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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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SHINE SUBCOMMITTEE

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OPEN

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TUESDAY

MAY 17, 2022

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

SUBCOMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

VICKI M. BIER, Member

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

WALTER L. KIRCHNER, Member

JOSE MARCH-LEUBA, Member

DAVID A. PETTI, Member

JOY L. REMPE, Member
MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:
DENNIS BLEY
KEN CZERWINSKI

DESIGNATED FEDERAL OFFICIAL:
CHRISTOPHER BROWN

ALSO PRESENT:
MICHAEL BALAZIK, NRR
JEFFREY BARTELME, SHINE
JOSH BORROMEO, UNPL Branch Chief, NRR
ERIC EDWARDS, SHINE
TREVOR HART, SHINE
CATHERINE KOLB, SHINE
JEREMY MUNSON, NMSS
ALEXANDER NEWELL, SHINE
TRACY RADEL, SHINE
EDWARD ROBINSON, NSIR
GLENN TUTTLE, NMSS
DEREK WIDMAYER, ACRS

T-A-B-L-E O-F C-O-N-T-E-N-T-S

P R O C E E D I N G S

8:30 a.m.

CHAIR BALLINGER: It's 8:30 or close to it. The meeting will now come to order. This is a meeting of the SHINE subcommittee of the Advisory Committee on Reactor Safeguards.

I'm Ron Ballinger, Chairman of today's subcommittee meeting. ACRS members in attendance are Davie Petti, Jose March-Leuba, myself, Joy Rempe, Matt Sunseri, Greg Halnon, Charlie Brown, and let's see here. Vicki Bier is here, Dennis Bley, Ken Czerwinski, our consultant. Thank you very much. I hope you're listening.

Walt Kirchner, Vesna Dimitrijevic, and that probably does it. Thank you. Oh, Myron Hecht might be on and Dennis Bley might be on and Steven Shultz might be on, our consultants somewhere. Derek Widmayer of the ACRS staff is a designated federal official for this meeting, although Chris Brown is here too.

During today's meeting, the subcommittee will receiving a briefing from the NRC staff and SHINE Medical Isotopes, Inc. The subcommittee will hear presentations by and hold discussions with the NRC staff, SHINE representatives, and other interested persons regarding Chapter 12.7, emergency planning, 6(b)(3), criticality safety, and Chapter 13, accident analysis. As part of the presentations by the applicant and the NRC staff -- a part of the presentations by the applicant and the NRC staff may be closed in order to discuss information that is proprietary to the licensee and its contractor pursuant to 5 USC 552(b)(c)(4).

Attendance at the meeting that deals with such information will be limited to the NRC staff and its consultants SHINE and those individuals and organizations who have entered into an appropriate confidentiality agreement with them. Consequently, we need to confirm that we have -- we will at that time. Need to confirm we have only eligible observers and participants in that part of the meeting.

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

We have received no written statements or requests to make an oral statement from the public. The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full committee. The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register.

Today's meeting is being held in person and also over Microsoft Teams. A telephone bridge line, a line participation of the public over the computer using Teams by phone was made available. Additionally, we have made an MS Teams link available on the published agenda. This will be the same link for tomorrow's meetings also.

A transcript of today's meeting is being kept. Therefore, we request that meeting participants on Teams and on the Teams call-in line identify themselves when they speak and to speak with sufficient clarity and volume so they can be readily heard. Likewise, we request that meeting participants keep their computer and/or telephone lines on mute when not speaking to minimize disruptions. The chat feature on Teams should not be used for any technical exchanges.

Okay. Some additional comments, these meetings were scheduled in terms of the length based on what we anticipated to be what would be needed. After looking at the slides for today's meetings, it looks like we probably will finish quite early. So we'll have to keep that in mind.

But I don't think that we can just push forward for tomorrow's agenda because it's public. So we just have to stick to it and go from there. I should also comment that today's and tomorrow's meetings in addition to the earlier meetings will serve as input for discussions related to potential focus area meeting in June.

So it's important that we -- if there are issues related to that that we get them to Chris or myself so that we can decide whether or not we're going to have a focus area meeting in June. So having said that, I think we're ready to proceed. So Josh, are you there?

MR. BORROMEO: I'm right here.

CHAIR BALLINGER: He's right there.

MR. BORROMEO: I'm in the room, in person.

CHAIR BALLINGER: I'm so used to looking at the screen to see somebody. So UNPL branch chief, NRR, for opening remarks. Josh?

MR. BORROMEO: Yeah, thanks. My name is Josh Borromeo. I'm chief of the nonpower production utilization facility license branch in NRR. So as Professor Ballinger said, today you're going to hear presentations from the staff at SHINE on emergency planning, criticality safety, material control and counting. And tomorrow you're going to hear about accident analysis.

We recognize ACRS interest in these areas. They are unique and they're critical of the review. And we appreciate the feedback that we got prior to this meeting to help us prepare.

So the staff hopes between the FSAR as well as our SE and the presentations today, ACRS has an understanding of SHINE's approach as well as how the staff came to our regulatory determination. So I want to thank SHINE and the staff for the preparations for the board meeting today. And thank you, ACRS, for your time, and we look forward to the conversation today. Thanks.

CHAIR BALLINGER: Okay. So I guess SHINE is up. Are you folks ready to go?

MS. KOLB: Yes, we are. So good morning. My name is Catherine Kolb. I'm the senior director of plant operations for the SHINE facility here in

Janesville. And today, they will be talking about the emergency plan that we prepared. Next slide.

So we'll be covering an instruction talking about the emergency response organization, the classification system, how we are preparing to respond to emergencies per the plan, recovery, and aspects of maintaining emergency preparedness. There we go. So the purpose of our emergency plan is to -- it describes essential elements of planning and provisions for coping with and mitigating the consequences of emergencies at the SHINE site.

It's focused on situations that may cause or threaten radiological hazards to affect employee or public health and safety. But there are some classifications that are not directly radiological in nature. The plan was written to conform with 10 CFR 50 Appendix E, and it follows the guidance that is listed here for research of test reactors and then some guidance most applicable to fuel fabrication facilities because of the unique design of the SHINE facility.

The Emergency Response Organization as described in the plan consists of two groups. One group is the on-site organization. That's the Facility Emergency Organization that will be initially staffed by on-shift facility, trained and qualified SHINE personnel.

And additional staff were called in to relieve the on-shift staff as necessary. The other group are the emergency support organizations. So those are off-site entities that can assist with emergency, for example, the fire department's hospital that we've identified and other organizations.

People that will be on-shift at the facility include the shift supervisor. That is the senior licensed person in the facility at any given time. We'll have other license operators that will be there and non-licensed operating staff, security personnel, and radiation protection personnel. So these people will serve as the initial facility emergency organization which is on the next slide.

MEMBER HALNON: So Catherine, this is Greg Halnon. Is that last bullet, is that the minimum shift staffing for emergency plan implementation?

MS. KOLB: Yes, the minimum shift staffing is described in the plan. The radiation protection isn't necessarily a department. It is just an individual that is trained and qualified in those duties. But yes, this is the predominantly the minimum shift setting.

MEMBER HALNON: Okay. Have you verified that the minimum shift staffing for E-Plan implementation does not take away from the minimum staffing required for tech specs and other items such as security and their specific positions and taking the SROs out of the command and control of the control room and put them in command and control, the E-Plan? Have you verified all that and minimum shift staffing analysis to ensure that there's no conflict there?

MS. KOLB: We have not performed a minimum shift staffing analysis. The document that described minimum shift staffing, as you mentioned, this emergency plan, the technical specifications, and the physical security plan. We intend to implement those independent such that they're -- unless otherwise specified.

So for example, the shift supervisor is minimum shift staffing in both things. But they have dual roles. So the plans were all written to coordinate with each other such that there isn't a conflict.

MEMBER HALNON: Okay. So you have connectivity there because there's a lot of documents saying we're going to do certain things on-shift. But they're independent such as the tech specs talking about plan operations. And then now you have the E-Plan, talking about E-Plan.

You may have some other fire brigade issues and stuff like that. I just wanted to make sure that all those are connected so that you don't overcommit with under staff.

MS. KOLB: Yes, they are all interconnected. They're written to coordinate I imagine.

MEMBER HALNON: Okay. Thank you.

CHAIR BALLINGER: This is Ron Ballinger. Time is a bit unique in the sense that we have both radiation issues that could crop up as well as chemical safety issues that could crop up. Which one of these people or personnel are trained in the area of the chemical safety side?

MS. KOLB: So there are no EALs, emergency action levels, identified that are specific to chemical hazards that exceed the guidance for requiring an EAL. The people that are on-shift and part of the Emergency Response Organization are trained. I think we have a little bit about that in the next couple slides, but trained to respond to the emergencies that are described in the plan.

CHAIR BALLINGER: Thanks.

MS. KOLB: Any other questions on this slide?

So this slide describes the Emergency Response Organization. This is for the facility. So these positions are all staffed by SHINE personnel.

So this is the configuration during the -- implementing the emergency plan. So the lead person is the emergency director that's initially filled by the shift supervisor. And it can be filled. We describe lines of succession within the plan to be fulfilled by other people who are trained and qualified in that role.

We have the emergency communicator who is responsible for communicating with all five agencies, both government agencies and meeting agencies as necessary. The radiation safety coordinator is responsible for advising for radiation expertise. Once the shift supervisor has been relieved by another emergency director, they are still part of the Emergency Response Organization in the facility control room and with the control room staff and another other operations personnel reporting to them.

We also have identified a technical support coordinator that is mostly an engineering role that can be filled by any person who is trained and qualified to fill that role. And a criticality safety engineer is required. And any other technical staff would be directed by them.

Security personnel are always at the sites and may be called in depending on the situation at the discretion of the emergency director. And then other personnel would fill the roles of assessment teams to determine the extent of any events and reentry and damage control teams, both of those as required depending on the event.

MEMBER HALNON: So just a quick question on here. This is Greg again. For your augmented staff from off-site, is it just -- I guess the question is what is the timing of it? Is it 60 minutes, 90 minutes? What are you assuming there?

MS. KOLB: I don't believe we have in all cases identified a timing response. We can look that up. But the -- so we can get back to you on that momentarily.

But the SHINE facility is located a couple hundred yards from the headquarters building. I know that doesn't help for off-site. But we have various other buildings in the area. So we're not expecting a long duration for calling in assistance.

MEMBER HALNON: Right. Well, you always

assume Sunday morning at 2:00 o'clock in the morning time changes. That's when the problem is going to occur. So you have to look at the worst case.

So there's a -- and I go back to my minimum shift staffing issue. If it does happen off hours, just some things to consider is how many roles the shift supervisor has to obtain immediately through a communicator -- emergency communicator I guess you'd call it. Who's going to do that when there's very few people on-site?

Fitness for duty for the off-site people relative to coming in. The on call issue of maintaining fitness for duty during their on call periods and stuff like -- just things to consider. You all have done a good job of repeating back the requirements in your plan.

But obviously, the details of the implementing procedures and how you implement it is really where it's going to be in compliance. So I just want to make sure that you benchmark all the issues at the present large light water reactors undergo with their E-Plan. And some of them probably don't apply. But you certainly have to consider some of those issues, at least out of a practicality perspective.

MS. KOLB: No, thank you for the feedback there for your question of initial staffing. So the rules that are required by the plan, we've made provisions on who's going to be trained and qualified to fill those such that the ones that are required initially. Those non-as required positions are filled by people who are there at all times. So the text spec minimum as we discussed is not the same group of people specifically identified as these people.

MEMBER HALNON: Okay. As you get more into your staffing plans and whatnot, you'll explore different areas of how you can consolidate and be efficient. But I just wanted to make sure that I mention that there's a lot of experience out there trying to maintain the smallest staff possible but still enough to maintain shift supervisor command and control at off hours.

MS. KOLB: So understand.

MEMBER BIER: Hi, quick question. This is Vicki Bier. I assume just from the wording that criticality safety is probably a college degreed engineer. Any thoughts on how many other of the folks listed here are likely to be college degreed in terms of knowledge-based response for things that may depart from planned emergency response actions?

MS. KOLB: We have not identified a college degree as a prerequisite for anything -- well, I guess other than the criticality safety engineer that it doesn't say that that person needs to have a college degree. But they need to be a qualified criticality safety engineer which that qualification scheme leads to that. As for expected, most of our technical staff that would be qualified to fill the technical support coordinator role are college degree individuals that we currently have on staff. Most, if not all, of the people in the shift supervisor role currently have college degrees, although that is not a requirement for that role.

MEMBER BIER: Okay, great. Thank you.

MS. KOLB: Next slide. So here we are describing the off-site support organizations. So these are people that we have contacted with that have been provided the plan and we've incorporated into our planning. So the Janesville Fire and Police Department, a hospital that we've identified that we have a memorandum of understanding with would be able to handle potentially contaminated or radiologically affected individuals.

Rock County where Janesville is located has an emergency management division as part of the chair's office that coordinates other major emergencies for the county and coordinates with the state and other local governments. And then the State of Wisconsin has general authority and responsibility for assisting local government units and law enforcement in disasters. And they coordinate with Rock County Emergency Management.

MEMBER HALNON: This is Greg again. Has any of one of your staff looked at the Rock County Emergency Management emergency operations plan, the radiological annex to make sure that it's adequate for their radiological response?

MS. KOLB: I believe we looked at that a long time ago but not from the intent of making sure that it was adequate for them. We have provided them the plan. We discussed it at numerous meetings. And in provisions for the plan, we have descriptions of continuing training and offering them tours and things in order to elevate their understanding of what we are doing at the facility.

MEMBER HALNON: Okay. The State of Wisconsin plan -- an emergency operations plan is approved by FEMA. Have you determined whether or not FEMA will continue to have an approved plan with them? Or will they have to go back to approval or re-approval because of this commercial reactor being -- or commercial facility being put in place?

MS. KOLB: I don't know the answer to that.

MEMBER HALNON: Okay. Have you have any discussions with the state or the county relative to FEMA's knowledge of the emergency plan?

MS. KOLB: We have, of course, talked to the county and the states about our plans. But I don't recall a conversation on how FEMA treats their plant, no.

MEMBER HALNON: Okay. All right. Thanks.

MEMBER REMPE: This is Joy. And since our chairman for this subcommittee said we had some extra time, I'd like to explore something that's not really specific to you but typical ACRS because we don't get involved in the finances. But I'm just curious how you're planning to do all of the training in the future.

I mean, it takes hours for all these people from the State of Wisconsin at a hospital. Do you guys -- how do you -- do they just donate their staff to come to the meetings and you pay for the trainers? Or how do the bucks work on something like this?

MS. KOLB: So what we're intending is that the training will be conducted by our SHINE employees. We have the training departments as part of our corporate structure. That would be conducted by them.

As for these individual people from the off-site agencies, we would offer them the opportunity to come and receive training, the topics of which are found in the plan and/or the tour of our facilities. And we've offered tours of construction sites, other things to date and other meetings. And they've always come and reported they're generally interested in our facility, and you know --

MEMBER REMPE: And I've seen that you have agreements signed by or letters of support from all these different organizations. So there's an implied agreement that they're always going to provide the manpower or hours and staff to come to the training, even though it does cost them because they can't be on call for a fire if they've coming to take your training. But there's not been an issue that way?

MS. KOLB: They have not brought up an issue like that. They have always been happy and enthusiastic to engage with us previously.

MEMBER REMPE: Thank you.

MEMBER BROWN: This is Charlie Brown. Can you go back two slides, please?

MS. KOLB: This one?

MEMBER BROWN: No, slide 4. Oh, wrong slide 4. The one that says -- oh, no. That's the right one. Combining this with what you just talked about with the Janesville, Rock County in Wisconsin an here you talk about your responsible actions consist of two groups: the facility emergency operation and then the support.

Is there a written agreement between you all and the county and the city and state as to who's in charge? There's got to be somebody that overall coordinates everything. And normally it's best to have that written down as opposed to adjudicating it at the time something is called for.

MS. KOLB: Yes, the county would be in charge. Wisconsin emergency planning requirements have the lowest level. That would be the county for this situation.

MEMBER BROWN: Okay. Not the city in other words? Not Janesville?

MS. KOLB: No.

MEMBER BROWN: Okay. All right. And that's in writing?

MS. KOLB: Yes, that's in writing.

MEMBER BROWN: When somebody shows up, they know who's in charge. That's all I'm interested in. Okay. Thank you.

MS. KOLB: I think we're at -- all right. No, I think we're done with this unless there are any questions about the other organizations.

All right. So moving on to facilities and equipment. So the plan provides for facilities and equipment for emergency assessment, communications, first aid under medical care, and performing corrective and recovery actions. So the facility has a control room which will be continuously occupied as a centralized on-site location where from which direction can be given during emergency.

It is in the safety-related area of the main production facility and as instrumentation and other communications equipment such that the people there can communicate with individuals on-site and off-site. We've also identified emergency support centers. So the primary location of that is the breakroom, the largest meeting room or largest room I suppose in the main production facility as the primary location.

A backup location is the storage building office area. That is a warehouse and with cubical and meeting room area. That is just south of the main production facility with a contingency location being in the SHINE headquarters building that is just north of the main production facility.

MEMBER HALNON: Can you give us -- this is Greg. Can you give us maybe a vision of how you see the primary location main production facility breakroom? Is that going be in cabinets and you have to break it out and set it all up? Or will there be some dedicated facility? What's your vision there?

MS. KOLB: The vision is that it'll be things that are required to be stored there will be in cabinets. So we have lists of equipment and medical supplies and other contingency things that would be stored in a cabinet there. The communications we envision would be there.

Most of the time, it's just telephones and areas for computers. But some of the equipment would need to be broken out. The radios we'd envision would be there all time for normal use.

MEMBER HALNON: Okay. So there's be some set up required. Again, your implementing procedures account for that time before because if you want to activate it 60 or 90 minutes, typically, you have to get people in earlier than that to start setting it up.

MS. KOLB: Yeah, we have an emergency plan implementing procedure and that is drafted. That directs the first person at the location on what they should do, unlock all the cabinets, set things up.

MEMBER HALNON: Okay, good. Thanks.

MS. KOLB: Other questions?

So the plan describes the emergency classification system that is used for the facility. We have emergency classifications for notification of unusual events, alert, and site area emergency. We have not identified any credible accidents in the facility that would result in radiological levels exceeding action levels for general emergencies.

Therefore, the plan does not include provisions for that classification. The Emergency Planning Zone, there have also been no radiological emergencies that result in an off-site plume disclosure exceeding one rem whole body or a five rem thyroid. So therefore, we've identified the Emergency Planning Zone as the operations boundary.

That is the area inside in the fence around the little campus buildings. It's not the site boundary. And that is the same as the control access area.

MEMBER HALNON: So this is Greg. I've got just a handful of small comments that would enhance things. One of them is in Figure 1 of your plan. If you take a look at Figure 1 and then synchronize the language on Figure 1 what the definition of your EPZ, I think that would be helpful because you use security fence in some places and none at others.

And you use operational boundaries. It's not on the -- it would be more clear if the language was synchronized. And that's just an enhancement comment.

MS. KOLB: Yes, you are looking at that figure where it says security fence, that is the operation boundary.

MEMBER HALNON: Yeah, it'd be -- like I said, just sync up the language. And since you're trying to show it pictorially, it'd be helpful to have the language the same.

MS. KOLB: Thank you for the feedback. Any other questions on our classification scheme?

So the next slide. So the categories of accidents that the plant describes fall into these areas. So there is various levels of security events, criticality which is ether an alert or a site area emergency per the criticality safety guidance that we followed, fire events, others or external events such as tornados, seismic flooding, or an aircraft crash and radiological release events. And the plan also provides the emergency director to classify other things at their discretion.

MEMBER HALNON: Does the cybersecurity fall under security? I can't remember. I looked at tables, but I forget where the cybersecurity falls.

MS. KOLB: I don't believe cybersecurity is one of the things called out for the security events which are all physical security type events, although the plan does have provisions in the classification tables and the EAL tables for other and the various categories --

(Simultaneous speaking.)

MEMBER HALNON: Well, that was one of the other enhancement comments I had in your organizational aspect. There's no mention of cybersecurity falls as far as responsibility. So that's just another one of those comments that might make it more clear. So there's no EALs for cybersecurity.

(Simultaneous speaking.)

MEMBER HALNON: So I guess we're more symptom-based in that respect. If something happens, then it's going to be physical -- what's physically happening to the plan itself.

MS. KOLB: Correct.

MEMBER HALNON: Okay. Thanks.

MS. KOLB: Next slide. So upon identifying missions that meet or exceed the EAL thresholds for each of those categories, the emergency director would declare the emergency within 15 minutes. And the facility emergency organization and the off-site agencies would be activated. Or a notification of unusual events, the notification of the ERO is required but it's optional to activate depending on the situation and at the discretion of the emergency director.

The off-site agencies are notified and request for aid will be made in the same communication when necessary, when applicable to the local governments. That would be to the Rock County 911's communication center by calling 911 within 15 minutes, the NRC immediately thereafter but no later than an hour, and the State of Wisconsin after the NRC notification. The notification to the State of Wisconsin is after the NRC because it is not required.

We discussed with the State of Wisconsin on when they would like to be notified and this is where we agreed upon in the plan. When the support center is staffed and activated for the emergency plan implementing procedures that we described earlier, command and control will be turned over from the country room where the shift supervisor is to the new emergency director in the support center. And then protected actions for all classifications are based upon a guideline of one rem to the whole body and five rem thyroid.

MEMBER BROWN: This is Charlie Brown. Can I ask a question here?

MS. KOLB: Yeah.

MEMBER BROWN: I think I almost forgot it. Oh, no. Pardon me. You said if something happens, the notification is made to the county via 911?

MS. KOLB: Correct.

MEMBER BROWN: Is that standard? I'm looking for an answer from anybody. That seems like you don't know who you're going to get when you call 911. Somebody who's used to dealing with car accidents or a shooting or whatever the current action of the day is.

MEMBER HALNON: So Charlie, the sheriff's office of county will have their internal protocols for 911. Most --

MEMBER BROWN: Okay.

MEMBER HALNON: -- calls into the emergency operation centers are through 911.

MEMBER BROWN: Okay.

MEMBER HALNON: And they'll transfer it over as appropriate.

MEMBER BROWN: All right. That's all I ask. Thank you. Thank you, Greg. Thank you. I'm done.

MS. KOLB: Okay. Thank you. Any other questions on this slide?

All right. For assessment of the situation, the individuals will use both installed and portable monitoring instruments, origins for dispatching assessment team of individuals who have been trained and qualified in those roles. And monitoring outside the facility at the site boundary would be established as necessary and within two hours of declaring a Site Area Emergency involving a potential or an actual release.

Protective actions include evacuations or shelter in place if there were security or weather-related events would be ordered and required. And assembly and accountability is performed whenever there's an evacuation. And it's always performed in the event of a Site Area Emergency.

Corrective actions are described in the plan which predominately include the shutdown or isolation of any effective equipment immediately provisions for other directions as depending on the type of event. And when conditions warrant, recovery is entered. Next slide. So different than the typical guidance for research and test reactor, we have events related to criticality assets. Those fall into two categories of an alert which would be a discovery of a critical mass of special nuclear material and unsafe geometry that creates criticality hazard but not criticality.

And then an emergency would be an eminent or an actual occurrence of uncontrolled criticality indicated by our installed criticality accident alarm system or other critical report. Moving on to the criticality events, the immediate evacuation is known and is evacuated without hesitation to the storage building outside the main production facility or that would be the backup ESC. And it is -- the criticality safety engineer is called in by our emergency response organization notification system.

MEMBER MARCH-LEUBA: Hey, this is Jose March-Leuba. Back when I was being trained as a worker in my old life, we were trained that whenever you hear you never question an alarm. You just drop what you're doing on the floor and leave.

Is that what you mean without hesitation? Or if you are handling a chemical hazard, are you allowed to -- have you thought of under which conditions you drop everything you have on the floor? Or do you leave it in a safe condition?

MS. KOLB: Well, I'd like Trevor Hart -- if he here to answer that?

MR. HART: It's mostly drop everything and leave. And you're not going to just throw a chemical necessarily on the floor. But the intent is to stop what you are doing, exit immediately through the planned evacuation routes, and then we would -- in terms of, like, contamination control, we would segregate at the assembly area to make control as far as contamination in that regard.

MEMBER MARCH-LEUBA: Yeah, I think that's a good plan. Evacuate first and then come back if necessary if you have evaluate what the conditions are. Thanks.

MR. MUNSON: Can I ask a clarifying question to the ACRS member that posed that question, please? This Jeremy Munson, criticality safety, NRC.

MEMBER MARCH-LEUBA: Sure. This is Jose.

MR. MUNSON: Jose, is your question specific to just any operator in the area that may hear the criticality alarm? Or is it specific to the person that in the event of criticality saw the bright blue flash or realized that they were outside their operating procedures?

MEMBER MARCH-LEUBA: No, my background is -- I mean, I had to take every couple of years of training on radiation worker and do the SAB with all the suits and everything and you cross the yellow line. And what the professor told me every time is you drop the screwdriver on the floor and leave when you hear the alarm. Don't think of where it falls.

I was asking if you have thought of handling fluoride or I'm handling a chemical -- a dangerous chemical reaction. Do I leave it into a safe condition before I leave? Or do I leave and then come back afterwards?

MR. MUNSON: Okay. Thanks for that clarification. The only reason I ask is because in the event of a criticality or for the operator that may have inadvertently created the criticality or been outside of their operating procedures, outside of their limits or something to that effect. For the purposes of criticality, we don't want them to take any corrective actions because they might actually make the situation worse.

But it sounds like you're talking about just operators in general. You actually hear an alarm. So I think that response would address that. Thank you.

MEMBER MARCH-LEUBA: Yeah, I concur with what you're saying. I mean, in the heat of the moment, you can make the wrong decision. So it's best to leave things as are, go outside, evaluate, and then come back. And I think we're in agreement. Thank you.

MR. MUNSON: Yes, sir. Thank you.

MS. KOLB: Any other questions about this slide?

Next slide. So the plan describes a recovery state. It consists of actions required to restore the facility to a steady status. The emergency director determines when the emergency condition no longer exists and declares that recover can begin.

The emergency response organization will be the recovery organization. We don't have a separate set of people identified. The criteria --

you can begin reentering the facility. For an accident is that the radiological surveys indicate the levels have returned to an acceptable level for reentry. It is possible to -- using normal 10 CFR 20 exposure limits and the emergency condition alarm poses an immediate danger to the reentry personnel.

Criteria to be used when operation facility may be resumed and the technical specifications are satisfied. Emergency condition no longer exists. Damage has been addressed for the systems and components affected and anything that has not been repaired has been isolated or abandoned.

MEMBER HALNON: And this is Greg. The criteria to use, I assume that there's an unspoken bullet there that says that all regulatory people are happy and we can go forth and conquer.

MS. KOLB: Of course. The last section is about maintaining emergency preparedness. So our operations manager is responsible for making preparedness for the plan. The training for individuals is also described in the plan.

So basic emergency plan training is provided to all individuals with access to the facility. The facility emergency organization also receives training on the plan and the roles and responsibilities. Specific training for the different roles were identified for the emergency response organization.

Off-site organizations are offered training in other orientation activities such as tours and community orientation which is mostly tours and/or basic information about the facility. Or radiological information is also offered to other government officials or news people of that nature.

Drills and exercises are planned and executed. The off-site organizations are invited to help plan participate in those exercises. The emergency plan and implementing procedures are reviewed annually by the operations manager or a designee in the room. And the emergency action levels are reviewed with the local government authorities.

MEMBER HALNON: This is -- yeah, this is Greg. I just have a couple of comments on this. Mainly I think it's just going to finish up on my enhancement comments.

In the Section 3.3.1, there's a list of decisions that can't be delegated by the emergency director. One of them is also -- there's a double entry. I'm trying to think of which one it was of activation of the ERO, being able to delegate and not be able to delegate. Look at that and make sure that you have that correct.

MS. KOLB: So I think the decision there -- or I mean, it's the decision. So the difference rather is the decision to activate the ERO is an non-delegable duty of the emergency director. Actually, activating the ERO, using our software programs and type in the emergency classifications that people get the notifications on, whatever the mobile devices are. Using that -- doing that action, that can be delegated to someone else.

MEMBER HALNON: Okay. So you're parsing between the difference between activation and activate. That's the only difference in those two statements. So you might want to make sure --

(Simultaneous speaking.)

MEMBER HALNON: -- you define that.

MS. KOLB: We're differentiating between the decision to activate -- so the decision rests with the emergency director, whether or not the ERO will be activated, and then actually doing the activation, calling people on a phone or whatnot. So that can be delegated.

MEMBER HALNON: Okay. The comment is obviously this discussion wouldn't have to take place if it was much more clear. The second thing is back when I was an emergency director, those non-delegable or those tasks you can't delegate are very important. And just to make sure those are on the annual list for refreshment for the emergency director as well because those are easy to forget. And I recall in my training that we were drilled constantly into it because we were forgetting during our exercises what could and could not be. So just a comment that those -- put a high level of importance of those on your refresher training for emergency directors.

MS. KOLB: Understand. Thank you.

CHAIR BALLINGER: This is Ron Ballinger. I'm looking at the bullet that says off-site organizations are periodically invited to help plan and participate in drills and exercises. Periodically invited.

A lot of times when you first exercise or you've got a nice plan that you've written down. But when it comes to actually doing it and you actually start trying to do it, things come up that you need to change. Is there a plan for an exercise if you want to call it that of your plan so that you can sort out any issues that might crop up that need to -- that would require a change?

MS. KOLB: Do you mean an exercise other than those described in the plan?

CHAIR BALLINGER: I guess maybe Greg knows a better way to put the words. A case where you actually are drilled where you have a training off-site and on-site emergency where you have to execute the plan. And so you go through the procedure which involves the off-site people to make sure everything works.

MEMBER BROWN: Does that mean an unannounced? I would've looked at it as an unannounced drill --

CHAIR BALLINGER: Okay. Sometimes along those lines.

MEMBER BROWN: -- to make sure everything coordinates.

MEMBER HALNON: Yeah, it's unannounced. But there's probably where you exercise the program and procedures. And there's a drill where you -- and whether it's announced or not, it's, like, here's the problem. Now go do it as opposed to tabletop and other things that may happen --

(Simultaneous speaking.)

MS. KOLB: So I guess the difference there is that the -- so drills are conducted annually. That can be a portion of the plan, just not doing the whole thing. It could be some aspect of the plan or some scenario whereas exercises will be done every two years, full participation, any off-site authority having a role in the plan.

And that -- so I think that is what we're discussing. So that would be actually using the telephone systems and/or the radios and going through simulated events. That's what we're defining as an exercise versus a drill.

CHAIR BALLINGER: Yeah, just when I see the words, periodically invited, that could be a little bit on the loose side.

MS. KOLB: I understand. The plan is more specific. That is a summary of two different things because the drills are offered annually. The off-site organizations are invited when they want. The exercises are every two years. And then it's offered because per 10 CFR 50.47(c)(1), they don't -- we can't make them participate. So it's technically an invitation.

CHAIR BALLINGER: I guess I didn't know that. Thank you.

MEMBER BIER: Another question from Vicki Bier. What are the accountability measures for any problems identified during a drill or exercise? Sometimes it's easy to write down, okay, so-and-so will be counseled not to do it that way again or whatever. But those are not necessarily very reliable fixes. And what are the plans for any problems that are identified?

MS. KOLB: Yeah, we intend to use our corrective action system for identifying any issues with the plan and documenting the resolution of those. We also use or at least are prescribed in the plan for post-drill or post-exercise. What could have been done better for documentation and for future plans, for future exercises and drills.

MEMBER BIER: Okay. Thank you.

MEMBER HALNON: This is Greg. Since you mentioned it, you can't make the off-site organizations do anything, notwithstanding that they've agreed to. But two questions, who's assessing their continued readiness and capabilities, and what are you going to do if they don't meet your standards?

MS. KOLB: We don't have provisions to assess their readiness. We don't have any jurisdiction over them. All we can do is communicate with them, share the plan, invite them for training. We can give them feedback when we go and we don't have any formal assessment of their preparations.

MEMBER HALNON: And second question, what are you going to do if they clearly don't meet standards necessary to support your emergency plan? I guess it's a loaded question. It's a loaded --

MS. KOLB: Yeah.

MEMBER HALNON: -- question because FEMA is not involved. It's a loaded question. So you don't have to answer it. I mean, you're going to continue to discuss with them and try to help them as much as possible. That's the only thing you can do.

MS. KOLB: Or if there are some things that we could do to bolster our capabilities, we may choose to do that. But we don't really have any jurisdiction over their resources and their staffing and their plans.

MEMBER HALNON: Thanks.

MEMBER SUNSERI: This is Matt Sunseri. I have a question. I know we're asking a lot of detailed questions about procedures that may not exist in the details and those procedures. So I'm actually in the conduct of operations section looking at your procedure approval process. There's a requirement for the review and audit committee to review procedures -- and emergency plan procedures is on the list -- and assist management in approval of these procedures.

Now if you get into the details of the review and audit committee, it's a very small group. But there are caveats to augment that with other people. So maybe it would help our competence if you could just discuss a little bit. How do you plan to bring in subject matter expertise outside of the SHINE organization to help you develop the details of these procedures that would be commensurate with your peer groups or other facilities?

MS. KOLB: So most of our procedures are drafted. And we started going through internal processes including participation, the requirements of the review and audit committee for that as required. We've periodically had contractors review our procedures and our plan, both initially and more recently as members of the review and audit committee.

The review and audit committee outside membership, you know, along those lines. But that would be inviting people when we don't have specific capabilities on-site as you mentioned to invite other people into that. So we have not done that to date.

MEMBER BIER: Another question, Vicki Bier. I don't know whether there's an opportunity for you to engage with INPO, the Institute for Nuclear

Power Operations. Have you looked into that?

MS. KOLB: No, we have no talked to INPO. We don't really fit into their membership as we're not a power reactor. But no, we have not looked into that.

DR. BLEY: Maybe -- this is Dennis Bley. I had a couple of things I wanted to bring up. I'll ask you, Catherine. But maybe Greg can tell us more. I know that internationally WANO who mirrors kind of INPO has brought facilities that are not reactors into their membership because the operating experience and guidance you get has been very helpful for those facilities.

I don't know if INPO does that or not. But if they do, they're a very valuable resource. And the other thing I wanted to ask, I listen to the discussion with Greg about what if the local organizations aren't doing the role as you see them. Is there any responsibility on your part to convey that kind of information back to NRC who's also counting on the local people to do be doing their part?

MS. KOLB: I don't know of any mechanism for that. I mean, we do have communication lines with the NRC staff we may bring up. But I don't know of any requirement for us to do that. As for the comment about WANO, we have not reached out to them. Thank you for the suggestion.

MEMBER HALNON: And this is Greg. I don't want to go away thinking that FEMA would not be involved because they do participate in the all-hazard planning process with the counties and in state. So they may very well be there.

But it's not designed into the E-Plan because of the facility itself and how it's falling under the regulations, the test reactors, and whatnot. So this kind of falls under the radar of FEMA from a nuclear facility perspective. But they may very well be part of the all-hazard planning which in turn may fine tune some of the radiological planning aspects of this.

So Dennis, I think that there is an avenue. It's just not designed into the, quote, nuclear portion. It's just the FEMA process itself. I think there is some avenue there. But it would have to be requested from the counties themselves.

DR. BLEY: Okay, thanks.

MS. KOLB: Okay. Unless there's any other questions, this ends our presentation on the emergency plan.

CHAIR BALLINGER: All right. Any other questions from members?

MEMBER BIER: Yeah, one other quick question, Vicki Bier. Maybe this is really for NRC staff. But is there any plan to have a resident inspector from NRC on site? Or what is the level of NRC involvement that's anticipated?

MR. BALAZIK: This is Mike Balazik, the project manager for SHINE -- emergency project manager for SHINE. Now we do not plan to have a resident inspector on-site. None of the research reactors have this. So we'll have inspectors that go out periodically to perform inspections. And one area that we do -- one of the inspection modules is emergency preparedness.

MEMBER HALNON: Michael, this is Greg. So I understand the research reactor. This is a commercial facility. It's got a different objective than a research reactor. It's actually trying to make money. Does that not change the calculus a little bit?

MR. BALAZIK: No, it's -- no, I don't think it does just because they're a 103 that they have a resident inspector, no.

MR. MUNSON: This is Jeremy. I would add

to that, that there many aspects of the SHINE facility that are similar to a fuel facility. And our fuel facilities do not have resident inspectors with the exception of the two naval reactor sites. And that is based on the fact that they have very high enriched uranium. So the lack of a resident here would also be supported by our operating fuel facilities not having residents.

MEMBER HALNON: Thanks, Jeremy. I didn't know that. I thought that they all did. So appreciate that.

MR. MUNSON: Yes, sir.

CHAIR BALLINGER: Okay. If there aren't any other questions, that concludes the presentation on emergency preparedness. Now we can shift over to the staff. Are you guys ready to go, I assume?

MR. ROBINSON: Yes, yes.

CHAIR BALLINGER: Okay.

MR. ROBINSON: We are. We are. Well, thank you, Catherine, very much for the insights from the SHINE perspective on emergency plan from the application perspective. My name is Edward Robinson, and I am the emergency preparedness specialist within the division of preparedness and response.

This morning I will be providing a brief overview of the staff evaluations as it pertain to Revision 1 of the SHINE submitted emergency plan. Next slide. At this time, I would like to kind of highlight the regulations and guidance utilized by the staff to perform the review of the SHINE emergency plan submittal. NRC regulations require each applicant for an operating license to include an FSAR that contains among other things the applicant's plans for coping with emergencies, including the items specified in Appendix C to 10 CFR Part 50 which is emergency planning and preparedness for production and utilization facilities.

Appendix E specifies Regulatory Guide 2.6, emergency planning for research in text reactors, is the guidance to be used to determine the acceptability of emergency plans for complying with the commission's emergency planning regulations as those pertain to non-power reactors. Regulatory Guide 2.6 endorses American National Standards or ANSI 15.16, 2015 which is emergency planning for research reactors. This standard identifies the elements of an emergency plan for minimizing the accident consequences at non-power reactors.

It also makes reference to NUREG-1537 Part 2 which is the guidance for preparing and reviewing applications for the licensing of non-power reactors and to review plan and acceptance criteria. And it also makes reference to NUREG-0849 which is a standard review plan for the review and evaluation of emergency plans for research and test reactors. This is what provided the staff with the acceptance criteria for the evaluation of emergency plans for the SHINE facility. Next slide, please.

I'd like to point out to the ACRS staff and those in attendance that there were no significant challenges associated with the EP review. The staff used the guidance set forth in NUREG-0849 for the review and evaluation of the SHINE emergency plan and to assure that a complete review was performed for the SHINE facility. During the course of the staff's review, the staff identified seven RAIs, and those were developed based on emergency plan Revision 0.

But specifically, Revision 4 of the FSAR, these RAIs primarily involve clarification on how specific EP items were met. EP was discussed also at the government-to-government meeting that was held in February of 2020. Discussions related to EP pertain to clarification of the event declaration process utilized by SHINE as well as state exercise participation.

This was also utilized by the staff as a kind of feet on the ground perspective that actually was able to -- the staff was able to utilize what the facility layout was to kind of put things in perspective as we crafted up the Safety Evaluation Report. And then an FSAR Revision 5 was provided by the applicant in August of 2020 and satisfactorily addresses seven EP RAIs that the staff had created. Next slide. The EP staff completed its review of Revision 0 of the EP SHINE emergency plan in September of 2020 with no issues and provided that to NRR.

The EP staff completed its review of Revision 1 of the EP SHINE emergency plan submitted in January 2022, again with no issues and no open items. The EP staff continues to engage with NRR on updates related to FSAR Chapter 12 as well as any updates to be submitted, the emergency plan, in order to ensure the staff's SER content and evaluation continue to remain true. Next slide.

So in conclusion, staff emergency plan finding meets applicable EP regulations and guidance. It adequately addresses the necessary provisions for coping with radiological emergencies and provides reasonable assurance that should operating license be issued, the emergency plan as described will function in a manner that protects public health and safety. Are there any questions from the ACRS staff members or anyone?

DR. BLEY: Yeah, this is Dennis Bley. You heard the discussion earlier between Catherine and Greg about cybersecurity and that the emergency plan doesn't specifically address it. It addresses training aspects for security people, especially physical security, but that kind of cyber would come in under other.

Where do you at NRC sit on that cybersecurity issue? Or does that show up somewhere else here? Because this kind of facility is supplying a vital resource to the country. It seems like it ought to have a pretty good focus on cyber.

MR. ROBINSON: Well, absolutely. I did hear the previous dialogue. As far as the EP safety review is concerned, that cybersecurity wasn't addressed as far as the safety aspects of it. But Michael, do you have anything to shed on that as far as the cybersecurity aspects in the previous conversation?

MR. BALAZIK: Yeah, this is Mike Balazik, project manager for SHINE. We will come back to the ACRS and talk specifics regarding our cybersecurity review. I mean, right now there's a possibility that might point to certain pieces of the emergency plan. But again, we're still reviewing the cybersecurity.

DR. BLEY: Okay, thanks.

MEMBER HALNON: This is Greg. I have no specific questions. I just want to make a comment that I felt that the EP portion was well written notwithstanding a few comments here and there.

But it was well thought out, well written. I thought the staff review was very good. So I won't have any comments relative to the ACRS letter for that, Ron. But just wanted to put that on the record.

MR. ROBINSON: Okay. Thank you, Greg. I appreciate that. And also, I also appreciate your feedback that you were providing during the course of the presentation to the SHINE applicants. I was taking some notes on that, so I appreciate the feedback that you provide.

CHAIR BALLINGER: Other comments from members?

Okay. Now that concludes this topic. We're about -- say again?

MEMBER MARCH-LEUBA: Want me to call the --

CHAIR BALLINGER: No, we're going to wait until before the closed session, I think. So now we need to shift topics to criticality safety. So I'm assuming that SHINE is getting ready to go here, I hope.

MR. NEWELL: Yeah, just getting the slides right here.

CHAIR BALLINGER: Ah, good.

MR. NEWELL: Hello, everybody. I'm Alexander Newell, nuclear criticality safety lead. I'm going to be giving SHINE's presentation on our nuclear criticality safety program.

So the goals of the criticality safety program are to ensure that workers, the public, and the environment are protected from the consequences of nuclear criticality events. All practical measures are implemented to prevent an inadvertent nuclear outcome. Additionally, the program contains provisions necessary to alert personnel to evacuation and inadvertent nuclear criticality occurred.

And the program establishes expectations and requirements for SHINE personnel whose duties involve fissionable material at SHINE facilities. The program implements the applicable requirements of 10 CFR Part 70.24 for monitoring and response to accidents in a staging building, 10 CFR 70.50, 70.52

Appendix A for reporting requirements as described in the technical specifications. 10 CFR 70.61(b) applies criticality accidents which are considered high consequence events, and 10 CFR 70.61(d) which ensures that all processes remain subcritical under normal and critical abnormal conditions including an approved margin of subcriticality and the use preventive controls as primary means of protection.

The criticality safety program commits to use a following consensus standards subject to clarifications and exceptions identified in Regulatory Guide 3.71. And I'll hold on this slide for a minute. The overall responsibility for the criticality safety program is with the CEO.

The safety analysis manager is the responsible manager for the program and may delegate authority over the program to the near criticality safety or NCS lead. The authority generally delegated to the lead includes administration of program documentation, qualification of NCS staff, approval of NCS evaluations, and monitoring of the criticality safety program effectiveness and implementation of changes as needed. The NCS staff consists of an NCS lead, one or more NCS engineers, and any number of NCS engineers in training.

The NCS lead is a qualified senior NCS engineer and serves as a supervisor for NCS staff regarding NCS activity. The NCS staff are kept administratively separate from the operations organization to the extent practicable. Criticality safety evaluations are performed whenever a new fissionable material operation has begun or before an existing operation has changed.

The evaluations determined that the entire process will be subcritical with an approved margin of subcriticality for both normal and credible abnormal conditions. NCS evaluations clearly identify process boundaries. NCS staff determined normal and credible abnormal conditions from input from knowledgeable individuals and personally observed existing equipment activities and processes.

NCS evaluations utilize formal methods of process hazards analysis including a what-if checklist and event tree analysis. Identified scenarios are screened based on qualitative determination of likelihood. And credible events are evaluated for appropriate control selection. NCS evaluation put a strict emphasis of selection of controls which prevent nuclear fatality.

MEMBER MARCH-LEUBA: Hi, this is Jose.

Can I ask you a question?

MR. NEWELL: I'm sorry?

MEMBER MARCH-LEUBA: Can I ask a question?

MR. NEWELL: Absolutely.

MEMBER MARCH-LEUBA: Yeah. Okay. The most likely place where we are going to get the criticality event will be the TSV between startup, right? Is an FMO every time you start a cycle? Or clearly, you're not going to be doing all these things every five days. How is the criticality and the TSV handled?

MS. RADEL: So this is Tracy Radel, VP of Engineering. The TSV is not part -- the target solution vessel is not part of the criticality safety program. It's not covered under the crit safety.

MR. MUNSON: This is Jeremy, NRC. And I'll get more into this in my presentation. But the criticality safety program applies to everything except the target solution vessels. And part of that as was discussed in previous slides is the application of 70.61(d) which requires the assurance of subcriticality under normal and credible abnormal conditions with an approved margin on subcriticality for safety.

The margin associated with the target

solution vessels inherently prevents that from being met. So the target solution vessels have been treated differently. They're not subject to the criticality safety program. And I'll discuss that more once I get to my staff presentation.

MEMBER MARCH-LEUBA: Okay. I understand that. So then we are to rely on what we heard on Chapter 4 of offline calculations?

MS. RADEL: So the insertion of accessory activity discussions are covered in Chapter 4 as well as Chapter 13. And we'll have quite a bit of discussion tomorrow on Chapter 13 and the events that were analyzed there.

MEMBER MARCH-LEUBA: Okay. I'll wait for them then. Thank you.

MR. MUNSON: And also, I want to point out that there are many stages of the process including the target solution preparation system in which there will be no shielding provided. So criticality would be -- would not -- there'd be no protection from the results of criticality for those operators there. So the crit safety program is primarily on prevention of criticality in those areas.

MEMBER MARCH-LEUBA: Yes, but that's the EC problem because there you can have a safe geometry and control parameters. You'll never reach it. You do have to have a program to make sure that you don't mess up with the geometry or the moderator or the concentrations. Okay. Thank you. Keep going.

MR. NEWELL: Thank you for that. Any other questions on this slide before I move on?

Control parameters and associated limits are determined and explicitly identified in the NCS evaluations. The limits are derived from industry accepted and peer reviewed references, including ANS standards. Any hand calculations performed use industry accepted and peer-reviewed techniques.

Computational methods are what we use to generate some NCS limits. All NCS limits are derived based on assuming optimum or most reactive credible parameter values unless specific controls are implemented to limit parameters to a particular range. The operating limits including process variability and uncertainty are used to ensure that NCS limits are unlikely to be exceeded.

MEMBER REMPE: This is Joy. And I guess maybe it's going to be Chapter 7. Maybe it'll be under Chapter 13. It clearly wasn't in 4.

But it seems like that the concentration of uranium is very important and that the level is very important. And I'm just wondering where we'll get more detailed information on how those values are very -- how one obtains confidence in those values. And what is the levels, for example?

MS. RADEL: This is Tracy again. Joy, are you -- just to clarify, are you referencing to the target solution vessel in particular?

MEMBER REMPE: I'm looking at the staff SE and they talk about section 6.3.2. And it says, SHINE states -- and I guess this is open because the SE was open, right? That whenever mass limits are based on assuming a certain weight percent of uranium, either the entire mass present will be ascribed to uranium or the actual weight percent determined by physical measurement. Thus any material associate -- and it goes on.

SHINE assumes the conservative process density to calculate mass when the dimensions of equipment or containers. So it sounds like it's a more general statement. And then it has the use of instrumentation to measure mass is addressed by a general statement of -- and later on, it's talking about a high level sensor.

And I'd have to go look and see where it was. But I didn't see that it was the TSV when it was talking about that. So generally, I just want to know how you are having confidence that you don't exceed those concentrations and the levels.

MR. MUNSON: So this is Jeremy again. I'll talk more about this in the staff portion -- in the staff presentation. But understand that for each stage of the process, there may or may not control a different NCS parameter.

For example, there are certain glove boxes in certain operations early in the process which rely only on mass control. There may be some moderator controls in order to protect those mass limits. But it's primarily on mass control.

Now later down in the process when you actually have already had uranium oxides, uranium metals dissolved in acid, now you have solution systems. Now they're relying on favorable geometry. And when you have a favorable geometry, that is based off of an optimum moderation or an optimum concentration.

Other stages of the process like waste, for example, may rely on concentration control because the concentration is very low. And you can afford to have unfavorable geometries and things like that. So there's no one NCS parameter that's being controlled throughout the facility. And I'll get more into that in my presentation to try and help you understand what parameters are being controlled at what stages of the process and which systems. But the TSVs are not part of this presentation.

MEMBER REMPE: Right. And again, I'm looking at your SE and it's referencing back to 6B.3.1. And it talks about the instrumentation -- the expectation that instrumentations relied on to varied compliance with limits on mass density enrichment will be subject to facility management measures. And I'm curious what instrumentation that you're relying on.

MS. RADEL: Yeah. So this is Tracy again. I believe the statements you're referencing are referring the solution tanks. And those do have a level in them in order to -- if there was a leak in the condensers there that we wouldn't overfill those and result in a situation where fissile material is in a place where it was not expected to be. Those dissolution tanks are favorable geometry. And that level is to ensure that if there was an upset condition that we wouldn't have material outside of this favorable geometry tanks.

(Simultaneous speaking.)

MEMBER REMPE: Go ahead. I'm sorry.

MS. RADEL: I was just going to say as Jeremy said, there are different controls for every process in order to reach that double contingency principle.

MR. MUNSON: For areas that rely on mass control, for example, the equipment or instrumentation used may be something as simple as a scale whereas for a tank that's unfavorable geometry where it's under concentration control, you may have dual independent samples or in-line gamma monitors which monitor material concentration. It's going to depend on -- I think you're trying to apply those general statements to the entire site. But it really depends on what NCS parameters are being controlled, whether they be mass, density, concentration, so forth. Not all parameters are controlled in every part of the facility. Again, I'll talk about that in my presentation.

(Simultaneous speaking.)

MEMBER REMPE: Okay. So am I going to expect to see then specific sensors identified and then at some point will I know how you guys are validating that they remain calibrated for some of the conditions we see in the various locations?

MR. MUNSON: So to answer that question, I will discuss generally what the control strategies are, what the parameters are. And then the facility will be subject to management measures also which is more what you're describing which would be covered in the management measures presentation which would describe the types of things that are implemented or performed in order to maintain those controls as reliable as they're credited in the SSA. So it's sort of a pairing between presentations. I'll discuss the control strategy and the controls, and then you sort of have to piece that together with the measures portion to ensure the reliability of those controls.

MEMBER REMPE: And will that be, like -- where will the management measures portion be? Is that Chapter 7? Or where is that going to be?

(Simultaneous speaking.)

MS. KOLB: Sorry. This is Catherine Kolb. We don't have a presentation planned where we go through every sensor and its requirements, its calibrations, or its management measures. We don't have that planned in that level of detail.

Chapter 7 does identify those safety-related instruments that are credited both from the SSA and a couple of them for criticality safety, those level of instruments that Tracy was describing earlier. The calibrations of things are described in the technical specifications explicitly in those requirements for the LCOs for things that apply or other things that are not explicitly in limiting conditions of operation in the technical specifications. We do have requirements for having a maintenance program for ensuring that the calibrations and the other management measures around equipment is maintained as described in our safety analysis.

MEMBER REMPE: What I'm hearing if that you have identified the key sensors that are need to ensure criticality safety and you have tech specs that identify what the calibration and the allowable uncertainty is so that a regional inspector could come and say, yeah, they're doing what they should be doing. Am I putting words in your mouth? Is that all a true statement?

MS. KOLB: Not every sensor that has some ancillary function in the nuclear criticality safety evaluation is explicitly in the tech specs. The things that are in the tech specs are the safety-related sensors that provide input to the target solution vessel reactivity protection system or the engineered safety feature actuation system. The two safety-related instruments INC systems, so all of those -- all of the instruments that provide input into those are in the technical specifications. And the calibrations are required by surveillance requirements.

If you extend the definition of instruments to include, like, balances, like, scales, we don't have an LCO for scales. We would rely on our maintenance program to ensure that the balance is checked and calibrated periodically as required in that program. That wouldn't be explicitly in the tech specs.

MEMBER REMPE: Okay. But, like, the level sensor, it is --

MS. KOLB: The level --

MEMBER REMPE: I'm getting an echo. I think someone has got their mic open. Is it Munson perhaps? Okay. Thank you. Anyway, so, like, a level detector would be in the tech specs. Allowable margins would be in the tech specs. And then when you get into allowable margins on some of these things or criticality radiation detectors, for example, I'm curious if we've considered the appropriate time not just for when a sensor will trigger some sort of safety system but for the sensor to actually detect that something is not quite right too.

And that's why I'm pulling the thread on the sensors because what I was looking -- again, some of this may up in Chapter 13 perhaps more than here. It seems like that they do talk about once the sensor initiates some sort of actuation the time for that other system to actuate. But I never saw anything about how long it takes the sensor to detect that there's an error because of allowable margins. Does that make sense what I'm asking?

MS. KOLB: Yeah, no. That makes sense. So those level detectors in the dissolution tanks are identified in the technical specifications. A set point calculation, an uncertainty calculation has been done on those instruments in order to identify those margins that you're talking about and including response times are within there in order to the set points relative to the analytical limits to identify that margin. So the technical specifications identified at set points in engineering documents -- other engineering documents identified analytical limits as protected by the set point. So that is how that works for things that provide input to the safety-related instrument control systems.

MS. RADEL: This is Tracy. Chapter 7 also lists the response time of the instruments themselves. And that will be covered more in the I&C Chapter 7 discussion.

MEMBER REMPE: Okay. Thank you.

MEMBER MARCH-LEUBA: Sorry, this is Jose. Can you repeat what you just said because I couldn't understand it? Can you talk closer to the microphone and slower? Because there's a very bad echo in that room.

MS. RADEL: Yeah, this is Tracy. And the response times of the instruments are in Chapter 7 of the FSAR and will be covered in the I&C meeting discussions.

MEMBER MARCH-LEUBA: Okay. Thank you. Try to speak slowly in that room because it really sounds terrible.

MR. NEWELL: All right. Moving on next slide. Prior to beginning operations, the NCS evaluation is independently reviewed by a member of the NCS staff to confirm its adequacy. As part of this review, all dimensions and nuclear properties on which reliance is placed are verified and proper implementation of NCS controls is verified. Additionally, the supervisor responsible for fissionable material operation confirms the NCS evaluation adequately identifies normal and credible abnormal conditions and that the requirements established are verifiable and compatible with planned operations.

MEMBER MARCH-LEUBA: This is Jose again. This seems to be a requirement for the first step before placing the plant in operation mode. I assume everything is good in configuration controls. So if you buy a new tank, you have to redo this again?

MR. NEWELL: That is correct.

MEMBER MARCH-LEUBA: Okay. Thank you.

MR. NEWELL: All fissionable material operations complied with the double contingency principle at SHINE. When analyzing the fissionable material operation for double contingency principle compliance, a single NCS control which maintains two or more parameters is considered to be a single process upset. Processes in which there are no credible criticality sequences meets the double contingency principle by definition.

MEMBER MARCH-LEUBA: So that statement for the safe geometry configurations, you need to have two contingencies if it's safe --

MR. NEWELL: Correct.

MEMBER MARCH-LEUBA: -- by geometry.

MR. MUNSON: We have guidance -- this is Jeremy again. We have guidance that states that when there's no credible means of deformation with respect to geometry controlled systems, there's no credible means of deformation or anything like that, no credible accident sequences which could lead to a loss of geometry that it meets double contingency by definition or by default.

MEMBER MARCH-LEUBA: And you would need -- maybe if you have a higher concentration, more than 20 percent enrichment, for example. But maybe that's a double contingency of failure.

MR. MUNSON: Well, a favorable geometry tank would be assuming that the concentration was optimized. So it wouldn't matter what the concentration was.

MEMBER MARCH-LEUBA: I agree that you optimize concentration and moderation. Is that correct for all those times?

MR. MUNSON: Well, when you're talking about solution-based systems, they're almost synonymous with one another. But yes, that's correct. It's optimally concentrated, optimally moderated. All the parameters have been essentially put at their worst case condition in order to develop that -- the safe dimensions for the geometry controlled system.

MEMBER MARCH-LEUBA: Yeah, that's what I

like to hear. Very nice. Thank you.

MR. NEWELL: MCNP is verified and validated on all computer systems that are used for NCS calculations. These computers are maintained under a configuration control program and re-verification is performed following changes to the system and on a periodic basis. Validation of MCNP is performed by a comparison to critical experiments. The validation report is documented and maintained. Where computer generated limits are used, the NCS evaluations ensure that the evaluated processes are within the area of applicability of the validation reports. The subcritical margin for calculated subcritical limits is 0.06.

MEMBER MARCH-LEUBA: Okay. And I know we'll hear a lot more about the cybersecurity in the future. But this MCNP code is highly likely to be set in a work station in an office with access to the internet probably under activity control of a server. Since the safety of the facility depends on these calculations, cybersecurity protecting and ensuring confirmation control of this MCNP code at the input decks is crucial. I'll ask the question again when we talk about cybersecurity. Because clearly this is an important pool to maintain out of the hands of bad guys.

MR. NEWELL: Yeah. Thank you for the comment.

MEMBER MARCH-LEUBA: Yeah, because the temptation is to put this on a laptop in the office of whoever is working on that. And when you start thinking cybersecurity, what can possibly go wrong, lots of bad things can happen. And it's not only the source code of MCNP but all the input decks define the geometry and such. Thank you.

MR. NEWELL: Control strategies in NCS evaluations follow the typical hierarchy of controls, passive, active, and administrative. All administrative controls are specifically annotated in SHINE's operating procedures. And NCS evaluations, the explicit use of NCS controls is preferred to alliance on the natural and credible course of events.

Additionally, controls on two independent criticality parameters is preferred over multiple controls in a single parameter. As mentioned earlier, single parameter limits are used. All other parameters are evaluated at their most reactive credible values and safety limits on the control values which counter tolerances and uncertainty are established. On the screen, you can see the --

(Simultaneous speaking.)

DR. BLEY: Excuse me.

MR. NEWELL: Yeah?

DR. BLEY: It's Dennis Bley. Could you explain your first bullet a little more? I'm not -- reliance on natural and credible course of events seems a pretty good basis the physics say it has to go that way. So explain that one a little bit.

MR. NEWELL: In general, we prefer to explicitly control a sequence rather than rely on that. Not to say that we don't take credit for that in some sequences, for example, the draining of fissile material on a drip pan. But we prefer to have explicit controls in place.

DR. BLEY: Okay. Go ahead. I'm just -- I'm a little -- and I understand why we would want to be able to control the situation. I'm not completely convinced I prefer that to knowing the physics will prevent something from happening. Go ahead.

MR. NEWELL: On the screen, you can see the philosophy of how we implement mass limits including accounting for over-batching. An example of mass controls is in the uranium receipt and storage system where we have limits on the mass of special nuclear material inside of the uranium oxide and uranium metal canisters. Both of these limits are well below half of the critical mass use.

Geometry controls rely on fuel parameter limits or NCS calculation to demonstrate favorable geometry. Examples of geometry controls include limits on the dimensions of target solution staging system and their tanks and volume limits on select pumps and filters. Enrichment is verified prior to adding material to URSS canisters.

Because of this, enrichment is considered fixed in every evaluation when calculating NCS limits. The SHINE facility has limited instances of the need for moderation control. The uranium receipt and storage room is one example. Included in these controls are limits on liquid being present in the room and a three-inch berm which reduces the likelihood of flooding in the URSS room from external sources.

Liquid density is explicitly controlled in the NCS governed process. However bounding high densities are assumed when performing NCS calculations. The reflection is not specifically controlled in the NCS evaluation but is considered when performing NCS calculations. Maximum credible reflection is considered for each unit analyzed.

Uranium concentration is controlled only in the RLWS and RLWI systems. In the RLWS, waste material is first added to a favorable geometry vessel and sampled for measurements of uranium concentration. Once the concentration is shown to be below the 25 gram per liter limit, the material is moved to a second in series stable geometry vessel where a sample is taken and measured by a different chemist using a different method than the first.

MEMBER MARCH-LEUBA: So hold on a minute. You said the license independent sampling, you really mean diverse sampling. It's a different method, not a different person.

MR. NEWELL: There is a different person and a different method.

MEMBER MARCH-LEUBA: Okay. So then yeah, I would call that diverse. Thank you.

MR. NEWELL: Thank you.

MEMBER MARCH-LEUBA: For the record, diverse is good. Independent is good, diverse is bad.

MR. NEWELL: Once results for both methods are obtained, they are reviewed by a supervisor and solution is moved to an unfavorable geometry waste vessel if the concentration is deemed to be acceptably low and that both values agree with each other with reasonable uncertainty. Additionally, valves on lines to concentration control tanks are normally closed to prevent inadvertent transfer of material. Physical chemical form is controlled by maintaining the pH of the uranium barium solution to under pH 2.

Controls are established on any re-agent addition lines which will contain basic solution to ensure that it is highly unlikely that interaction between the two materials will occur. Additionally, requirements are established in the URSS that require the uranium exiting the furnace to be of a non-hygroscopic type in order to maintain low moisture content in the oxide material. Interaction is controlled between vessels by establishing minimum separation distances where necessary.

Examples of this type of control include the dissolution tanks and the target solution preparation system as well as the vacuum lift tanks and vacuum transfer system. Both volume and interaction are controlled in some systems, including the target solution preparation system. In this system, units containing fissile material that are not maintained neutronically isolated are limited to a volume to 1 over n of a volume limit where n is the number of units in question.

Heterogeneous effects are controlled in a similar manner to physical chemical form focused on preventing the interaction of fissile material with organic or basic solutions that could cause uranium precipitation or wearing. NCS controls are implemented by the operations staff for the use of operating procedures. The purpose of these procedures is to facilitate and document the safe and efficient conduct of operations.

As mentioned earlier, the procedures include specifically annotated criticality controls. Any new or revised procedures that could impact NCS are reviewed by NCS staff. To ensure that not unevaluated changes to process conditions have occurred over an extended shutdown, operations and NCS staff perform a review to identify any changes that could impact nuclear criticality. Any changes identified are addressed in an NCS evaluation and verification of the implementation of appropriate controls is performed prior to restart.

CHAIR BALLINGER: This is Ron Ballinger. I hate to keep coming back and beating a dead horse. But whenever I hear pH 2 for solutions, I keep coming back to the issue related to the material selection for the vessels and the choice of the -- I think it's

347 stainless steel.

I want to keep putting it on the record that procedures for welding that material need to be very carefully monitored and controlled. pH 2 is pretty low. Thank you.

MS. RADEL: This is Tracy. The corrosion report that has been done for the vessels in the facility, we did include, I know the --

MEMBER MARCH-LEUBA: You're breaking up again. Can you talk closer to the microphone?

MS. RADEL: Yeah. So this is Tracy. I know there's a previous question and a previous meeting on knife-line attack corrosion did verify that was considered and evaluated as part of the corrosion analysis for the vessels and the material that was selected as well as other corrosion mechanisms that would potentially occur. And mitigation strategies for that and the manufacturing process were outlined and implemented during the manufacturing to help mitigate that and reduce likelihood of those occurring.

CHAIR BALLINGER: Thank you. This is the first time I've heard anyone on the SHINE staff use the word, knife-line attack. I'm glad you know it.

MR. NEWELL: NCS training requirements for on-site personnel are determined and documented. The content of the training programs is tailored to the job responsibilities. While two tiers of NCS training are established, both tiers include stop work authority, procedural compliance, response to criticality alarms, and reporting of defective conditions.

Tier 1 training includes content from ANSI/ANS 8.20 and is directed to those who manage or work near areas where the potential for criticality exists. Tier 2 training is specific to NCS staff and meets the requirement and recommendations in ANSI/ANS 8.26. SHINE uses qualification cards to report an individual's progress or its qualification.

Qualifications granted by external organizations may be recognized based on verification and completion of SHINE facility specific portions of the qualification card. Experience may be used to exempt individual training and qualification requirements. Where this is used, appropriate documentation is attached to the qualification card and retained.

Facility familiarity and walkthrough requirements may not be accepted. The maintenance of NCS qualifications is required. Completion of re-qualification is required every three years and continued active participation in development of NCS evaluations.

Senior NCS engineers continue active participation in the independent review of NCS evaluations and completion of annual professional development activity as determined by the NCS lead. All SHINE employees are encouraged to provide feedback on the criticality safety program. Personnel are required to report any defective NCS conditions to the NCS program management.

All fissionable material operations are reviewed at least annually to verify procedural compliance and normal process conditions. These reviews are conducted with consultation with operations personnel and are documented. This includes an NCS staff walkthrough of the facility processes and procedures.

The NCS lead scheduled coordinates all routine NCS oversight activities. This includes a routine audit of NCS practices, examination of reports of procedural violation or other deficiencies. Additionally, each evaluation and calculation important to NCS are reviewed at least once every few years.

And at least once every three years, the criticality safety program is audited for effectiveness. Any deviations from features and unintended changes to process conditions are reported to management, investigated, corrected, and documented. Any action taken to correct deviations or changes to process conditions are taken in accordance with procedural requirements and with input and guidance from NCS staff.

The conditions that require corrective action include violation of NCS requirements, conduct of fissionable material operations without an evaluation, discovery of an unanalyzed condition, and discovery of deficiencies in NCS evaluations. Upon the loss of double contingency principle, the fissionable material operation is suspended and the process is rendered safe until a double contingency principle protection may be reserved. As stated earlier, NCS events are reported to the NRC in accordance with a reporting requirement as with prior technical specifications.

SHINE's configuration management includes the engineer controls are significant to nuclear criticality safety. Configuration management program is relied upon to maintain controls and their analyzed conditions. Any change that could affect NCS limits is evaluated in facility process requirements. And prior to implementing any change, the corresponding NCS evaluation is reviewed and updated as needed.

SHINE's emergency plan provides guidance on how to respond to emergencies. Response to an imminent occurring or past indication of criticality accident invokes a special procedure for criticality accident loss. The NCS staff plays a role in preparing emergency plans and procedures in accordance with ANSI/ANC 8.23.

SHINE provides a criticality accident alarm system, or CAAS, to detect a criticality event in the facility and should not accept quantities of fissile material greater than the limits identified in 10 CFR 70.24(a) are used, handled, or stored outside of the target solution vessels. CAAS meets the requirements of 10 CFR 70.24 and conforms to the recommendations in ANSI/ANS 8.3 and incorporated any exceptions or recommendations from Regulatory Guide 3.71. We have neutron-sensitive detectors placed at locations shown by calculation to provide sufficient coverage and detect the minimum accident of concern.

Generally, CAAS detectors are arranged in a way that that each area receives coverage from three detectors. If an accidental criticality occurs, CAAS energizes clearly audible alarm signals. All mandatory evacuation areas are clearly marked with evacuation routes that are selected to lead personnel away from areas with a potentially higher dose.

For conditions which could disable multiple detectors or the logic unit, temporary criticality detection equipment with audible alarms will be used for personnel remaining in or entering the affected area. Personnel access to the affected area will be limited to essential activities. These administrative controls include a short allowance for the full preparation. That is the conclusion of the presentation on the criticality safety program. Are there any questions?

MEMBER KIRCHNER: This is Walk Kirchner. I have a question on your last bullet of the last slide. What conditions do you envision that might disable multiple detectors? Are you talking about upset conditions like accidents, fire? Or are you talking about just maintenance and other potential loss of electric or something like that?

MR. NEWELL: It's more along the lines of a loss of normal power or maintenance activities. Any other questions?

CHAIR BALLINGER: Hearing none, we're scheduled now for a break. We're a little bit early, but that's fine. Let's recess until 11:40 -- excuse me, 10:45.

(Whereupon, the above-entitled matter went off the record at 10:26 a.m. and resumed at 10:45 a.m.)

CHAIR BALLINGER: Okay, folks. We're ready to go again. Back in session. I see the staff slides up there. So if we're ready to go, let's do it.

MR. MUNSON: Okay. I am Jeremy Munson. I work in the Office of NMSS Division of Fuel Management. And I did the nuclear criticality safety review in FSAR Chapter 6(b)(3). Can you move to the next slide, please?

CHAIR BALLINGER: We're getting a little bit of an echo. Where have I been wrong?

MR. MUNSON: Is that any better?

CHAIR BALLINGER: Yeah, I think so.

MEMBER MARCH-LEUBA: You sound like you're in a tunnel or something.

MR. MUNSON: I'm sitting right in front of my computer, but --

MEMBER MARCH-LEUBA: It's fine. We can

understand you.

MR. MUNSON: Okay. So this slide is simply to point out that there is quite a bit of crossover with the Chapter 13 accident analysis portion because many of the criticality -- or many of the accident sequences associated with the SHINE are criticality sequences. Chapter 13 will be in a separate presentation. Next slide.

Okay. In terms of regulatory requirements, you've seen this before most likely. But 50.34 requires the licensee to describe the facility's equipment. 50.68 requires the licensee to maintain a criticality accident arm system and emergency procedures in accordance with 70.24. It actually gives a set of alternative criteria to meet.

But SHINE chose to go with the requirements of 70.24. Through the course of the review because this is a facility that's very much like a fuel facility, there were certain Part 70 provisions that were identified to be applicable to the SHINE facility. And they were achieved via commitments in the SHINE FSAR.

70.61(b) requires the licensee to limit the risk of high consequence events such that the likelihood of its occurrence is highly unlikely. And in that context, criticality is always considered to be high consequence. 70.61(d) requires the assurance of subcriticality for normal and credible abnormal conditions and the use of an approved margin of subcriticality for safety. And there are certain reporting requirements in Part 70 including 70.50, 70.52, and Appendix A which requires specific criticality-related events to be reported to the NRC, whether they be an hour reportable or 24-hour reportable. All right. Next slide, please. The area --

MEMBER MARCH-LEUBA: Sorry. This is Jose. How do we separate the requirements for the TSV and the rest of the facility? Is that a regulatory separation, or can you talk about that?

MR. MUNSON: The criticality safety program applies to all areas and all operations of the facility except the TSVs. And if you could go back one slide, please. I mentioned this earlier, but the reason for that is because the most stable, the most rudimentary, the most important criticality safety requirement is 70.61(d).

And it actually is almost verbatim in the ANS standard. It's called the process analysis requirement. And that's the assurance of subcriticality under normal and all credible abnormal conditions.

The difference in the ANS standard and the regulation is we go so far as to tell you what we mean by subcritical by adding including the use of an approved margin of subcriticality for safety. And because of the margins associated with the TSVs, it was determined that really can't be met in that case. So the criticality safety program does not apply to TSVs. It's been treated separately.

MEMBER MARCH-LEUBA: Yeah, but from where I sit, the fact that I cannot meet the requirement doesn't let me not use them. There has to be a reason why we handle it as a Chapter 13 accident. But what you're saying is we couldn't possibly meet the 0.06 requirement for the TSV. Therefore, we don't need to. And I don't think that's what you mean.

MR. BALAZIK: This is Mike Balazik.

MR. MUNSON: Go ahead, Mike.

MR. BALAZIK: Yeah, this is Mike Balazik, project manager for SHINE. So the SHINE TSV is part of the utilization facility which is licensed under Part 50. We went through a rule making to designate it as a utilization facility. So that's why the TSV is being looked at under Chapter 13 and not the --

I'll say the production facility side of the facility.

MEMBER MARCH-LEUBA: Okay. That's a much more satisfying explanation. Okay. We're getting it. We're getting it.

MR. MUNSON: Just understand that the 70.61(d) has been imposed via a commitment. And the commitment is limited in scope to everything but the TSVs. So it's actually not a Part 50 requirement but rather a commitment. So it's not like we have a regulatory requirement that we're just ignoring. Next slide, please.

MEMBER MARCH-LEUBA: What I thought I heard is that everything but the TSVs under license under Part 70 and the TSV because that's the production facility's license under Part 50. We don't require reactors to be subcritical. They are critical.

MR. MUNSON: So no --

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: -- analysis.

MR. MUNSON: This is a Part 50 license. Certain divisions of Part 70 have been committed to in the SHINE FSAR. This is not --

MEMBER MARCH-LEUBA: Okay.

MR. MUNSON: -- a dual license. There's

no Part 70 license and a separate Part 50 license. It's all one Part 50 license. It's just certain Part 70 provisions given the nature of the SHINE processes have been committed to by SHINE and the FSAR.

And understand this is a unique facility, right? Many stages of the process are very much like a fuel facility. When they bring the material in the way that it's treated, the way that it's handled, the dissolution of uranium oxides into your whole solution, basically, this is a fuel facility except for the irradiation piece. So it makes a lot of sense to utilize the Part 70 provisions where appropriate in order to reach the desired outcome which is the reasonable assurance of adequate protection.

MEMBER MARCH-LEUBA: Okay. Thank you. I think I have it clear now. Keep going. Unless somebody wants to diagnose the echo because it keeps coming up.

DR. BLEY: Jose, I'm not hearing the echo that you're hearing. So --

CHAIR BALLINGER: We're not hearing it now.

DR. BLEY: -- I'm not sure why it's been a problem.

CHAIR BALLINGER: Yeah, we're not hearing it now. But every once in a while, it comes up.

MEMBER MARCH-LEUBA: Okay. Keep going.

MR. MUNSON: Okay. In terms of areas of review, the use of the appropriate ANS standards, a review of the criticality accident alarm system, emergency planning and response. There are strategies for entering subcriticality and adherence to the double contingency principle, the organization and administration of the criticality safety program, the SSA and management measures piece that are appropriate to crit safety, the technical practices and treatment of NCS parameters, including validation of neutronics methods and the minimum margin of subcriticality as referred to in 70.61(d). Next slide, please.

Okay. Just to summarize the review findings before we get into more details, the review findings that the licensee has described in NCS program as appropriately -- that appropriately reduces criticality and processes under normal and all credible abnormal conditions. The licensee will develop, implement, and maintain emergency response procedures for the alarm system requirement of 56.8 and 72.4. The license described in the NCS program provides reasonable assurance of the protection against criticality as to the worker, public, and environment. Next slide.

Okay. There were several points of interest here. The way that our guidance was structured sort of separate from the radioisotope production facility and irradiation facility side, there are many aspects of the irradiation facility where it would be appropriate to apply the elements of the criticality safety program. For example, the validation techniques and the MCNP code that was used to determine what the safe limits would be or what the design of the TSV dump tanks would be, they were all the same.

The TOGS system which is on the irradiation facility side also has credible criticality hazards. So we met a challenge earlier on in sort of determining what aspects of Part 70 would be appropriate and where. And we determined that the most appropriate thing to do would be to have the criticality safety program applied to everything except for the target solution vessels as opposed to just the radioisotope production facility.

Because like I said, there were many areas of the irradiation facility that would also -- it would be appropriate for the crit safety program to cover. So appropriate 10 CFR Part 70 requirements have been imposed via SHINE's commitments in the FSAR which are about 70.61(b), 70.61(d), and the reporting requirements. I have an asterisk there by Appendix A because Appendix A actually is written in terms of the facility that has an integrated safety analysis.

So the way that is written has many references to IROS, items relied on for safety, in the ISA. Obviously, a commitment to Appendix A won't mean anything if you don't have an ISA or IROS. So what SHINE did there was they basically wrote out equivalent commitments that would meet the intent of Appendix A requirements for reporting and put those into the FSAR.

CHAIR BALLINGER: This is Ron Ballinger. There's some kind of beeping that's going on. Is there somebody that's not muted that should be muted? Because every once in a while, it does hurt us on understanding what's being said. Oh, it's coming from the actual speaker? Oh, gosh. Well, okay. Well, we'll do the best we can. Okay. Let's go again, I guess.

MR. MUNSON: Next slide. Okay. I'm just going to -- as I was mentioning before during SHINE's presentation, different areas of the facility may utilize different control strategies or control different NCS parameters. So I was just going to briefly walk through stages of the process and discuss what the control strategies there are, starting with the target solution staging system. This is a system which will convert uranium oxides into a solution through the dissolution in acid.

The TSPS consists of eight target solution hold tanks and two target solution storage tanks, all of which are favorable to the dual passive overflows to prevent scenarios. Drip trays or equipment drains in the event of leak or overflow to avoid an unsafe slab from being exceeded if a leak were to occur. Next slide, please.

The radioactive liquid waste storage system consists of two uranium liquid waste tanks, four radioactive liquid waste tanks, and eight liquid waste blending tanks. Uranium liquid waste tanks are favorable geometry with redundant passive overflows. The radioactive liquid waste tanks and liquid waste blending tanks are not favorable geometry. But they are under concentration control which is verified via dual independent sampling or diverse sampling.

And again, drip trays are equipped with drains in the event that there is a leak or an overflow. So here you see a deviation from a geometry system to a system that is relying on concentration control and, again, verified by sampling methods. Next slide, please.

The molybdenum extraction and purification system, the majority of its components are favorable geometry, including the pump, piping, everything like that. However, the molybdenum eluate hold tank and facility chemical reagent system are not favorable geometry. In order to prevent inadvertent transfer to those favorable geometry tanks, a three-way valve and isolation valve is advised.

There is a credible sequence involved in the precipitation due to inadvertent addition of cost of reagents. That is prevented by administrative controls and the addition of caustics and the nature of column wash sequence. Next slide, please. For the target solution preparation system, uranium oxides, I split this into basically two different areas because it begins with uranium oxides and it ends with uranium solutions.

For uranium oxides, administrative limits on oxide mass are utilized in the event that uranium powder or oxide were to become trained into the ventilation system. There are HEPA filers with favorable geometry. And there are moderator exclusions which help to protect those mass limits.

However, they're primarily relying on mass control here. This is an operator action. So it's primarily going to be administrative in nature, and they're going to be relying on mass control.

Once dissolution occurred, you now have your solution. And the target solution preparation tank pumps and filters are all favorable geometry. They're high level controls, in general utilized in order to prevent back flow scenarios. And back flow scenarios would include any process chemical limes coming in.

If there were to be an overfilling of one of the vessels, it could back flow into an unfavorable geometry process line or process tank. And those are sequences which have been prevented through check valves and high level controls. Next slide, please. The vacuum transfer system, the majority of its components are favorable geometry and robust enough to design to prevent leaks.

The vacuum buffer tank is equipped with a demister which will separate potential entrained uranium solution. Vacuum headers are equipped with liquid detection that will stop transfer upon detection of liquid. Next slide. In the uranium receipt and storage system, there are administrative controls on mass.

There are both administrative and engineered controls on moderation. It's a moderator exclusion zone, so you can't bring sources of moderator in, things like that. And the outside storage rack and metal storage rack have favorable geometry. Next slide.

In the radioactive drain system, it consists primarily of favorable geometry tanks. The hold tanks are equipped with level instrumentation to detect solution leaks into the RDS to prevent precipitation of solids. Next slide. And the radioactive liquid waste immobilization system, the drums are subject to mass control, and they also have a waste acceptance criteria for uranium activity that would help to indicate mass. Next slide.

MR. BORROMEO: Hey, Jeremy.

MR. MUNSON: Yes, sir.

MR. BORROMEO: Can we do a little test here? Can you turn down your speaker all the way? And then we'll IM you if you have -- if ACRS has a question. We're still trying to fix the feedback problem.

MR. MUNSON: Sure. Would you like for me

to continue? Okay. The laboratory is subject to mass control. They will be working with very limited quantities of fissionable material, and it will be less than minimum critical mass. So next slide, please.

The iodine extraction and purification system, there's a three-way valve and isolation valves that prevent inadvertent transfer, the IXP eluate tank and the facility chemical reagent system, because they're both unfavorable geometries. Next slide. Okay. Another point of interest is the minimal margin of subcriticality. As I said before, 70.61(d) which SHINE has committed to in the FSAR requires the use of a minimum margin of subcriticality for 50.

Although MCNP is pretty good, our in depth cross section libraries are pretty good, they're subject to many sources of uncertainty. So we typically require licensees to do a validation to establish the degree to which the code is either overpredicting or underpredicting reality. And we call this a bias.

There's uncertainty associated with a bias. But they're also unqualifiable or difficult to quality, difficult to quantify sources of uncertainty that are not explicitly identified by the validation and hence included in the calculation of the bias. And for that reason, we impose an administrative margin or an MMS to make sure that systems calculated to be subcritical are in fact subcritical.

Many stages of the process will rely on the use of subcritical limits -- or that should actually say single parameters, that's my mistake -- derived from NRC endorsed ANS standards. It's not explicit k-effective calculations. So ANS 8.1 actually has -- which is endorsed by the NRC in Reg Guide 3.71 -- actually has tables which will provide you with things like mass limits, concentration limits and so forth.

And the NRC has endorsed those. Those do not require explicit k-effective calculations for these MCNP. For cases where MCNP will be used and explicit calculations will be necessary, those calculations will be subject to administrative margin of 0.05 with an additional penalty of 0.01 added to account for a lack of experimental data for uranyl sulfate systems resulting in a minimal margin of subcriticality of 0.06. It was identified during a review of the validation report that many of the systems or that the benchmark experiments selected for validation were not uranyl sulfate systems.

NUREG-6698 is the guidance that we use to perform reviews of validation reports and the minimum margins to criticality in addition to Appendix B of Chapter 5 to 1520. And it does provide guidance for what an appropriate penalty would be for situations like this. And to accommodate a lack of experimental benchmark data for uranyl sulfate systems, this 0.01 penalty was imposed.

So you end up with a k-effective limit of essentially 0.94. But that's also before the bias and bias uncertainty have been subtracted out. So the guidance documents that I referenced before in determining whether the MMS is appropriate primarily rely on the validation rigor and the statistical methodology used in performing validation, the quality, quantity, and similarity of benchmark experiments, and any conservative practices which may result in safety margin and other sources of safety margin.

Safety margin meaning margin in parameters which does have a result on the subcritical margin. But they are not the same thing. For example, a 2 percent change in moderation does not necessarily result in a 2 percent change in k-effective. It's sort of a nonlinear type of thing, although if you were to set a mass limit, if you were to calculate a minimum critical mass that, for example, 10 kilograms and the limit that you imposed is 5 kilograms, the k-effective would not necessarily be on a percentage basis, would not necessarily be linear in that.

But that safety margin that you have imposed does result in a consistent reliable impact to subcritical margin. Next slide, please. SHINE has requested an exemption from the criticality accident alarm system requirements of 70.24 for the material staging building and the irradiation units. This is partly based on the Part 71 criteria for fissile exempt packages. That is being reviewed by the staff, and that's about all I can say about that -- say on that at this time. Next slide, please.

DR. BLEY: This is Dennis again. At what point will this come back to the committee here?

MR. MUNSON: Say again?

DR. BLEY: Is there some point in the future after your review is complete that this issue comes back to the committee on the exemptions.

MR. MUNSON: Well, perhaps Mike could take that question. The review is already complete. But in order to not discuss any pre-decisional information, I can't really comment on whether the exemption will be approved or not. But perhaps Mike or Josh knows a better answer to that.

DR. BLEY: Okay. And we have a closed session I believe coming up.

MR. BALAZIK: Yeah, this is Mike Balazik, project manager. I mean, we can discuss this in closed session. Or we can have a focused discussion on the exemption if needed.

DR. BLEY: Okay. Try it in the closed session. That'd probably work.

MR. MUNSON: Next slide, please. That may be the last slide. Yeah, that's the last slide. So with that, that was a summary of the review performed for the criticality safety program. Are there any questions?

MEMBER KIRCHNER: This is Walt Kirchner. Jeremy, when you did your review, you systematically went through the different systems where there were potentialities for criticality. And you pointed at a number of places where there was not favorable geometry and there was use of fissile solutions which always are probably of most concern in this business. Did you flag any particular areas for your review that you put it at attention where there was reliance on administrative controls or concept of operations was an important factor in maintaining the subcriticality margins? I'm thinking of things.

(Simultaneous speaking.)

MEMBER KIRCHNER: I'll lead you to one or two that I've looked at. Certainly the moly extraction purification system, the target solution tanks. There are several areas where there are controls in place as well as administrative controls. In your review, did you convince yourselves that the concept of operations was such that there was sufficient margin?

MR. MUNSON: Absolutely. We're in absolute agreement that solution systems represent the highest risk of the 23 actual process related criticalities we've had worldwide. And throughout history, 22 of them had been solution systems. And transfers -- inadvertent transfers to unfavorable geometry whether they be through a maintenance activity or through a back flow scenario, whatever the case may be or have always been the high concern and the point of interest in criticality reviews.

In terms of identifying specific systems that stood out that I would primarily go with systems that do not rely on geometry control but rather on administrative control. So the target solution preparation system where they're dealing with outsides and they're doing the dissolution and things like that as well as the TOGS and the moly extraction purification system like you referenced before all were definitely areas that I chose to dig a little deeper on vertical/horizontal slides.

MEMBER KIRCHNER: So I don't know the extent that actual operating procedures exist. But did you for those -- I'll call them sensitive processes. Then you looked at the administrative controls that are being proposed and convinced yourself that the concept of operations would prevent -- reasonably prevent inadvertent criticality?

MR. MUNSON: Yes. I did a detailed review of the criticality safety evaluations. As SHINE stated in their presentation, they're committed to ANS 8.1 as well as ANS 8.19 which provide guidance and requirements -- not regulatory requirements but within the context of the standard requirements for conducting criticality safety evaluations. So the criticality safety evaluations not only include a detailed process description but also the identification of controls, the identification of important limits, the actual calculations themselves, the demonstration of double contingency and subcriticality within approved margin.

And I did a detailed technical review on a number of the criticality safety evaluations. That's really a starting point for crit safety, right? So everything comes from the crit safety evaluation including the -- the crit safety evaluation is developed.

And then the controls and limits identified therein, that's what feeds -- informs the SSA. And that's what informs the procedures. And that's what informs everything that comes thereafter. So certainly the crit safety evaluation, it's the best place to start. And I did a detailed technical review of those as well as a sample of some of the operating procedures and the SSA.

Now are there any -- obviously I think Greg earlier this morning made an important distinction about this particular facility, unlike doing criticality experiments that Pajarito Site at Los Alamos or other places. This is going to be where they're one-off typically kind of experiments. Here, you are actually operating a chemical facility whose objective is to produce this very valuable moly isotope.

There's going to be lots and lots of

repetitive operations. Did you look at those administrative and other procedures from the standpoint that these -- just the demand of producing the material is going to be over and over again repetitive operations? Are there any potential weaknesses there in terms of human system interaction, potential for not following precisely a procedure and then having a much higher risk of approaching criticality?

MR. MUNSON: So there are a number -- this sort of requires a detailed response. There are a number of technical practices, conservative practices that SHINE utilizes in the development of their NCSes and their limits and ultimately their controls which provide a number -- a degree of safety margin in the event that an operator does make an error or something to that effect. With that being said, the human reliability is always a factor.

The reliability of the human is very low in a lot of cases. And we have guidance for what constitutes appropriate credit for human reliability, what the likelihood of failures would be, things like that. That might be better discussed in the review of the SSA methodology or Mike Call's presentation because he's the one who looks specifically at what appropriate credit would be for which appropriate controls.

I will say that consistent with sort of an ISA-like methodology, as SHINE's SSA is, it's more along the lines of instead of applying the principles of probabilistic risk assessment in determining what the likelihood of human error would be for each individual system or each individual action. It's more on sort of, like, a magnitude-based approach, like, a 10 to the minus 2 or 10 to the minus 1, that sort of thing, because it's more semi-quantitative in nature with lots of qualitative aspects. But certainly, the human factors have been considered. And what SHINE has proposed is consistent with our guidance in terms of reliability for human actions. And I think Mike Call might be able to provide any information beyond that.

MEMBER KIRCHNER: Well, that's good for the time being. Thank you for that answer.

DR. BLEY: Yeah, this is Dennis Bley. I wanted to push you in this area just a little. I raised a question when SHINE was presenting their talk where they say their preferences that nuclear criticality safety controls are preferred, relying on essentially credible physics and chemistry.

But it sounded a little funny with me, especially if you don't specify what kind of controls you're talking about. And if we're talking about administrative controls, that one really bothers me because over time they tend to get violated at some point. And I wonder if you folks thought about that issue much and that preference for controls over physics and chemistry.

MR. MUNSON: So what you saw on SHINE's presentation there is actually sort of pointed to because it's an acceptance criteria for our review and our --

DR. BLEY: Sure.

MR. MUNSON: -- standard review plan. And the reason why that's in there is it's sort of limited to -- let's say if you have uranium oxide powder and you spill it into a glove box. It's probably going to spread throughout to a reasonable degree. But we're going to assume that -- conservatively assume that it forms a hemisphere because that's a more reactive shape.

DR. BLEY: Sure.

MR. MUNSON: Or it's referring to things like that. Gases flow up typically. Gravity works in the downward position typically, things like that.

But it only provides you -- it provides you with a reasonable argument.

It doesn't provide you with control over process necessarily. So it's really intended to discuss those types of things and ensure that there's not too much reliance upon assumptions or things like that because we typically want controls in place to verify that things are occurring. For example, if you put uranium oxide powder into a furnace, it comes out the other side.

There's been a change in density that has occurred. If you're doing a criticality safety evaluation and you have to have an assumed density, we're probably going to want you to check and make sure, have some sort of control that that density that you're assuming when deriving your limits is appropriate as opposed to just saying, okay, well, it's been in this furnace. And through the natural course of the furnace and the oxidation process, the change in density is such that we end up with this result. Does that answer your question?

DR. BLEY: It helps. And if you think of it the way you just described, then the idea of credible physics and chemistry doesn't -- I get what you're talking about. It's the administrative control side of this that leaves me feeling always a little uncomfortable. But I liked your explanation. I'm glad you look at it that way.

(Simultaneous speaking.)

MR. MUNSON: That does not -- it's not speaking to -- or preventing us from evaluating. The very likely scenario where a human through administrative action has some sort of error because it's a redundant sort of -- or some sort of task to where they're doing it many, many times. And it's subject to a higher likelihood of error or something along those lines.

That's not what that is really speaking to. And the assumptions associated with human reliability and what credit they receive for administrative actions in the SSA are intended to bound that sort of thing. And the numbers that are in our guidance which again SHINE's numbers that they have proposed are consistent with our guidance are intended to bound all those types of errors.

DR. BLEY: Thank you.

CHAIR BALLINGER: Other questions from the members?

Hearing none, then we are at the break that we were supposed to take lunch, we're about a half an hour ahead which is probably a good thing. And so the next set of presentations is a completely different topic. So I would propose that we recess and come back at 1:00 o'clock and take an extra half hour for lunch. Are there any comments from members?

Okay. Then let's recess until 1:00 o'clock. Thank you.

(Whereupon, the above-entitled matter went off the record at 11:26 a.m. and resumed at 1:00 p.m.)

CHAIR BALLINGER: Okay. We're back in session. So okay, that's good. Material control and accountability, the SHINE folks are there. So are you folks ready to go?

MR. EDWARDS: Yeah, SHINE's ready to go.

CHAIR BALLINGER: Thank you. Let's go.

MR. EDWARDS: All right. This is Eric Edwards. I'm a chemical process systems manager here. And this is going to be a brief introduction to the material control and accounting plan. We'll go into a little more detail in the closed session.

Okay. The purpose of the material control and accounting plan is to fulfill the requirements of 10 CFR Part 74 which is titled material control and accounting for special nuclear material, also called SNM. The requirements of Part 74 are to maintain accurate, current, and reliable information on, confirm the quantities and location of SNM in the licensee's position, conduct investigations, and resolve any anomalies, rapid determination of whether an actual loss of a significant quantity of SNM has occurred and generate information to the investigation and recovery of missing SNM in the event of a loss.

And then the next slide here, I'm just going to go through what is defined material control and accounting plan. We also call this MC&A. We frequently use the acronym here. So the MC&A plan achieves the requirements of 10 CFR Part 74 by describing the items on this list.

First, the plan defines programmatic requirements or measurements, measurement control system, and statistics involved with the measurements. It describes how to perform the inventories, the item control program which ensures that systems used for the MC&A that they're monitored and controlled and a receiving and shipping program or received in shipment out of the special nuclear material. The MC&A was assessed periodically to evaluate the effectiveness of the organization implementing the program.

It defines how and when tamper safe methods may be used to assist with MC&A. Inventories are taken based on material balance areas and item control areas which are defined in the plan. And SNM, special nuclear material, are responsible for maintaining control of the material and their designated areas.

And roles and responsibilities and organizational structure for this position is defined in the plan. The section defining how to resolve an indication of loss, theft, diversion, or misuse as well as a section on aiding the investigation and recovery. The records are outline in the plan including the retention periods for each record. And that's it for just a brief overview in the open session here. Are there any questions on the plan outline?

CHAIR BALLINGER: Okay. I think we just probably keep questions in the closed session. Should we switch over to the staff side? Okay. Anytime you are.

MR. TUTTLE: Okay. Thank you. This is Glenn Tuttle. Good afternoon. I am the MC&A material control and accounting technical reviewer, material control and accounting, also called MC&A. I work in the material control and accounting branch, the Office of Nuclear Material Safety and Safeguards.

I wanted to mention that Tom Pham also had a big part to play in this review. He was a longtime NRC employee. He's now retired. So just wanted to make sure I gave him credit where it was due. Next slide.

And I think the first part of this will look a lot like what we just saw. But I'll go through it anyway quickly. Material control and accounting is intended to ensure that a licensee maintains accurate, current, and reliable information on the quantities and locations of special nuclear material in its possession.

And one of the main objectives I think that was mentioned, the MC&A program needs to be able to deter and detect loss after diversion of special nuclear material or SNM. SHINE will possess and use SNM of moderate strategic significance that makes it a Category II facility. Moderate strategic significance in general just means between 10 and 20 percent U-235.

Subparts B and D of 10 CFR Part 74 apply. Subpart B is very good, probably from the '60s. MC&A regulations just kind of held on and remained in the rulemaking -- in the rules, excuse me, for any facility. So for example, a reactor would still have to do a Subpart B.

But the specific MC&A requirements for a Cat. II facility are in Subpart D. And as mentioned, an applicant is required to submit a fundamental nuclear material control plan which is very wordy. But we tend to just abbreviate it as an MC&A plan. Next slide.

The regulatory basis as I mentioned, Subpart D, 74.41, 74.43, and 74.45 and then also, again, the general reporting and record keeping from Subpart B with the meat of the regulations for a Cat. II facility would be in 74.43 and 45. Next slide. Our acceptance criteria which comes from this interim staff guidance augmenting NUREG-1537. There is -- for this type of facility, there is a small section on MC&A.

And it basically says that our review shall verify that the MC&A plan contains all information prescribed in 10 CFR Part 74 for the specific class the facility contained in the application. So again, this means it's a Category II facility. It means Subpart D. Next slide.

This is what you saw earlier on, I think, the third slide from SHINE in a little bit more abbreviate form. But these are the MC&A program elements. And on these next two slides, I'll just mention each of the program elements in brief.

The ones in bold, I'll mention in a little more detail in later slides. But it's just important to know that these program elements, these five on this page, four on the next are common to any kind of fuel facility. Excuse me. So the Cat. Is, the Cat. IIIs, and the enrichment plants all have this same kind of structure.

The MC&A organization is found in SHINE's Chapter 3 of their plan. And their plan describes in detail how MC&A functions fit into the overall facility. It makes sure that MC&A is independent from production, that there are separation of key responsibilities. And that chapter also talks about procedures and training.

So it's a very good chapter. It gives a lot of information about how the MC&A program is going to work within the facility. The next element is measurements. This is common to any facility. Any facility has to take measurements.

They must know what they have. So SHINE and their Chapter 4 describes their measurement points, the measurement systems they're going to use. And this is kind of -- compared to a Category III facility, it's a lot more limited, not as many measurement systems to have to control or keep track of. Measurement control system, as I said, I'll talk a little bit more about that in a future slide.

But measurement control just means you have measurements that you want to make sure are accurate or precise. You're going to control those measurements on a regular basis, and every facility does something in measurement control. Physical inventory, again, every facility must do a physical inventory at some frequency.

Basically what it means is you have a book inventory that you've been keeping. You're going to go out periodically and put your eyes on all the materials in your facility. And again, everybody has that kind of a program.

In this case, SHINE's inventory is every nine months as required. That control program is how does the facility control its items through, for example, use of custodians as I mentioned, how do they store material, who gets access to the material. So that's all part of item control. And again, I'll talk about this in a little bit more detail in a future slide. Next slide, please.

The rest of the elements again are common to every facility. Shipper/receiver differences, that's in Chapter 9 of the SHINE plan. You're receiving material from a site -- from a supplier, excuse me. They tell you what's in the container or what's in the shipment, and you have to make sure that what you're getting what you think you're getting.

So facilities do it different ways. But they will in some way measure -- typically measure the containers they receive, do a shipper/receiver comparison. And if that difference between the two, the shipper and receiver is large enough, then they have to react to it and resolve that indicator.

The assessment program, every facility does this at some frequency. It's basically you must have an independent assessment of your entire MC&A program. SHINE describes this in Chapter 10 of their plan, making sure that it is truly independent. It covers everything in the MC&A program.

And it also -- findings and recommendations are acted upon by management. The next element resolution is how do they resolve any indicators of loss, theft, or diversion, whatever it might be, an item missing, a tampered seal that maybe has been broken, an inventory -- for example, an inventory that doesn't match up with -- the physical inventory doesn't match up with the book inventory. And so all this chapter is -- Chapter 13 and 14 of their plan is how are they going to resolve any kind of indicator.

And they describe the different indicators that they're looking for and kind of response they will have. And then the last element is recordkeeping. Again, that's just about making sure you keep records of all MC&A activities, shipping, shipments, receipts, disposal, any kind of activity.

And you keep them in accordance with the regulations as far as the retention periods. And SHINE describes that in their Chapter 15 very thoroughly. Next slide. These next three slides are -- I just mentioned each of these briefly earlier.

But these are, I think, the big hitters for an MC&A program, especially for a Category II because, for example, here the measurement control regulations are much more specific, much more -- yeah, much more specific for the Cat. II versus the Cat. III. And so where a Category III facility might choose to do some of these things here that are listed, a Category II facility must do these particular things. And there are several others here.

These are just some examples of things

they have to do. So that program includes performing process sampling tests. We need to make sure that your samples are representative of the materials.

And that's obviously -- it gets more important the higher enrichment -- the higher you go up in enrichment. SHINE will generate current data on the performance of each management system. So again, this needs -- measurement systems need to be analyzed routinely and it needs to be current data. It shouldn't be something from the historical records.

SHINE commits to the use of standards for calibration and control of all measurement systems. That's typical for any facility type. Both controls are traceable to national standards from a national lab or another organization.

SHINE has committed to evaluating all measurement data to determine significant contributors to measurement uncertainties. This is very important because when you're evaluating inventory which is on the next slide, measurement uncertainties are a big part of how do you determine whether your inventory was adequate or not. And it involves measurements certainly because every measurement has an uncertainty.

When you're talking about a lot of items that are being inventoried, you're talking about a lot of uncertainty. And you have to be able to adequately evaluate whether your inventory met the requirements. And you do have what you say you have.

And then the last bullet there is SHINE maintains a statistical control system to monitor the quality of each system. So there's every measurement system has to be monitored for quality periodically. It could be very week. It could be every day depending on throughput.

But basically what you're doing is control charting with limits -- control charting with warning and alarm limits. And then how do you resolve those if there are any warning or alarms. Next slide. Physical inventory, that's found in Chapter 7 of the SHINE plan.

They have a very detailed description of their inventory from preparation to conduct or what they call I think physical inventory taking, also reconciliation of your inventory. And then final step is the statistical analysis. Every facility has to do an inventory as I said before.

In this case, a Category II, have to do it every nine months. The quantities of SNM on inventory are based on measured values. You can have things that are calculated based on measured values, but there has to be some measured values in there. It can't be an estimate.

SHINE commits to having procedures in place to ensure all items are inventoried and no item is inventoried more than once. They have procedures to specify the extent to which each area and process is shut down or cleaned out or remains static. And this is one of the -- something all facilities have to do also is you have to decide are you going to clean out your processes, are you going to keep them going as you take the inventory? And you have to have really good procedures and processes to make sure you do that right.

Lastly, for inventory, the book records are reconciled to the results of the physical inventory. So your book says you have one thing. You go out and physically inventory, that says you have another and you need to reconcile those, make sure they match up.

If something is missing, you need to figure out where it is. If something is out in the field but you don't have it on your records, you have to correct that. So it's just reconciling to make sure the two match up, the physical and book.

And then at the end of this process, you're going to evaluate what's the difference between the two, the book versus physical. It's called an inventory difference, and you have to evaluate that partly -- in part, using the measurement of uncertainties that you calculated in the last subject, the measurement control. Next slide. Item control is described in Chapter 8 of the SHINE plan.

They describe their item control program to make sure current knowledge is maintained for all items, especially nuclear material. The items are stored, handled, and measured to ensure detection of unauthorized or unrecorded removal of SNM. One of the ways you do that is through use of tamper safe if a facility wants to do that through the use of custodians, through the use of item control areas.

And also in this case what SHINE commits to also is to do item monitoring tests which every facility does some sort of item monitoring test. They're conducted periodically to confirm the items that are in the records are stored and identified as indicated in the record. So that's kind of like a sampling, kind of an audit type thing, a sampling with a sampling plan to it.

And then if there are discrepancies,

they're investigated and resolved. And SHINE describes how they will investigate the different kinds of item discrepancies and the timing for resolution. Next slide. So that's the MC&A program, SHINE's plan, and what the findings and conclusions.

SHINE's plan does contain the necessary commitments to meet the applicable MC&A requirements in Part 74, particular Subpart B and Subpart D, and that their plan provides reasonable assurance that the applicant will adequately control and account for the special nuclear material in its possession during the term of the license. So that's the last slide. Questions?

MEMBER HALNON: Yeah, this is Greg. Just one question for the open session. And you mentioned that there was a tremendous amount of detail in the plan. SHINE did a good job of committing to the appropriate commitments or regulations and requirements. And you guys did a good review of it. Is there a point in this process where you will verify that there are procedures that are actually implementing this will translate the appropriate commitments and requirements into those procedures?

MR. TUTTLE: I --

MR. BALAZIK: This is --

MR. TUTTLE: Go ahead.

MR. BALAZIK: This is Mike Balazik, NRC project manager for SHINE. Yeah, I mean, that would be looked at in the pre-operational readiness inspections that we would perform to ensure that they have those procedures ready and to verify that those procedures are approved, authorized by SHINE. So that would be the point we'd look at those.

MEMBER HALNON: Thanks, Mike.

MR. TUTTLE: Yes, and I was going to say too not just procedures. But for example, they have measurement systems. You're going to make sure that when you go on that readiness review that those measurement systems are ready to go. So yes, it is inventory. It is procedures. But also, for example, measurement systems are ready when the material comes on-site.

CHAIR BALLINGER: Questions from members?

MEMBER KIRCHNER: Yes, Ron. This is Walt. This is kind of a general question. From the planning and procedural standpoint, things look very good. Have you stepped back and thought about the facility, its operations, and where there might be -- I don't want to use the word, vulnerability.

But there might be places within the

systems where you have uncertainty in the measurements and you can accumulate materials such that they might materially affect your -- what I'll call your mass balance on SNM. Have you looked at the systems from that standpoint, from an engineering standpoint, to see where with this production set of operations you might potentially accumulate more material than you expected? It ties obviously to criticality program as well. But keeping a running inventory of what's in the waste tanks and what's in the lines and so on may prove challenging.

MR. TUTTLE: I think that if you've -- like myself, I've been through -- I've inspected fuel cycle facilities. So one of the things you do as an inspector I think is exactly what you're talking about. You have to see -- you really have to see the facility and walk through it to kind of look around and see what spots look --

(Simultaneous speaking.)

MR. TUTTLE: Yes, so I agree that that's something I guess at the readiness review but also during your routine inspection. It's something you're thinking about as you walk around but nothing -- I guess nothing formal. Is that a good enough answer, or --

MEMBER KIRCHNER: No, as long as you're thinking about it too. And based on your experience with other fuel cycle facilities or DOE experience with their facilities, one hopes to avoid unintended accumulation of materials wherever in the process lines, ventilation systems and such that could prove problematic down the road in terms of doing your material balances. Just an observation more than a question.

MR. TUTTLE: All right. Thank you.

MR. MUNSON: I'll say typically a fuel facility the MC&A program will identify specific areas of holdup and they'll choose to take their measurements in those areas specifically for -- and it's typically in areas like elbows and things like that for uranium entrainment or in ventilation systems and things like that. And they may even monitor differential pressure for certain ventilation systems and things like that which would be indicative of clogged filters and things. But that's a good comment. Thank you.

MEMBER PETTI: So this is Dave. I had a question, but it may be more appropriate for SHINE which is when you look at the 0.125 percent inventory discrepancy allowable, that's pretty tight. And again, maybe you want to discuss this in the closed session. But have you dry run all the different parts of the system where you're going to do the measurements to know you have good enough accuracy and precision in terms of how you're going to do some of the sampling to know that you're not going to run into a problem? Even the newness of this facility is a little unique as a fuel facility.

MR. EDWARDS: The short answer, we have a dry run everything. But we are working on our methods for measurement systems with the chemistry group right now.

MEMBER PETTI: And somehow you have to account for the fact that uranium is fissioning in this system which one of the bullets said that they don't do calculation. They want measurements. So if we get into the closed session, it'd be interesting to understand how you do that because it's a very slow rate of burn up. But over time, right, it's going to start to show up. How you account for that in a measurement sense would be interesting to know.

MR. EDWARDS: We can talk about that. There's a slide about measurement systems.

CHAIR BALLINGER: Other questions, members?

Okay. We're at the end of what is public, the open session. So now we need to ask for public comments. So if there are members of the public that wish to make a comment, either through your phone, use *6, or if you're on the Teams process, please state your name and make your comment. The sound of silence, I think that's a song.

Okay. So hearing no public comments, I hope we didn't miss anybody, this will end the open session. By my notes and the schedule, we have a closed session coming up that will involve the MC&A part. But earlier in the morning, there was a comment about possibly having a closed discussion related to criticality safety.

I forget which member made that comment. But whoever it is, should we have a discussion on criticality safety in the closed session? Because that may mean that the SAB needs to get somebody.

MEMBER MARCH-LEUBA: Yeah, so somebody said that. It wasn't me.

MR. MUNSON: It was simply related to the CAAS exemption that has been requested from SHINE for the material staging building and IU cells. A quick comment in the open session on the status of that review. So it may be we could certainly do that. I guess I'd leave it up to Mike. But it may be better to discuss the exemptions as a whole, whatever Mike decides.

MR. BALAZIK: This is Mike Balazik, project manager for SHINE. I think we can discuss it in closed session. I would ask SHINE if they would want to have somebody that could support that discussion also because they may be able to answer some questions related to it.

MR. HART: This is Trevor Hart from SHINE. I think we -- I know we had a 6b.3 closed session tomorrow if needed. And we'll have the crit safety lead, Alex Newell, in attendance there. So if there are details of the exemption we want to discuss, we'd be better suited to do so tomorrow. But if we just want to talk sort of the status of it, we can speak to that this afternoon.

CHAIR BALLINGER: Okay. That sounds like a plan. So we'll save that part for tomorrow's closed session.

MEMBER BROWN: Including an discussion today, right, on the --

CHAIR BALLINGER: No, no. We have a closed session on MC&A.

MEMBER BROWN: No, no, no. He said we

could have a little bit if we wanted to talk about it. Are we going to put the whole thing off until tomorrow? Or are we going to have a little bit of chit chat on the criticality thing in the closed session this afternoon?

CHAIR BALLINGER: Now you've got me confused. MC&A --

MEMBER BROWN: We're going to do this afternoon?

CHAIR BALLINGER: Yes.

MEMBER BROWN: Okay.

CHAIR BALLINGER: And tomorrow we'll do the --

MEMBER BROWN: The whole thing.

CHAIR BALLINGER: -- yeah.

MEMBER BROWN: Okay. That didn't come across.

CHAIR BALLINGER: Is that what I heard?

MR. BORROMEO: But I think what was implied, though, is we give them a heads up of what we want to --

CHAIR BALLINGER: Right.

MR. BORROMEO: -- know that they'll be more prepared tomorrow.

CHAIR BALLINGER: Okay. Right, that's

true.

MEMBER BROWN: Better to do it once.

CHAIR BALLINGER: Okay. So by the schedule and the Outlook calendar and the like, we need to exit -- end this session and then come back and use the invitation for the closed session. So we'll take a five-minute recess and then come back on with the closed session invitation.

(Whereupon, the above-entitled matter went off the record at 1:30 p.m.)

Emergency Plan

CATHERINE KOLB, SENIOR DIRECTOR OF PLANT OPERATIONS

Outline

- Introduction
- Emergency Response Organization
- Emergency Classification System
- Emergency Response
- Recovery
- Maintaining Emergency Preparedness

Introduction

- Purpose of the Emergency Plan:
  - Describes essential elements of advance planning and necessary provisions for coping with and mitigating consequences of emergencies within and beyond the SHINE site boundary.
  - Focused on situations that may cause or threaten to cause radiological hazards that could affect employee or public health and safety.
- The Emergency Plan was written to conform with 10 CFR 50, Appendix E, following the guidance of:
  - Regulatory Guide 2.6, Revision 2, Emergency Planning for Research and Test Reactors and Other Non-Power Production and Utilization Facilities
  - ANSI/ANS-15.16-2015, Emergency Planning for Research Reactors
  - ANSI/ANS-8.23-2007, Nuclear Criticality Accident Emergency Planning and Response
  - NUREG-0849, Standard Review Plan for the Review and Evaluation of Emergency Plans for Research and Test Reactors
  - NUREG-1520, Revision 2, Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility

SHINE

Emergency Response Organization (ERO)

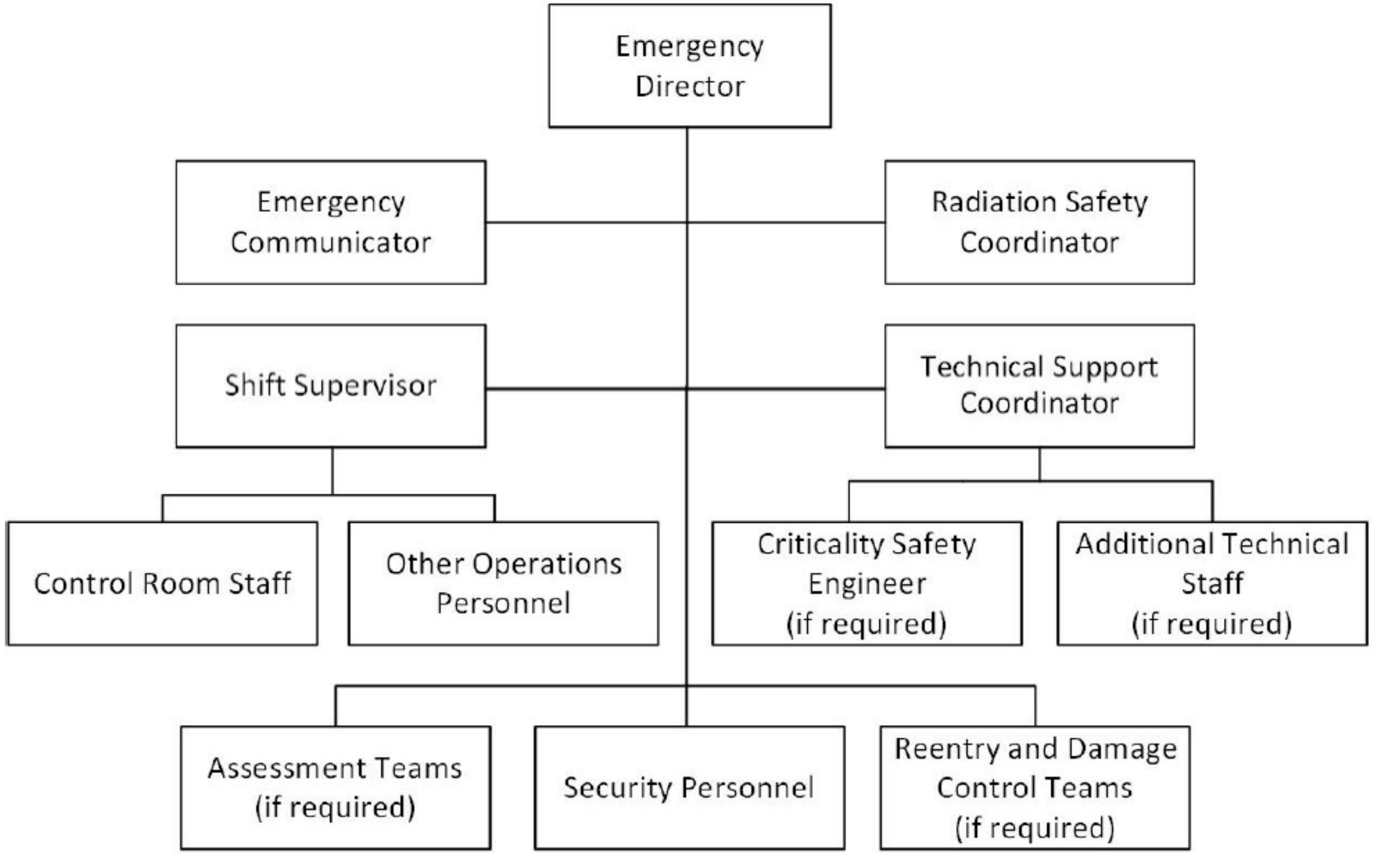
OVERVIEW

- Responsible for taking actions in an emergency to avoid an accident or to mitigate the consequences of one. Consists of the following two groups:
  - Facility Emergency Organization
    - Initially staffed by on-shift trained and qualified SHINE personnel
    - Additionally staffed/relieved by off-shift trained and qualified SHINE personnel
  - Emergency Support Organization
    - Consists of off-site support entities that can assist with various emergencies (e.g., first aid, fire response)
- On-shift personnel include (but are not limited to):
    - Shift supervisor
    - Licensed operators
    - Non-licensed operating staff
    - Security personnel
    - Radiation protection

Emergency Response Organization (ERO)

FACILITY EMERGENCY ORGANIZATION

- Emergency Director
- Shift Supervisor
- Emergency Communicator
- Radiation Safety Coordinator (RSC)
- Technical Support Coordinator (TSC)
- Criticality Safety Engineer
- Security Personnel
- Operations Personnel
- Assessment Teams
- Reentry and Damage Control Teams



Emergency Response Organization (ERO)

EMERGENCY SUPPORT ORGANIZATIONS

- Janesville Fire Department
  - Fire support, first aid support, ambulance services, HAZMAT support
- Janesville Police Department
  - Traffic control, access control, security assistance
- Hospital (SSM Health)
  - Trained/prepared to handle radiological emergencies (treatment for radiation exposed or contaminated injured individuals).
- Rock County Emergency Management
  - Coordinates major emergencies, disaster response/recovery in support of county and local governments.
- State of Wisconsin
  - General authority/responsibility to assist local units of government and law enforcement in responding to a disaster or threat of disaster.
  - Coordinates with Rock County Emergency Management as needed.

SHINE

Emergency Response Organization (ERO)

EMERGENCY FACILITIES AND EQUIPMENT

- Emergency facilities and equipment are available for emergency assessment, communications, first aid and medical care, and performing corrective and recovery actions.
- Control Room – continuously occupied, centralized on-site location from which the facility is operated, and from which effective direction can be given during an emergency.
  - Located within safety-related area of the main production facility
  - Equipped with instrumentation to supply information on facility status
  - Equipment available for communications with on-site and off-site personnel
- Emergency Support Centers (ESC) – on-site facility from which effective direction can be given. Located to oversee operations in the control room and facility.
  - Primary location – Main production facility breakroom
  - Backup location – Storage building office area
  - Contingency location – SHINE Headquarters breakroom

Emergency Classification System

- The emergency plan provides for classification of emergencies into three standardized classes according to the severity of off-site radiological consequences consistent with Table 1 of ANSI/ANS-15.16-2015:
  - Notification of Unusual Event
  - Alert
  - Site Area Emergency
- Emergency Planning Zone (EPZ)
  - There are no identified radiological emergencies at the SHINE facility that result in off-site plume exposure exceeding one rem whole body or five rem thyroid. Therefore, in accordance with NUREG-0849 and ANSI/ANS-15.16-2015, the EPZ for the SHINE facility is the operations boundary.

Emergency Classification System

- Emergency Action Level (EAL) categories
  - Security
  - Criticality
  - Fire
  - External Events
    - Tornado
    - Seismic
    - Flooding
    - Aircraft Crash
  - Radiological Release
  - Other

Emergency Response

- Upon initiation of conditions that meet/exceed EAL thresholds:
  - Emergency director declares the emergency within 15 minutes
  - Facility emergency organization and ESC are activated
    - For Notification of Unusual Event, notification of ERO is required, activation is optional
  - Off-site agencies are notified (ESO activation and off-site aid request made in same communication, when applicable)
    - Rock County 911 Communications Center within 15 minutes
    - NRC immediately after Rock County, but no later than 1 hour
    - State of Wisconsin – after NRC notification
  - When ESC is staffed and activated, command and control turned over from control room to ESC Emergency Director
- Protective actions for all classifications are based upon a guideline of one rem dose equivalent for whole body, five rem dose equivalent thyroid.

Emergency Response

- Conditions are assessed:
  - Installed and portable monitoring instruments used
  - Assessment Teams dispatched as necessary
  - Monitoring outside the facility and at the site boundary is established as necessary, and within two hours of declaration of a Site Area Emergency involving potential or actual release
- Protective actions taken:
  - Evacuations of on-site personnel (or shelter in place for security, weather, etc.) ordered, as required
  - Assembly and accountability performed, as required (always performed in a Site Area Emergency)
- Corrective actions taken:
  - Shutdown and/or isolation of affected equipment or suspension of related activities are considered
- When conditions warrant, Recovery is entered

Emergency Response

CRITICALITY ACCIDENT DIFFERENCES

- Criticality related events fall into either Alert or Site Area Emergency classifications
  - Alert – Discovery of critical mass quantity of special nuclear material in unsafe geometry or other condition that creates a criticality hazard
  - Site Area Emergency – Imminent or actual occurrence of an uncontrolled criticality, indicated by criticality accident alarm system (CAAS) or credible report
- Upon detection of a criticality event:
  - Immediate Evacuation Zone (IEZ) is evacuated without hesitation to the storage building (instead of the breakroom)
    - IEZ consists of the entirety of the main production facility <u>EXCEPT</u> for the control room.
  - ESC also established in the storage building
  - Criticality Safety Engineer is called in via ERO notification system to assist

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Recovery

- Recovery consists of actions required to restore facility and its impact on public health and safety to a safe status
- Emergency Director determines when emergency condition no longer exists, recovery can begin
- The ERO will also be the Recovery Organization.
- Criteria used to determine when reentry of the facility following an accident is appropriate:
  - Preliminary radiological survey indicates radiation levels acceptable for reentry
  - Reentry is possible within normal 10 CFR 20 exposure limits
  - Emergency condition no longer poses an immediate danger to reentry personnel or has been mitigated to a safe level
- Criteria used to determine when operation of the facility may be resumed:
  - All applicable technical specifications are satisfied
  - Emergency conditions no longer exist
  - Damage to structures, systems and components designated for restart are repaired, tested, and inspected
  - Structures, systems or components not repaired/restored are properly isolated or abandoned

Maintaining Emergency Preparedness

- Operations Manager is responsible for maintaining emergency preparedness, including administration of the Emergency Plan training program
- The following training is provided regarding the Emergency Plan:
  - Basic emergency plan training (all individuals with unescorted access to the facility)
  - Basic facility emergency organization training (all SHINE personnel with ERO roles/responsibilities)
  - Specific ERO role training
  - Off-site organization training and orientation
  - Community orientation
- Drills and exercises are planned and executed regularly
  - Off-site organizations are periodically invited to help plan and participate in drills/exercises
- Emergency plan and implementing procedures (EPIPs) are reviewed annually by the Operations Manager or designee
- EALs are reviewed with local governmental authorities annually

SHINE

Nuclear Criticality Safety

ALEXANDER NEWELL, NUCLEAR CRITICALITY SAFETY LEAD

Introduction and Applicability

- Goal of the Criticality Safety Program (CSP):
  - Ensure that workers, the public, and the environment are protected from the consequences of a nuclear criticality event
  - All practicable measures are implemented to prevent an inadvertent nuclear criticality from occurring
  - Additionally contains provisions necessary to alert personnel to evacuate should an inadvertent criticality occur
  - Establishes expectations and requirements for SHINE personnel whose duties involve fissionable material at SHINE facilities

Introduction and Applicability

- Implements applicable requirements of 10 CFR Part 70:
  - 10 CFR 70.24 for monitoring and response to accidents, except for irradiation unit (IU) cells and the material staging building (MATB)
  - 10 CFR 70.50, 70.52, and Appendix A for reporting requirements, as described in the technical specifications
  - 10 CFR 70.61(b) as it applies to criticality accidents which are considered ‘high consequence’ events
  - 10 CFR 70.61(d) which ensures that all processes remain subcritical under normal and credible abnormal conditions including an approved margin of subcriticality and the use of preventive controls as the primary means of protection

Consensus Standards Used

- The CSP commits to use of the following consensus standards, subject to clarifications and exceptions identified in Regulatory Guide 3.71, Revision 3:
  - ANSI/ANS-8.1-2014, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*
  - ANSI/ANS-8.3-1997 (R2017), *Criticality Accident Alarm System*
  - ANSI/ANS-8.6-1983 (R2017), *Safety in Conducting Subcritical Neutron-Multiplication Measurements in Situ*
  - ANSI/ANS-8.7-1998 (R2017), *Nuclear Criticality Safety in the Storage of Fissile Materials*
  - ANSI/ANS-8.19-2014, *Administrative Practices for Nuclear Criticality Safety*
  - ANSI/ANS-8.20-1991 (R2015), *Nuclear Criticality Safety Training*
  - ANSI/ANS-8.22-1997 (R2016), *Nuclear Criticality Safety Based on Limiting and Controlling Moderators*
  - ANSI/ANS-8.23-2007 (R2012), *Nuclear Criticality Accident Emergency Planning and Response*
  - ANSI/ANS-8.24-2017, *Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations*
  - ANSI/ANS-8.26-2007 (R2016), *Criticality Safety Engineer Training and Qualification Program*

Organization

- SHINE's CEO holds overall responsibility for the CSP.
- The Safety Analysis Manager is the Responsible Manager for the program and generally delegates administrative authority to a Nuclear Criticality Safety (NCS) Lead.
- NCS staff consists of an NCS Lead and one or more NCS Engineers and any number of individuals identified as NCS Engineers-in-Training.
  - The NCS Lead is a qualified Senior NCS Engineer who serves as a supervisor for the NCS staff regarding conduct of NCS activities.
- NCS staff are kept administratively separate from operations organization to the extent practicable

Nuclear Criticality Safety Evaluations

- Before a new fissionable material operation (FMO) is begun, or before an existing operation is changed, it is determined and documented that the entire process will be subcritical, with an approved margin of subcriticality, for both normal and credible abnormal conditions.
  - Process boundaries are clearly defined in the evaluation
  - Normal and credible abnormal conditions are determined with input from operations or other knowledgeable individuals
  - During development, staff personally observes existing equipment, activities, and processes
  - Formal methods of process hazards analysis (What-If/Checklist and Event Tree) are employed in the evaluation process

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Nuclear Criticality Safety Evaluations

- NCS evaluations determine and explicitly identify controlled parameters and associated limits upon which nuclear criticality safety depends.
  - NCS limits used in evaluations are derived from industry-accepted and peer-reviewed references, including ANS standards, from hand calculations using industry-accepted and peer-reviewed techniques, or from computational methods.
  - Operating limits, which take process variability and uncertainty into account, are used to ensure NCS limits are unlikely to be exceeded.
  - Controls used to enforce safety and operating limits are specified in the NCS evaluations.

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Nuclear Criticality Safety Evaluations

- Prior to the start of operations:
  - The NCS evaluation is independently reviewed to ensure its adequacy
  - All dimensions and nuclear properties on which reliance is placed are verified
  - Proper implementation of NCS controls is verified
  - The supervisor responsible for the FMO confirms that the NCS evaluation adequately identifies normal and credible abnormal conditions and establishes requirements that are verifiable and compatible with planned operations
- All FMOs comply with the double contingency principle (DCP):
  - *Process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible*.
  - A single NCS control which maintains two or more parameters is considered to be a single process upset
  - Processes in which there are no credible criticality sequences meet DCP by definition

Verification and Validation of MCNP

- Where MCNP is necessary, verification of code installation is completed prior to validation
- MCNP installations are maintained under a configuration control program
  - Re-verification is performed following changes to the system and on a periodic basis
- Validation is performed by comparison to critical experiments
- A written validation report is documented and maintained
  - NCS evaluations ensure that the evaluated processes fall within the range of the validation report
- The subcritical margin for calculated subcritical limits is 0.06

Control Strategies and Philosophy

- Control strategies employ a preferred design approach that favors crediting controls in the following order:
  - Passive engineered controls
  - Active engineered controls
  - Administrative controls
- Administrative NCS controls are specifically annotated in operating procedures

Use of Controlled Parameters

- Use of explicit NCS controls is preferred to reliance on the natural and credible course of events.
- Control on two independent criticality parameters is preferred over multiple controls on a single parameter.
  - If redundant controls on a single parameter are used, a preference is given to diverse means of control on that parameter.
- General
  - When single-parameter limits are used, all other parameters are evaluated at most-reactive credible values.
  - Safety limits on controlled parameters are established, accounting for tolerances and uncertainty.
- Mass
  - When over-batching is credible, the largest mass resulting from single failure is shown to be subcritical.
  - When mass limits are derived for a material that is assumed a given weight percent of special nuclear material (SNM), determinations of mass are based on either:
    - Weighing the material and assuming the entire mass is SNM; or
    - Conducting physical measurements to establish the actual weight percent of SNM in the material.

Use of Controlled Parameters

- Geometry
  - Before beginning operations, in response to changes, and at periodic intervals, all dimensions relied on in demonstrating subcriticality are verified.
  - Means of losing geometry control are evaluated and controls are established as needed if credible.
  - Neutron interaction with other SNM-bearing equipment is considered, unless individual units meet the criteria for being considered neutronically isolated.
- Enrichment
  - A facility-wide maximum authorized enrichment is used, and a bounding enrichment is applied to all material when conducting NCS evaluations or calculations.
- Moderation
  - Moderation-controlled areas are used to exclude moderator from areas of the SHINE facility.
  - Moderation-controlled areas are conspicuously marked, and administrative controls are established to prevent introduction of moderators.

Use of Controlled Parameters

- Density
  - The general criteria listed above are applied.
- Reflection
  - Wall thicknesses of units and adjacent reflecting materials are considered.
  - Full reflection is represented by 12 inches of tight-fitting water or 24 inches of tight-fitting concrete.
  - Minimum reflection conditions equivalent to 1-inch tight-fitting water reflector are assumed to account for personnel or other transient, incidental reflectors.
- Concentration
  - Tanks containing concentration-controlled solution are kept closed to prevent unauthorized introduction or precipitating agents.
  - Transfers to unfavorable geometry tanks containing concentration-controlled solutions are only authorized based on dual, independent sampling. No single error may result in transfer of concentrated solution to a tank with unfavorable geometry.
  - Process variables that affect solubility of fissile material are controlled and monitored.

Use of Controlled Parameters

- Physicochemical Form
  - Explicit controls are established to limit material composition to particular forms.
- Interaction
  - Engineered controls are used to maintain physical separation between units, where necessary.
  - Structural integrity of spacers, storage racks, etc. is sufficient to ensure subcriticality during normal and credible abnormal conditions, including seismic events.
- Volume
  - Fixed geometry is used to restrict the volume of SNM. Limiting material to part of a larger geometry and using overflow lines is also employed.
  - Maximum subcritical volume is evaluated using the most reactive credible geometry, optimum moderation, and water reflection.
- Heterogeneity Effects
  - Methods of causing fissile material to become in-homogeneous are evaluated in NCS evaluations and controls are established as necessary.

Implementation of Controls

- NCS controls are implemented by operations personnel through operating procedures. The purpose of operating procedures is to facilitate and document safe and efficient conduct of operations.
  - Procedures include administrative controls and limits significant to nuclear criticality safety
  - Administrative NCS controls are specifically annotated in operating procedures
  - New or revised procedures that impact nuclear criticality safety are reviewed by NCS staff
- Before a process that has been in extended shutdown is restarted, operations personnel and NCS staff perform a review to determine if there are any changes that could affect nuclear criticality safety.
  - Changes are addressed by NCS evaluation
  - Implementation of appropriate controls are verified prior to restart
  - Supplemental worker training may be provided

Training and Qualification

- NCS training requirements are determined and documented.
- Content of the training program is tailored to job responsibilities and supports conduct of individual jobs.
- Two tiers of NCS training are established, and both tiers include stop-work authority, procedural compliance, response to criticality alarms, and reporting of defective conditions.
  - Tier 1 training includes content identified in ANSI/ANS-8.20-1991 and is directed towards those who manage, work in, or work near areas where potential for criticality exists.
  - Tier 2 training is specific to NCS staff, meeting the requirements and recommendations identified in ANSI/ANS-8.26-2007.

Oversight

- SHINE personnel are encouraged to provide feedback on CSP.
  - Personnel are required to report defective NCS conditions to NCS program management.
- Operations are reviewed at least once annually to verify procedures are being followed and process conditions have not been altered .
  - These are conducted in consultation with operating personnel and are documented.
  - NCS staff conduct walkthroughs of facility processes and procedures as part of the annual operations review.
- NCS Lead schedules and coordinates routine NCS oversight activities.
  - Staff participate in routine audits of NCS practices.
  - Examine reports of procedural violations and other deficiencies.
  - Each evaluation and calculation is reviewed at least once every three years.
  - At least every three years the CSP is audited for overall effectiveness.

Nonconformances

- Deviations from procedures and unintended alterations in process conditions are reported to management, investigated promptly, corrected as appropriate, and documented.
  - Action to correct deviations or alterations are taken in accordance with procedural requirements and with guidance from NCS staff.
- Conditions that require corrective action include:
  - Violation of NCS requirement (e.g., operating NCS limits)
  - Conduct of FMO without an NCS evaluation
  - Discovery of an unanalyzed condition
  - Discovery of deficiencies in NCS evaluations
- Upon the loss of double contingency protection, operations are suspended and processes rendered safe until double contingency protection can be restored.
- NCS events are reported to the NRC in accordance with reporting requirements of 10 CFR 70.50, 10 CFR 70.52, and 10 CFR Part 70, Appendix A, as described in the technical specifications

Configuration Management

- Facility configuration management includes engineered controls significant to the nuclear criticality safety of operations.
- The SHINE configuration management program is relied upon to maintain controls in their analyzed state.
- Processes or design changes that could affect NCS limits or controls are evaluated using the facility change process requirements.
  - Prior to implementing the change, the NCS evaluation is reviewed and updated if needed.

Emergency Response and Criticality Accident Alarm System

- The SHINE Emergency Plan provides guidance to management, technical staff, and response personnel for various emergencies.
  - Response to imminent, occurring, and past indications of a criticality accident invokes a special procedure for response to a criticality accident.
  - NCS staff prepares emergency plans and procedures in accordance with ANSI/ANS-8.23-2007.
- SHINE provides a criticality accident alarm system (CAAS) to detect a criticality event in the facility in which non-exempt quantities of fissile material greater than the limits identified in 10 CFR 70.24(a) are used, handled, or stored outside the target solution vessels.
  - The CAAS does not monitor the IU cells or the material staging building.
- CAAS meets the requirements of 10 CFR 70.24 and conforms to recommendations in ANSI/ANS-8.3 as endorsed by Regulatory Guide 3.71.

Emergency Response and Criticality Accident Alarm System

- The CAAS consists of neutron-sensitive detectors located within the facility at locations designated to provide sufficient coverage and to detect the minimum accident of concern.
- CAAS detectors are arranged so generally each area covered by the CAAS receives coverage from three detectors.
- The CAAS will energize clearly audible alarm signals if an accidental criticality occurs.
  - Mandatory evacuation areas are determined and clearly marked with evacuation routes with routes selected to ensure personnel are evacuated away from areas with potentially higher dose.
- For maintenance or other conditions which would disable multiple detectors or the logic unit, the following compensatory measures are implemented to ensure an equivalent level of safety:
  - Temporary criticality detection equipment with audible alarms will be used for personnel remaining in or entering the affected area, and
  - Personnel access to the affected area will be limited to essential activities.

Material Control and Accounting (MC&A) Plan (Open Session)

ERIC EDWARDS, CHEMICAL PROCESS SYSTEMS MANAGER

Purpose

- The purpose of this Material Control and Accounting (MC&A) Plan is to fulfill the requirements of 10 CFR Part 74 for the SHINE facility.
  - The MC&A Plan meets the requirement to submit a fundamental nuclear material control (FNMC) plan as described in 10 CFR 74.41(b)(1).
- The program is intended to deter theft or misuse, especially theft or misuse by a facility insider (i.e., someone who has authorized access to the SNM or information about it).

Material Control and Accounting Plan Overview

- The MC&A Plan describes the programmatic requirements and methods for the following:
  - Measurements
  - Measurement Control System
  - Statistics
  - Physical Inventory
  - Item Control Program
  - Receiving and Shipping Program
  - Assessment and Review of the MC&A Program
  - Tamper-Safing
  - Designation of Material Balance Area, Item Control Areas, and Custodians
  - Resolving Indications of Loss, Theft, Diversion or Misuse of Special Nuclear Material
  - Aiding Investigation and Recovery of Missing Special Nuclear Material
  - Recordkeeping

Advisory Committee on Reactor Safeguards

SHINE Medical Technologies, LLC
Operating License Application

Chapter 12.7 - Emergency Planning

Edward Robinson
Emergency Preparedness Specialist
Office of Nuclear Security and Incident Response

May 17, 2022

Regulatory and Guidance Framework Used

- 10 CFR Part 50 Appendix E- “Emergency Planning and Preparedness for Production and Utilization Facilities”
  - Specifies Regulatory Guide 2.6, “Emergency Planning for Research Test Reactors,” as the guidance that will be used to determine the acceptability of emergency plans for complying with the Commission’s emergency planning regulations as it pertains to non-power reactors.
- Regulatory Guide 2.6 endorses American National Standard, ANSI/ANS-15.16-2015, “Emergency Planning for Research Reactors.”
- NUREG-1537, Interim Staff Guidance Augmenting NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria.”
- NUREG-0849, “Standard Review Plan for the Review and Evaluation of Emergency Plans for Research and Test Reactors,” issued October 1983.

No Significant Challenges with the EP Review

- 7 RAIs (e.g., EALs, Onsite & Offsite Survey Capabilities, Decontamination Facilities) generated based on Rev. 4 of SHINE FSAR

- Gov-2-Gov Meeting in Janesville, WI (February 2020)
  - Participants: NRC Staff, Janesville City Council and Wisconsin State Representatives

- FSAR Rev. 5 addressed the 7 EP RAIs

EP Safety Review Completed with No Issues

- EP Safety Review of Revision 0 to the SHINE Emergency Plan Completed September 2020

- EP Safety Review of Revision 1 to the SHINE Emergency Plan Completed February 2022

Conclusions of Staff Emergency Plan Findings

- Meets applicable EP Regulations and Guidance
- Adequately addresses the necessary provisions for coping with radiological emergencies
- Provides Reasonable Assurance that should an Operating License be issued, the Emergency Plan as described will function in a manner that protects public health and safety.

Advisory Committee on Reactor Safeguards

SHINE Medical Technologies, LLC
Operating License Application

Chapter 6b.3 - Nuclear Criticality Safety

Jeremy Munson
Criticality Safety Technical Reviewer
Office of Nuclear Material Safety and Safeguards

May 17, 2022

Nuclear Criticality Safety

License Application Chapters:

- 6b.3 - Nuclear Criticality Safety in the Radioisotope Production Facility
- 13 – Accident Analysis

Nuclear Criticality Safety

Regulatory Requirements

- §50.34 requires the licensee to describe the facilities, equipment, and procedures used to protect health and minimize danger to life and property, including the consequences of a criticality accident.

- §50.68 requires the licensee to maintain a criticality accident alarm system (CAAS) and emergency procedures in accordance with §70.24.

- §70.61(b) requires the licensee to limit the risk of criticality (high consequence) such that the likelihood of its occurrence is highly unlikely. [COMMITMENT]

- §70.61(d) requires the assurance of subcriticality under normal and all credible abnormal conditions, including use of an approved margin of subcriticality for safety. [COMMITMENT]

- §70.50, §70.52, and Appendix A to Part 70*, require the licensee to report specific events and conditions within specified timeframes to the NRC, including criticality accidents and other NCS-related events. [COMMITMENT]

Nuclear Criticality Safety

Areas of Review

- Use of ANSI/ANS-8 standards
- Criticality accident alarm system (CAAS)
- Emergency planning and response
- Subcriticality and the Double Contingency Principle
- Organization and Administration
- SSA and Management measures
- Technical Practices
- Minimum margin of subcriticality

Nuclear Criticality Safety

Review Findings

- The licensee has described a nuclear criticality safety (NCS) program that appropriately ensures the subcriticality of nuclear processes under normal and all credible abnormal conditions.
- The licensee will develop, implement, and maintain emergency response procedures and a criticality accident alarm system in accordance with the requirements §50.68 and §70.24.
- The licensee has described an NCS program that provides reasonable assurance of adequate protection against credible criticality risks for the worker, public, and environment.

Nuclear Criticality Safety

Points of Interest - Applicability

- The NCS program applies to all areas of the radioisotope production facility (RPF) and the irradiation facility (IF), except for the target solution vessels (TSVs).

- Appropriate 10 CFR Part 70 requirements have been imposed via SHINE's commitments:
  - §70.61(b) - limit the risk of criticality (high consequence) such that the likelihood of its occurrence is highly unlikely.
  - §70.61(d) - assurance of subcriticality under normal and all credible abnormal conditions, including use of an approved margin of subcriticality for safety.
  - §70.50, §70.52, and Appendix A to Part 70* - report specific events and conditions within specified timeframes to the NRC, including criticality accidents and other NCS-related events.

Nuclear Criticality Safety

Target Solution Staging System

- TSPS consists of 8 target solution hold tanks and 2 target solution storage tanks.
  - All tanks are favorable geometry with dual passive overflows (to prevent backflow).
  - Drip trays are equipped with drains (in the event of a leak or overflow).

Nuclear Criticality Safety

Radioactive Liquid Waste Storage System

- RLWS consists of 2 U liquid waste tanks, 4 radioactive liquid waste tanks, and 8 liquid waste blending tanks.
  - U liquid waste tanks are favorable geometry with redundant passive overflows.
  - Radioactive liquid waste tanks and liquid waste blending tanks are under concentration control with dual, independent sampling.
  - Drip trays equipped with drain (in the event of a leak or overflow).

Nuclear Criticality Safety

Molybdenum Extraction and Purification System

- MEPS
  - Majority of components are favorable geometry.
  - 3-way valve and isolation valve prevents inadvertent transfer to molybdenum eluate hold tank and facility chemical reagent system (not favorable geometry).
  - Precipitation (due to inadvertent addition of caustic reagents) is prevented by administrative controls on caustics and the column wash sequence.

Nuclear Criticality Safety

Target Solution Preparation System

- TSPS
  - Uranium Oxides
    - Administrative limits on u-oxide mass.
    - Favorable geometry HEPA filters.
    - Moderator exclusions on TSPS room.
  - Uranium Solutions
    - Target solution preparation tank, pumps, and filters are favorable geometry.
    - High level controls and check valve to prevent backflow scenarios.

Nuclear Criticality Safety

Vacuum Transfer System

- VTS components are favorable geometry and designed to prevent leaks.
- Vacuum buffer tank is equipped with a demister that separates potentially entrained solution.
- Vacuum headers are equipped with liquid detection that stops transfer upon detection of liquid.

Nuclear Criticality Safety

Uranium Receipt and Storage System

- URSS
  - Administrative controls on mass.
  - Administrative and engineered controls on moderation.
  - Oxide storage rack and metal storage rack are favorable geometry.

Nuclear Criticality Safety

Radioactive Drain System

- RDS consists of favorable geometry tanks.
- Hold tanks are equipped with level instrumentation to detect solution leaks into RDS to prevent precipitation of solids.

Nuclear Criticality Safety

Radioactive Liquid Waste Immobilization System

- RLWIS
  - Drums are subject to mass control and waste acceptance criteria for activity.

Nuclear Criticality Safety

Laboratories

- LABS
  - Subject to mass control.

Nuclear Criticality Safety

Iodine Extraction and Purification System

- IXP
  - 3-way valve and isolation valve prevents inadvertent transfer to IXP eluate tank and facility chemical reagent system (not favorable geometry).

Nuclear Criticality Safety

Points of Interest - MMS

- Many early stages of the process will rely on subcritical limits (SPLs) derived from NRC-endorsed ANSI/ANS-8 standards, not explicit k_{eff} calculations.

- Explicit calculations will be subject to an administrative margin of 0.05, with an additional penalty of 0.01 to account for a lack of experimental data for uranyl sulfate systems. This results in a minimum margin of subcriticality of 0.06.

- The MMS was evaluated (by NRC staff) using NUREG/CR-6698, “Guide for Validation of Nuclear Criticality Safety Calculational Methodology,” and Appendix B to Chapter 5.0 of NUREG-1520, “Standard Review Plan for Fuel Cycle Facilities License Applications.”
  - Validation rigor and statistical methodology
  - Quality, quantity, and similarity (to SHINE processes) of benchmark experiments
  - Conservative practices and other sources of safety margin

Nuclear Criticality Safety

Points of Interest – CAAS Exemption

- Requested exemption from the requirements of §70.24 for the material staging building (MATB) and the irradiation unit (IU) cells.
  - 10 CFR Part 71 criteria for "fissile exempt"

Advisory Committee on Reactor Safeguards

SHINE Medical Technologies, LLC Operating License Application

Chapter 12.13 - Material Control and Accounting (MC&A)

Glenn Tuttle
MC&A Technical Reviewer
Office of Nuclear Material Safety and Safeguards

May 17, 2022

Material Control and Accounting

- Material control and accounting (MC&A) is intended to ensure that a licensee maintains accurate, current, and reliable information on the quantities and locations of special nuclear material in its possession
- SHINE will possess and use special nuclear material of moderate strategic significance (Category II facility)
- Subparts B and D of 10 CFR Part 74 apply
- Applicant is required to submit a Fundamental Nuclear Material Control (also called MC&A) plan

Regulatory Basis

- Regulatory Requirements
  - 10 CFR 74.41, “Nuclear material control and accounting for special nuclear material of moderate strategic significance”
  - 10 CFR 74.43, “Internal controls, inventory, and records”
  - 10 CFR 74.45, “Measurements and measurement control”
  - Also 10 CFR Subpart B – General reporting and recordkeeping

Acceptance Criteria

- Final Interim Staff Guidance (ISG) Augmenting NUREG-1537, Part 2, for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors
- Review shall verify that the MC&A plan contains all information prescribed in 10 CFR Part 74 for the specific class of facility contained in the application

Review Procedures and Technical Evaluation

- MC&A Program Elements
  - MC&A Organization
  - Measurements
  - **Measurement Control System**
  - **Physical Inventory Program**
  - **Item Control Program**

Review Procedures and Technical Evaluation

- MC&A Program Elements (continued)
  - Shipper/Receiver Differences
  - Assessment Program
  - Resolution Program
  - Recordkeeping

Measurement Control Program

- Measurement control program is described in Chapter 5 of the SHINE MC&A plan
- Regulations for measurement control are found in 10 CFR 74.45(c)
- SHINE measurement control program includes:
  - Performing process sampling tests using well characterized materials to ensure samples are representative and verify the applicability of sampling procedures
  - Generating current data on the performance of each measurement system
  - Use of standards for calibration and control of all measurement systems
  - Evaluating all measurement data to determine significant contributors to measurement uncertainties
  - Maintaining a statistical control system to monitor the quality of each system

Physical Inventory Program

- Physical inventory program is described in Chapter 7 of the SHINE MC&A plan

- Regulations for physical inventory are found in 10 CFR 74.43(c)

- SHINE physical inventory program ensures:

  - A physical Inventory of all special nuclear material (SNM) is performed every 9 months
  - Quantities of SNM on inventory are based on measured values
  - Procedures are in place to ensure all items are inventoried and no item is inventoried more than once
  - Procedures specify the extent to which each area and process is to be shut down, cleaned out, and/or remain static
  - Book records are reconciled to the results of the physical inventory

Item Control Program

- Item control program is described in Chapter 8 of the SHINE MC&A plan

- Regulations for item control are found in 10 CFR 74.43(b)(5) and (6)

- SHINE item control program ensures:
  - Current knowledge is maintained for all items of SNM
  - Items are stored, handled, and measured to ensure detection of unauthorized or unrecorded removal of SNM
  - Item monitoring tests are conducted periodically to confirm that items shown in the MC&A records are actually stored and identified as indicated in the records
  - Item discrepancies are investigated and resolved

Evaluation Findings and Conclusions

- SHINE's MC&A plan contains appropriate and necessary commitments to meet applicable MC&A requirements as stipulated in 10 CFR Part 74, Subpart B, the general performance objectives of 10 CFR 74.41, and the system features and capabilities of 10 CFR 74.43 and 10 CFR 74.45

- The MC&A plan provides reasonable assurance that the applicant will adequately control and account for the special nuclear material in its possession during the term of the license

Full Name	User Actio	Timestamp
Brown, Ch	Joined	5/17/2022, 7:51:32 AM
Smith, Tod	Joined	5/17/2022, 7:55:44 AM
Smith, Tod	Left	5/17/2022, 7:59:32 AM
Smith, Tod	Joined	5/17/2022, 8:02:35 AM
Smith, Tod	Left	5/17/2022, 8:02:41 AM
Smith, Tod	Joined	5/17/2022, 8:02:48 AM
Smith, Tod	Left	5/17/2022, 8:04:15 AM
Smith, Tod	Joined	5/17/2022, 8:17:59 AM
Balazik, Mi	Joined	5/17/2022, 8:00:50 AM
Balazik, Mi	Left	5/17/2022, 8:01:15 AM
Balazik, Mi	Joined	5/17/2022, 8:10:25 AM
Hammelma	Joined	5/17/2022, 8:03:57 AM
Ballinger, F	Joined	5/17/2022, 8:10:23 AM
Hardesty, I	Joined	5/17/2022, 8:10:29 AM
Hardesty, I	Left	5/17/2022, 8:16:17 AM
Hardesty, I	Joined	5/17/2022, 8:16:53 AM
Hardesty, I	Left	5/17/2022, 8:17:58 AM
Salay, Mich	Joined	5/17/2022, 8:12:07 AM
Salay, Mich	Left	5/17/2022, 8:13:12 AM
Salay, Mich	Joined	5/17/2022, 8:13:32 AM
Eric Moller	Joined	5/17/2022, 8:13:21 AM
Smith, Jere	Joined	5/17/2022, 8:14:18 AM
Eric Moller	Joined	5/17/2022, 8:14:36 AM
Widmayer,	Joined	5/17/2022, 8:15:48 AM
Burkhart, L	Joined	5/17/2022, 8:16:09 AM
Cruz, Holly	Joined	5/17/2022, 8:20:49 AM
Kirchner, V	Joined	5/17/2022, 8:21:16 AM
Skov, Tam	Joined	5/17/2022, 8:22:23 AM
Dennis Ble	Joined	5/17/2022, 8:22:56 AM
Bier, Vicki	Joined	5/17/2022, 8:24:25 AM
Musico, Br	Joined	5/17/2022, 8:25:19 AM
Jeffrey Bar	Joined	5/17/2022, 8:25:52 AM
Vesna B. D	Joined	5/17/2022, 8:26:36 AM
Ken Czerw	Joined	5/17/2022, 8:26:50 AM
Robinson,	Joined	5/17/2022, 8:27:27 AM
norris, micl	Joined	5/17/2022, 8:29:21 AM
Munson, Je	Joined	5/17/2022, 8:29:43 AM
Wang, We	Joined	5/17/2022, 8:30:29 AM
Dickson, E	Joined	5/17/2022, 8:31:35 AM
Nourbakhs	Joined	5/17/2022, 8:32:38 AM
Call, Mike	Joined	5/17/2022, 8:33:09 AM
Foreman, I	Joined	5/17/2022, 8:33:41 AM
Schrader, I	Joined	5/17/2022, 8:40:42 AM
Moses, Joh	Joined	5/17/2022, 8:43:02 AM
Seymour, .	Joined	5/17/2022, 8:52:26 AM