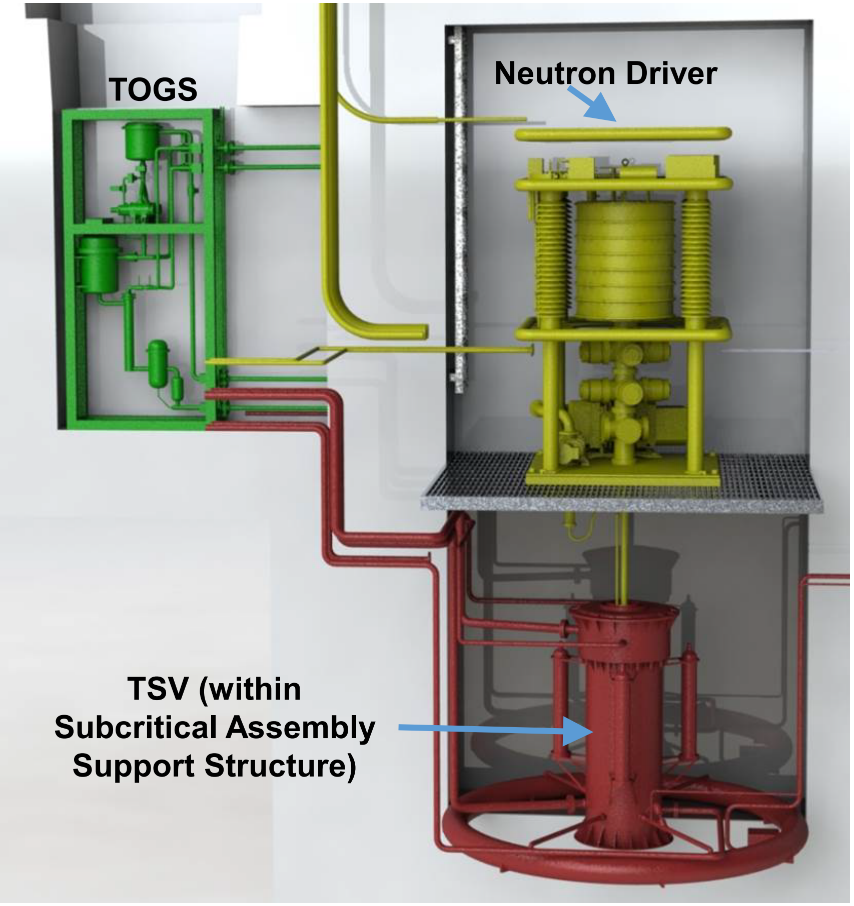
- Loss of Off-Site Power (LOOP)
  - Uninterruptible Power Supply System (UPSS) provides power to the emergency equipment described in Chapter 8
    - Detailed evaluation of the duration of emergency power requirements will be provided with the OL application
  - Neutron drivers require offsite power, and are automatically shut down and target solution is automatically drained to dump tank
  - Primary cooling pumps stop functioning, heat removal provided by pool
  - No consequences due to LOOP
- External events
  - SHINE production facility building designed to survive postulated wind loads, seismic loads, tornado loads, and aircraft crash loads (Chapter 3)
  - Safety-related SSCs are analyzed under loading conditions of design basis earthquake
  - No consequences due to external events

Mishandling or Malfunction of Equipment Affecting the PSB

- DBA analyzes failure of IF systems handling gaseous products from irradiation
- Limiting event determined to be release of inventory of TOGS into the TOGS shielded cell
- Maximum inventories assumed in TOGS (110% power, end of cycle, no decay before event)
- To bound possible release inventories, noble gases in both gas space and in the target solution are assumed released
  - Detailed evaluation of gas partitioning to be planned for detailed design
  - Assumption bounds results regardless of partitioning

Mishandling or Malfunction of Equipment Affecting the PSB

- Release of off-gas occurs from TOGS equipment within the TOGS shielded cell
  - Zeolite bed within TOGS assumed to retain 95% of iodine in gas stream
- High radiation signal in ventilation exhaust results in alarm and ESFAS actuation
- 25% of activity enters shielded cell before evacuation, 10% released through TOGS penetrations
- 1% bypasses dampers, charcoal adsorbers in exhaust ductwork credited for 95% efficiency for halogens
- Worker calculated TEDE: 1.9 rem
- Public site boundary TEDE: 0.016 rem



Large Undamped Power Oscillations and Deflagration/Detonation in the PSB

- Power oscillations
  - TSV experiences power oscillations with reactivity variations within the target solution
  - Power oscillations are self-limiting as a result of design and inherent safety characteristics of TSV and operating parameters
  - Aqueous reactor stability demonstrated at power densities of 1.8 kW/L, SHINE TSV significantly below this
  - Accelerator-driven fissile solution systems found to be unconditionally stable based on linear stability analysis by LANL (LA-UR-14-28684)
  - Oscillations estimated for preliminary design and do not affect safety of assembly, detailed transient analyses will be provided with FSAR
- Deflagration/detonation in the PSB
  - Potential failures of TOGS blowers, plugged zeolite beds, partial failures (reduced flow rate), and loss of recombiner functionality considered
  - Flow blockage of system found to be limiting event
  - Maximum credible deflagration pressure found to be less than 50 psig (Chapter 4)
  - Design pressure of components will be greater than credible deflagration pressure

Unintended Exothermic Chemical Reactions Other Than Detonation and PSB System Interaction Events

- Other Chemical Reactions
  - No chemical processing activities within the PSB
  - Target solution is uranyl sulfate, no potential for exothermic chemical reaction of solution from irradiation
  - During startup and irradiation modes, administrative controls prohibit storing or presence of chemicals within the IU cell except those required for normal operation
  - No credible path to high temperatures involving zircaloy and steam was identified in the HAZOPS/PHA
- System interaction events
  - Considered functional interactions, spatial interactions, and human-intervention interactions
  - A number of shared systems (electrical power, cooling, ventilation, fire protection, noble gas storage) exist and were evaluated for interaction effects
  - System interaction events did not result in a safety system failing to perform its safety function or were analyzed by other DBAs
  - No radioactive releases as a result of PSB interaction events

Facility-Specific Events

- SHINE facility was evaluated for unique, facility-specific IEs and DBAs
- Inadvertent exposure to radiation from Neutron Driver evaluated
  - Potential for inadvertent access during operation or operation during maintenance activities
  - IU cell biological shielding and the neutron driver personnel access door interlock prevent inadvertent exposure
  - Visual/audible warnings, key switches, and local shut-off switches will also further reduce potential
- Irradiation facility fire event was evaluated
  - Due to malfunction of equipment, loss of combustible/ignition control, hydrogen release from the TPS, or spread of fire from outside IF
  - Facility Fire Detection and Suppression System (FFPS) detects fires within the IF and initiates isolation of the fire area
  - Combustible loadings are limited to reduce consequences
  - Tritium inventory is less than that that would exceed LFL in glovebox
  - IF boundary and components (e.g., doors, penetration seals, dampers) are fire rated
  - No identified consequences from fire events

Facility-Specific Events

- Mishandling or malfunction of equipment in tritium purification system was considered, including failure of piping, processing equipment malfunctions, fire, and human errors
  - Tritium supply and return lines in double-walled pipe, and lines are subatmospheric
  - TPS glovebox and double-walled piping is inerted with nitrogen
  - Automatic isolation valves isolate tritium supply on loss of system integrity
- Limiting event determined to be loss of entire tritium inventory of the 8 neutron drivers
  - Release of inventory into IU cells, high radiation or other actuation signal activates bubble tight isolation dampers and tritium system isolation valves
  - Up to 1% of released material bypasses the isolation dampers to be released
  - Alarms (local and in the control room) notify personnel and evacuation is assumed within 10 minutes
- Confinement features would significantly reduce dose to workers, but no reduction was assumed in this analysis
- Worker calculated TEDE: 2.4 rem
- Public site boundary TEDE: < 0.001 rem

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Chapter 13 Irradiation Facility Accident Analysis

Steve Lynch and Tarek Zaki, Project Managers
Joseph Staudenmeier, Thomas Boyle, Sami Sherbini, Michael Salay, and Ray Skarda, Technical Reviewers
U.S. Nuclear Regulatory Commission

August 19, 2015

Accident Analysis

- Identify and analyze postulated accident scenarios that are representative of the range of events that are possible in an operating facility.

- Identify and evaluate challenges to the safety systems and defense in depth features of the design of the accident scenarios.

- Identify design features and procedures needed for the prevention and mitigation of potential accidents.

- Establish safety limits for facility operations and a technical basis for control of those limits through technical specifications.

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”
- Acceptance Criteria
  - NUREG-1537 and ISG, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria”

Areas of Review

- To provide reasonable assurance that the proposed design has adequate capabilities to mitigate accidents, the staff evaluated the accident analysis of SHINE's irradiation facility systems to ensure sufficiency of the proposed:
  - Identification and analysis of possible accident scenarios,
  - Identification of source term
  - Calculation of doses

Review Procedures and Technical Evaluation

The staff performed a thorough and complete section-by-section evaluation of the technical information presented in Section 13a of the SHINE PSAR, as supplemented by responses to RAIs, to assess the sufficiency of the accident analysis for SHINE's IF in support of the issuance of a construction permit.

Irradiation Unit (IU) Configuration

- SHINE IUs are accelerator-driven and sub-critical
- The TSV is submerged in a light water pool and located directly beneath the neutron driver assembly
- The TOGS is in a separate concrete chamber that is part of the IU

Significant Radioactive Inventories

- Neutron Driver and Tritium Purification System
- Target Solution Vessel and Dump Tank
- Gas Management System

Accident Scenarios

- A comprehensive set of generic and facility specific events were considered.
- MHA bounds all accidents
  - Instantaneous dump of target solution into the pool
  - No retention of iodine in pool

Design characteristics that impact accidents

- The facility has a low power density, low total power, and low pressure.
- Large passive heat sink to store decay heat.
- No large thermodynamic forces to drive the type of large energetic release that could occur in a power reactor.

Release Pathways

- Releases to liquid and gas spaces in IU considered.
- Fuel and fission product releases from IU to Radiation Controlled Area ventilation Zone 1 (RVZ1) through filtered ventilation system and leakage paths.
  - Isolation dampers close regular ventilation system pathway after high radiation signal leaving only leakage pathways
  - No credit for filters in ventilation system pathway
  - No credit for iodine retention in pool
- Release to environment through filtered ventilation system.
  - No filtering of noble gases or tritium

Dose Calculations

- Workers in facility.
  - Worker evacuation time assumed
- Member of the public at the site boundary.
- Member of the public at the closest residence.
- Uses 10CFR Part 20 for Dose limits
  - 5 rem workers
  - 0.1 rem off-site doses

Review areas deferred to Operating FSAR

- Other analyses
  - Licensee will demonstrate PSB integrity after a hydrogen deflagration or detonation due to failure of TOGS to keep hydrogen concentrations below LFL
  - TOGS integrity after the loss of radioisotope process cooling system (RPCS)
- Age dependent doses and pathways for doses to the public.

Evaluation Findings and Conclusions

- The applicant has proposed and analyzed a set of accidents that should be representative of the possible range of events that may happen in an operating facility.

- The analyzed set of accidents provides insights into the challenges to the safety systems and defense in depth features of the facility and considers how the potential accidents might be prevented or mitigated by administrative controls, engineered safety systems, and trained personnel actions.

- The proposed features of the design including the engineered safety features keep the radiation doses below acceptable limits(10 CFR Part 20 limits) and adequately protect the workers and the public for all proposed accidents. The safety systems are single failure proof and follow the defense in depth philosophy.

- The staff concludes that the proposed preliminary accident analysis of the IU and the calculated consequences show that the design including the engineered safety features adequately protect workers and the public.

Evaluation Findings and Conclusions (cont.)

Accordingly, SHINE has met the requirements of 10 CFR 50.35 for issuance of a construction permit:

- The applicant has proposed and analyzed a set of accidents that should be representative of the possible range of events that may happen in an operating facility.
- Further technical, design, or analysis information may be reasonably left for later consideration in the FSAR
- Safety features or components requiring research and development have been identified
- The proposed facility can be constructed without undue risk to the health and safety of the public

Discussion

Chapter 14 – Technical Specifications

Bill Hennessy, SHINE

August 19, 2015

Requirements

- Per 10 CFR 50.34 (a)(5), SHINE has identified the variables and conditions that will likely be the subjects of technical specifications.
- In accordance with NUREG-1537, technical specifications (TS) will be written with the guidance provided in ANSI/ANS 15.1, “The Development of Technical Specifications for Research Reactors”
- The TS will meet the regulatory requirements specified in 10 CFR 50.36.
- The TS will be submitted with the operating license application.

Safety Limits and Limiting Safety System Settings

- Safety Limits (SL)
  - TSV power
  - Uranium concentration
  - Uranium enrichment
  - Quantities of radioactive materials
- Limiting Safety System Settings (LSSS)
  - TSV cover gas hydrogen concentration high
  - TSV neutron flux high, source range
  - TSV neutron flux high, high range

Examples of Limiting Conditions for Operation

- Target solution parameters:
  - Precipitation catalyst concentration
  - Uranium concentration
  - Uranium enrichment
  - Fission product activity based on the maximum number of cycles prior to target solution cleanup
- Confinement
  - Tritium purification system (TPS) glove box system or confinement
  - IU and TOGS shielded cell confinement isolation valves
  - RPF confinement isolation valves

Examples of Limiting Conditions for Operation

- Ventilation Systems (RVZ1 and RVZ2)
  - Isolation dampers
  - Filters
- Emergency power
  - Emergency power system operable

Examples of Design Features

- Site and Facility Description
  - Fire resistant construction of supercells, hot cells, tank enclosures, and process enclosures; three hour fire-rated barriers that separate fire areas
  - Production facility biological shield; irradiation facility biological shield

Administrative Controls

- Organization
- Review and Audit
- Radiation safety
- Required actions
- Reports
- Records

Administrative Controls

- Procedures will be written for the activities described in the following programs:
  - Criticality-safety
  - ALARA
  - Procurement and use of transport and waste containers
  - Fire protection
  - Solvent
  - Tritium control
  - Light water coolant activity monitoring
  - Chemical control

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Chapter 14
Technical Specifications

August 19, 2015

Regulatory Basis

- 10 CFR 50.34(a)(5), “An identification and justification for the selection of those variables, conditions, or other items which are determined as the result of preliminary safety analysis and evaluation to be probable subjects of technical specifications for the facility, with special attention given to those items which may significantly influence the final design.”

- 10 CFR 50.36, “Technical Specifications,” pertaining to a fuel reprocessing facility. Fuel reprocessing facilities represent a specific type of *production facility* and these technical specification requirements may be applied to the SHINE production facility using a graded approach, as described in Section 14b.1 of the ISG Augmenting NUREG-1537.

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”
- Final Interim Staff Guidance Augmenting NUREG-1537, Part 2, October 17, 2012
- American National Standards Institute (ANSI)/American Nuclear Society (ANS) Standard 15.1, “The Development of Technical Specifications for Research Reactors”

Areas of Review

- Based on NUREG-1537, Part 2, Section 14, the areas of review for SHINE's technical specifications included the following:
    - That the technical specifications conform to ANSI/ANS Standard 15.1.
    - That the technical specifications conform to NUREG-1537, Part 1, the format and content guide, including the ISG Augmenting NUREG-1537, Part 1.

Review Procedure

As per NUREG-1537, Part 2, Chapter 14:

- Compare the proposed technical specifications with ANSI/ANS 15.1, as supplemented in the format and content guide, operating characteristics, site and environmental conditions, and use, and with the PSAR.

- The technical specifications and basis should be determined from the analysis in the PSAR.

- Confirm that the technical specifications are complete and follow the correct format.

Evaluation Findings

- In accordance with 10 CFR 50.34(a)(5), a list of proposed SHINE facility parameters for technical specifications is provided in PSAR, Table 14a2-1.
- While Table 14a2-1 and some preliminary information on the SHINE facility technical specifications has been provided, it is insufficient for the Staff to perform a review.

Conclusions

- The Staff's Chapter 14 review will take place during the operating license application when the design has been finalized and the actual technical specifications are submitted for review.

- The staff concludes that the information provided in Chapter 14 meets the applicable regulatory requirements and acceptance criteria, and is sufficient to support the issuance of a construction permit.

Discussion

SHINE Response to ACRS Subcommittee Members' Questions

Catherine Kolb, SHINE

August 19, 2015

Chemical Hazard Analysis Update

- Forklifts
  - SHINE will use electric forklifts in lieu of propane powered forklifts.
  - SHINE will revise the PSAR to reflect the use of electric forklifts.

Chemical Hazard Analysis Update

- Chlorine
  - A chlorine release from a rail car was not considered because chlorine was not included in list of chemicals transported on railways in Rock County provided by Rock County Emergency Management.
  - Regulatory Guide 1.78 provides guidance that only chemicals that are frequently transported near the site need to be considered.

Chemical Hazard Analysis Update

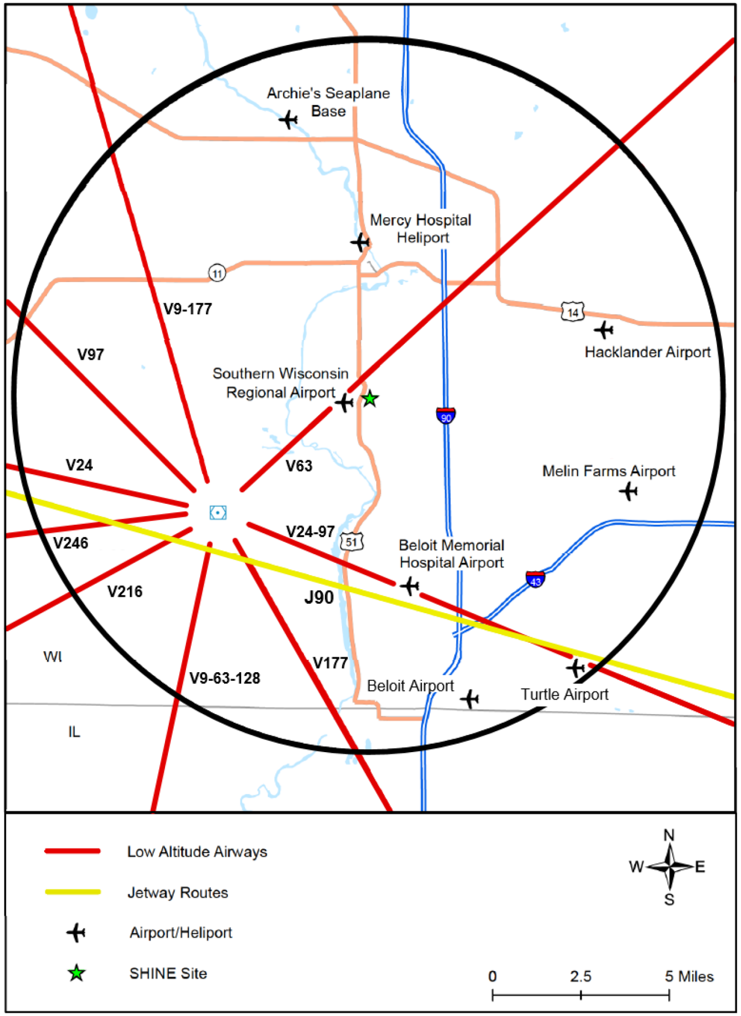
- Ammonium Nitrate
  - According to local Tier II reports, ammonium nitrate is present at stationary facilities only as part of a solution of urea ammonium nitrate (UAN)
  - Because ammonium nitrate is only present in solution form at stationary locations, it was assumed that the transportation of ammonium nitrate on nearby routes would also be in solution form
  - UAN is non-flammable. Although the solid residue that forms when the water from UAN evaporates is potentially explosive, a series of failures would need to occur to cause a hazard to the SHINE facility, namely
    1) a release of material large enough to affect the site,
    2) the resulting spill left un-mitigated for a duration long enough for the solution's water to evaporate, and
    3) an explosion
  - This sequence of events is highly unlikely and was therefore not analyzed

Chemical Hazard Analysis Update

- Margin
  - Regulatory Guides inherently have margin built into them
  - Regulatory Guide 1.91 acceptance criteria of 1 psi conservatively based on DOD UFC 3-340-02, “Structures to Resist the Effects of Accidental Explosions”
  - US DOD found that glass windows are shattered by a peak overpressure of 1 psi, non-reinforced concrete walls fail at 1.5 to 5.5 psi, but the strongest structures are heavily framed steel and reinforced concrete buildings, particularly those designed to be earthquake resistant
  - The safety-related structures of the SHINE facility will be made of reinforced concrete and seismically designed, and therefore would be readily expected to withstand overpressures in excess of 1 psi, providing a margin of safety in all calculations of stand-off distances

Aircraft Hazard Analysis Update

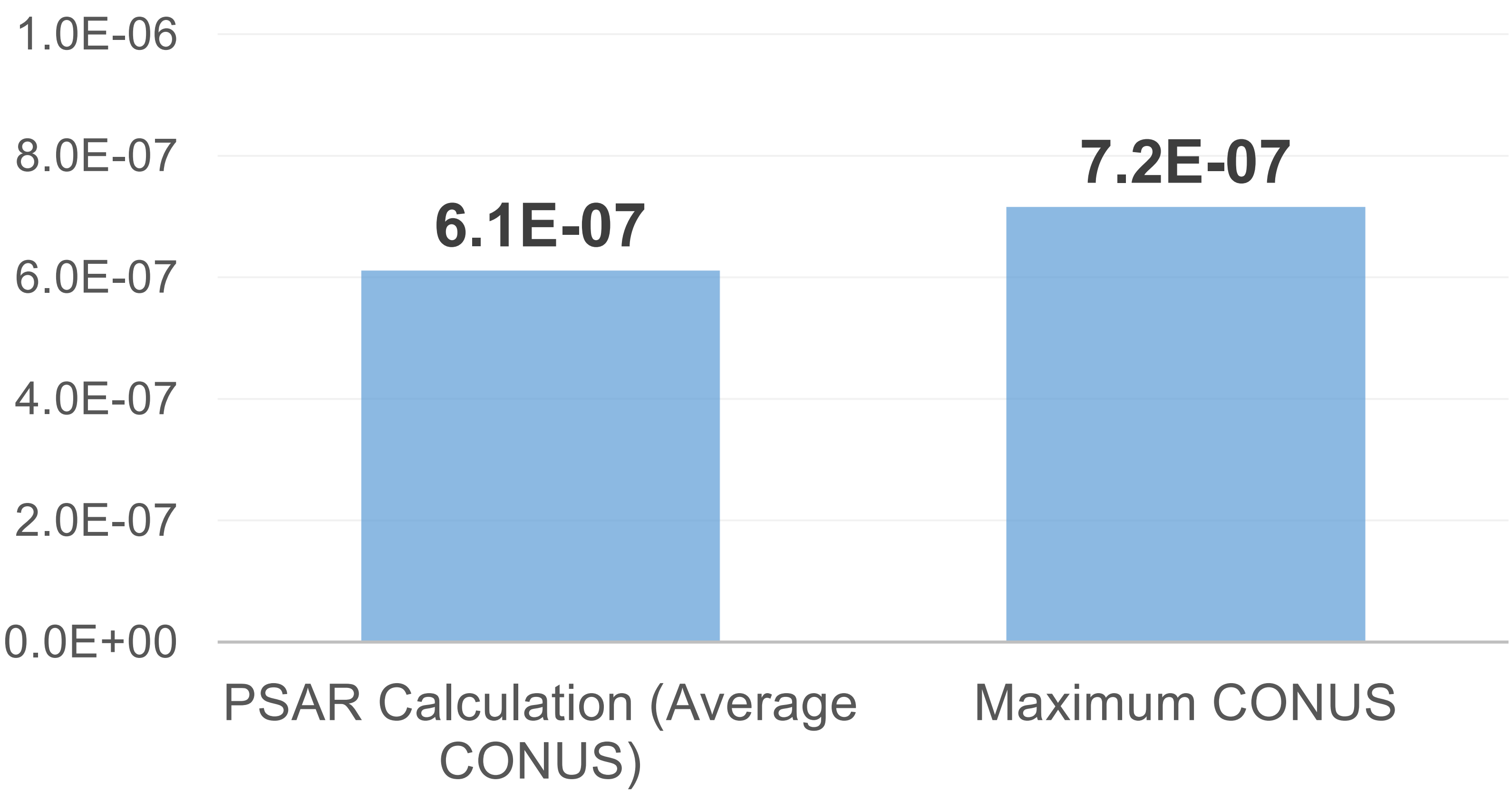
- Low altitude airways and jetway routes within 10 miles of the SHINE facility are shown.
  - SHINE will revise PSAR Figure 2.2-2 to reflect the low altitude airways and jetway routes shown.



Aircraft Hazard Analysis Update

- SHINE aircraft hazard methodology combined aspects of DOE-STD-3014-96 and NUREG-0800
- SHINE also performed confirmatory analyses using original methodology, but using maximum non-airport crash rates instead of CONUS average rates
  - Non-airport crash rate based on maximum rate contained in standard (i.e., Brookhaven National Lab for commercial and large military, Argonne National Lab for general aviation, and Nevada Test Site for small military)
  - Analysis shows hazard is still within acceptance criteria

Aircraft Hazard Analysis Update



Aircraft Hazard Analysis Update

- Air Show Impact
  - No air shows are currently planned at the Southern Wisconsin Regional Airport (SWRA).
  - Increases in the total number of operations at the airport resulting from a hypothetical air show are accounted for in the calculation by using a historical average number of operations, which includes past air shows.
  - To conduct an airshow at the SWRA, an FAA review and regulatory waiver would be required.
  - Ingress and egress routes to the aerobatic box are clearly defined, and the FAA would consider the risk to the SHINE facility when defining these routes.
  - Aerobatic box is required to be sterile (i.e., would not include SHINE site).
  - Per conversations with the FAA's National Aviation Events Specialist, the FAA would consider the safety of the SHINE site when granting waivers for future air shows at SWRA.

Aircraft Hazard Analysis Update

- In the opinion of the FAA's National Aviation Events Specialist, if the SHINE facility were not within the aerobatic box or near the ingress or egress routes, the risk to the facility would be reduced, similar to the risk due to normal flight operations in the vicinity.

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Non-Power Production and Utilization Facility (NPUF) Construction Inspection Program (CIP)

Carl Weber
Construction Inspection Program Branch
Division of Construction Inspection and Operational Programs
Office of New Reactors

August 19, 2015

Non-Power Production and Utilization Facility CIP Background

- NRO tasked with developing the CIP for NRR
- Existing CIPs not appropriate for NPUFs
  - NPUFs licensed under 10 CFR Part 50.
  - NRO CIP based on 10 CFR Part 52 (ITAAC Inspection).
  - NRR 10 CFR Part 50 CIP focused on power reactors.
- Generic CIP to cover NPUFs
  - Could be selectively applied to research reactors.

NPUF-CIP Framework – Inspection Manual Chapter (IMC)

- IMC 2550, “Non-Power Production and Utilization Facilities Licensed Under 10 CFR Part 50: Construction Inspection”
  - Inspection Report format.
  - Enforcement (Traditional).
  - Overall Inspection Strategy.
  - Assessment.
  - Transition to Operations (placeholder).

- Qualification and Training for Inspectors addressed in IMC 1245, “Qualification Program for Operating Reactor Programs”

NPUF -CIP Framework – Inspection Procedures (IPs)

- Facility Construction
  - IP 69020, “Inspections Of Structures, Systems And Components During Construction Of Non-Power Production and Utilization Facilities .”

- Quality of Construction
  - IP 69021, “Inspections Of Quality Assurance Program Implementation During Construction Of Non-Power Production and Utilization Facilities.”

- Quality of Construction
  - IP 69022, “Inspections Of Operational Readiness During Construction Of Non-Power Production and Utilization Facilities.”

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Open Discussion Items

August 19, 2015

June 23-24 ACRS Subcommittee Follow-up Items

- Open discussion items addressed at today's meeting:
  - Construction Inspection Program
  - Implementation of digital I&C systems at SHINE facility
  - Aircraft impact analysis
  - Impact of radioisotope process cooling system (RPCS) failure
  - Hydrogen deflagration and detonation accidents
  - 10 CFR Part 50 regulatory analysis

- Open discussion items to-be addressed in September:
  - Quality assurance considerations
  - Radiological release limits
  - Red oil considerations