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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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WEDNESDAY

JULY 20, 2022

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The Subcommittee met via Teleconference, at 9:30 a.m. EDT, Ronald G. Ballinger, Chairman, presiding.

COMMITTEE MEMBERS:

RONALD G. BALLINGER, Chairman

VICKI M. BIER, Member

CHARLES H. BROWN, JR. Member

VESNA B. DIMITRIJEVIC, Member

GREGORY H. HALNON, Member

JOSE MARCH-LEUBA, Chairman

DAVID A. PETTI, Member

JOY L. REMPE, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANTS:

DENNIS BLEY

STEPHEN SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

CHRISTOPHER BROWN

AGENDA

P R O C E E D I N G S

(9:30 a.m.)

CHAIRMAN BALLINGER: Good morning, everyone. This is the second day of the meeting of the SHINE Subcommittee of the Advisory Committee on Reactor Safeguards. I'm Ron Ballinger, chairman of today's subcommittee meeting. Today's meeting is an extension or a continuation, if you will, of yesterday's meeting.

Members present so that I'll be clear are myself, Charlie Brown, Charles Brown, Vicki Bier, Dave Petti, Greg Halnon, Jose March-Leuba, Matt Sunseri, Vesna Dimitrijevic, and our consultants, Dennis Bley and Stephen Schultz. If I have missed anybody, I apologize.

Today, we will be covering the following topics, operator training and requalification, human factors, conduct of operations, a startup plan, and any other loose ends that we might find that we need to discuss by the end of the day.

So, with that, are there any members or consultants that wish to bring up a topic that we discussed yesterday but might need further clarification? Okay, thank you. So, Josh, I understand that you're going to make a few comments?

MR. BORROMEO: I don't have anything in addition to what I said yesterday, so we can move onto SHINE.

CHAIRMAN BALLINGER: Okay, okay, great. So, the first presentation is the SHINE presentation on operator training and requalification, and I see the slides are up, so we're off and running. Thank you.

MR. WALLER: All right, good morning, everyone, and thank you for taking the time to let me present our operator training program. My name is Brent Waller and I am the training manager for SHINE.

First, we'll talk about our initial training program which actually starts before a candidate ever shows up. We have to select the candidates that would be appropriate for our training program.

The guidance that we use is ANSI-15.4-2016, selection and training of personnel for research and test reactors. We use that as the screening process during our hiring to make sure that candidates have the requisite background and experience to enter for the role that they are coming in, for example, licensed operator or senior licensed operator, and our medical screenings that we conduct are also per ANSI-

15.4-2016.

Upon identifying a candidate that we believe meets the requirements of ANSI-15.4-2016, they are enrolled in our initial training program. Our initial training program has a couple of phases. The first phase is the fundamentals phase. That includes topics that you would expect to be covered in a fundamentals type training program.

Examples of topics would include thermodynamics, heat transfer and fluid flow, nuclear theory and kinetics, and also includes components of training such as electrical components, sensors, that kind of thing, and then we also have a couple of topics that are unique to SHINE's application, for example, plasma physics.

We also have a radiation protection and administration requirements phase. That program goes into more detail about radiation protection principles, for example, calculating dose rates, shielding, that kind of stuff.

And then we also have an administrative requirements phase. That covers administrative topics relevant to licensed operators. That would include things like configuration management, conductive operations, and technical specifications.

We then go into a systems phase where we then teach the operators the systems that are in the SHINE facility, both safety related and non-safety related systems.

It then progresses into a plant evolutions phase. That includes our normal, abnormal, and emergency operating procedures, and that's also where the candidates have dedicated on-the-job training guides that they would be in the plant performing evolutions for their qualification.

We follow that up with an exam preparation phase to get our candidates ready to take the NRC written and operating exam, and then for those candidates designated as senior licensed operators, we have an additional supervisory training element to that.

For our initial program examinations, we follow the requirements of ANCI-15.4, which has a passing criteria of 70 percent. Any candidates that scores less than that 70 percent on our internal examination has to go through a remediation process and a reexamination process.

Examinations are good for checking of knowledge items. For performance items, we have on-the-job evaluations that are used for their

performance test. That coincides with their on-the-job training session.

And then we have the option in our program to use oral exams as needed to do level of knowledge checks of individuals or groups. We can also use it as an alternative in case we have to go through a deeper remediation.

As far as the contents of the initial license training program, they come from several sources. So, 10 CFR Part 55 lists several topics to be covered in the initial program. We cover all of those that are applicable to the SHINE design.

ANCI-15.4-2016 also provides some additional guidance and they are incorporated. Chapter 12, Section 10 of the FSAR has some topics delineated that are also covered, and then any additional topics that are determined by the systems approach to training that would be in addition to those listed above.

MEMBER SUNSERI: Hey, Brent, this is Matt Sunseri, just a question and a comment, or a comment and a question I should say. I realize you pulled the cut score of 70 percent from the reg guide.

It's my experience that the nuclear industry has moved away from 70 percent as the cut

score, especially when you use the systematic approach to training which is supposed to be a higher level of preparation for the candidates, and they really use 80 percent as a good industry standard now. Did you give any thought to that or --

MR. WALLER: Yes, so the difference between 70 and 80 percent is, as someone who comes from a commercial power plant background as well, commercial power regs and INPO accredited training, they all drive you towards an 80-percent standard.

When you look at the NUREGs and ANSI standards that are invoked for research and test reactor and production facilities, they all reference a 70-percent standard. And while we use 70 percent as the programmatic standard, we have internal controls that we take for candidates that are scoring or trending less than an 80 percent.

MEMBER SUNSERI: Yeah, I understand that. I mean, you can see the optics though as a commercial facility if you're, you know, passing your operators at a C level versus a B level. It might, you know, just create some optics. Anyway, it's just a comment. I mean, I know you're meeting the regulations.

And then my question, or, yeah, that was a comment, and the question I have is back on your

fundamentals preparation. Is it your intention to have your candidates sit for the generic fundamentals exam offered by the NRC or is that too much outside of the analysis of your systematic approach to training?

MR. WALLER: Yeah, so that's a good question. The generic fundamentals exam by regulation is unique to power plants when you look at the research and test reactor standards, including NUREG 1478.

The fundamentals portion as administered by the NRC is not required, and in some cases, would be detrimental to how we want to train our operators.

The nuclear theory topics specifically focus a lot on critical operations with a nuclear theory behind that where we are a subcritical facility and our concerns were the operations. Their knowledge are in a different area.

So, it's not really a good fit and would provide mostly probably some negative training value if we were to use the GFE as-is, and we also know that the NRC on the power plant side is getting away from administering the GFE anyway.

MEMBER SUNSERI: Yeah, okay, all right, that's a fair response. I would just -- you know, I don't disagree with what you just said. I would

maybe, caution is too strong a word, but don't underestimate the value of having your operators understand critical operations.

I mean, they're going to be operating at the subcritical, but they need to understand what crossing that line is and what a critical reactor looks like so they can recover from that if necessary.

It's kind of like a pilot. You don't ever want to stall your airplane, but you better darn sure know how it approaches and what it does when it does stall. Anyway, that's my comment.

MR. WALLER: Yeah, so that is a good, good point, and all of our operators, they do have to pass internal fundamentals exams, and one of the topics that's specifically identified is the identification of a critical state and how that critical state gets mitigated during their fundamentals training.

MEMBER SUNSERI: Okay, thanks.

MEMBER BIER: Hi, this is Vicki Bier. I had a couple of questions, one of which I think you just addressed, but my familiarity also is mainly from the commercial power reactor, so I wanted to make sure that there is a focus on how to avoid criticality and what to do about criticality, which wouldn't be a big deal for a commercial operator, but would be in your

context, so I don't know if you want to comment anymore about that?

MR. WALLER: Sure, so we, for the training aspect of it, and there are other aspects beyond training for how it's handled, but for how we train the licensed operators on that, in the fundamentals training, as previously stated, we cover indications of criticality, reactivity effects of criticality and what we expect those effects to have on an irradiation unit.

We also cover the theory and operation, and then the implementation of criticality avoidance such as one over M plots. When we get into the systems training, we have a specific system that deals with criticality detection. That is covered during their systems training.

During their integrated operations phase training, which includes the normal, abnormal, and emergency operations, we cover the procedural steps that operators take to check for getting close to criticality and avoiding it.

We cover the actions to take upon receipt of a criticality alarm, and then also emergency plan training deals with actions to take upon detection of a criticality event. So, it's covered in theory, it's

covered in system design, and it's covered multiple times during the operations.

MEMBER BIER: Great, thank you. One other question, I'm wondering whether you have a sort of chicken and egg issue with initial operation.

If part of licensee training, or operator training is performing evolutions in the plant, what is the level of training before you eventually operate at all and what's that transition look like to who's going to be doing those first evolutions, et cetera?

MR. WALLER: All right, so that's also a good question and something that we have considered for the initial class because the initial class will obviously be different than any subsequent class just because of the nature of the construction and commissioning.

We so have some models to follow from other recently constructed facilities and NRC licensing programs. The main thing that we're going to do for the on-the-job in the field training phase is the operators are an integral part of the commissioning and testing of the plant.

At the commissioning and testing of the plant, the tasks that the operators will perform line up very well with what we would identify as operators

performing as part of their on-the-job training.

So, we intend to take credit for operations that operators perform during the commissioning phase, and that's also in line with what ANCI-15.4 states as taking credit for evolutions for training that are not part of the training program as specified.

We also have -- we're using, for example, on the slide that we're about to cover in the application process, using the 398(a). We do have tools in the 398 via the waiver process, so for some things, it can't be done until we reach an operating license state to have those requirements performed at that point with appropriate levels of supervision in place.

MEMBER BIER: Thank you.

MR. WALLER: Okay, so moving onto the application process, the application process for us is really no different than any other place that has an NRC licensed operator.

We use the NRC form 398 for the application of the candidate. We follow the research and test reactor standards when filling it out, and we also use an NRC form 396 for medical evaluations and that medical evaluation is already set up with the

local hospital in the area in their occupational safety health department.

We do an internal review of a SHINE candidate before we sent them to the NRC exam. This is a review to make sure that the medical requirements are met, that the eligibility requirements are met, and that we are confident that they would pass an NRC written exam and NRC operating exam.

As far as a review of the program for initial training, there's two avenues that we use to assess it. One is part of the systems approach to training.

There is an actual performance evaluation after training that's targeted for a specific time frame after a candidate graduates the training program for feedback incorporation and improvement of the program. It's also assessed by the review and audit committee every three years.

CHAIRMAN BALLINGER: This is Ron Ballinger. I have, I guess, a two-part question, not being an expert in this area at all, so I'm probably going to duplicate things, but the application form is generally for operating a nuclear facility and I'm assuming that means the accelerators here, but there's an additional part of SHINE which involves the

separation and the chemistry side. Would you be modifying the application in some way to evaluate a candidate's aptitude for this kind of thing? I guess that's the question that I have.

MR. WALLER: Okay, so I interpret that question as you're asking about the radiopharmaceutical technicians that are performing the chemical operations for the hot cells?

CHAIRMAN BALLINGER: Yes, yes.

MR. WALLER: Okay, so those positions are currently not a licensed operator position --

CHAIRMAN BALLINGER: Right.

MR. WALLER: -- but they are under the supervision of a licensed operator, so the answer to that is two parts, the licensed operators that would be overseeing those personnel, their training program for the systems training, their integrated operations training, and anything as far as specific administrative controls. They are trained on all of those as relevant to what a radiopharmaceutical technician would do.

Radiopharmaceutical technicians also have a training program that's based on a systems approach to training, so they get a version of operator training. It's just not a licensed operator training

program.

CHAIRMAN BALLINGER: Yeah, thanks. I mean, I'm sure that's absolutely correct. I'm just -- there is at least the potential nexus with safety on the nuclear side, so that's why I asked the question.

MR. WALLER: All right, so that's how we train operators when they come in through the front door. Now let's talk about how we train an operator that has a license.

So, we'll start our licensed operator continuing training program within three months of receiving our first operator license, whenever that happens to be. It conforms to the requirements of 10 CFR 55.59(c) and follows the guidance of ANSI-15.4-2016.

Basically, what all of the regulations specify is you have to have a requalification program that is continuous and no more than 24 months in length, so that's what we used.

We have a 24-month long biennial requalification cycle. As soon as one cycle ends, the next cycle starts up immediately. The 24-month long cycle is divided into two 12-month long annual cycles.

The medical certifications are done every two years in accordance with ANSI-15.4-2016. That

two-year period ISI is independent of the biennial. It is its own period ISI. It is tracked separately.

And then as part of our requalification program, we do inform the NRC per 10 CFR 50.74 of any significant changes to operator license status, for example, if a licensed operator transfers internal to SHINE and is no longer in that role, if a licensed operator leaves the company, or if a significant medical event has occurred that would change the licensed operator status.

MEMBER HALNON: Hey, Brent, this is Greg Halnon. Can you go back on your requal cycle and just kind of frame it up for us from the way the operating shifts look like, how many shifts, how often?

You know, what is their shift rotations and how do they attend requal training? Is it -- you know, can you kind of just walk us through what a -- you know, is it a six-week cycle, a five-week cycle, whatever the case may be?

MR. WALLER: All right, so I'll handle the training piece and then I'll defer to our operations manager who is here for the actual operator shift cycles.

We do quarterly cycles for licensed operator continuing training, so four cycles a year,

eight cycles in a biennial requalification cycle. As far as the rotation, I'm going to turn it over to the ops manager, Kris Ruetz.

MR. RUETZ: Good morning, everyone. This is Kris Ruetz, the operations manager. So, as far as our operational shift schedule, we're going to use, follow kind of a typical DuPont type of schedule where we're going to have four crews of people that are going through rotating 12-hour shifts, day and night shifts. So, it's a four-week rotation until you start the rotation over again, so --

MEMBER HALNON: Okay, on the --

MR. RUETZ: -- does that answer the question about shift rotation?

MEMBER HALNON: Yeah, on the -- is there going to be like a reserve shift that's on sometimes or, I mean, or are they just one shift only?

MR. RUETZ: So, as of right now, we have no plans for a reserve shift. That's going to kind of depend on how our meeting looks coming out of the licensed operator training program.

MEMBER HALNON: Okay, that's fair. The first 12-month cycle, are you going to stagger them? Is there going to be a lucky group of people that get to do requal in 12 months or are you going to just

keep them all on the same two-year cycle?

MR. WALLER: Okay, so we plant to, when we have the initial license class comes through, we would expect all of the licenses to come in roughly within the same period of time. We would start our requalification cycle almost as soon as we have our licensed operators and that would start our biennial requalification cycle.

At some point in the future, we may short cycle a continuing training cycle to get the starting in any month at a more convenient point either for us or for the NRC examiners, but at the moment right now, that's a future thing and we just intend to start the biennial requalification cycle within three months of our first license.

MEMBER HALNON: Yeah, that makes sense. Thank you.

MEMBER BIER: One other question, do you envision that people would be permanently on day or night shift or could that change over the course of a month or two?

MR. WALLER: No, so the schedule I mentioned previously is our current plan and that is subject to change, but the plan is for people to rotate through the day and night shifts.

MEMBER SUNSERI: This is Matt. One more question maybe for the operations manager. Are you going to have the, like an active license and an inactive license arrangement where an operator has to stand so many watches to keep the license active?

MR. WALLER: Yeah, so there is a proficiency requirement. When we go to the next slide, you can kind of see where we have the check.

As far as the intention, I'll defer that to the operations manager, but as far as the capability goes, we do track anybody that has a license and making sure that they meet all of the requirements to maintain their license, which is medical, proficiency, manipulations that have to be performed in the plant, and up to date on training.

So, the program can support it. It's whether or not ops has the staffing to have that. I'll defer to the operations manager.

MR. RUETZ: Yes, so currently we have no plan for maintaining the inactive license type state that you had mentioned.

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

MR. RUETZ: Just the maintaining of tracking of proficiency like Brent, the training

manager, mentioned.

MEMBER SUNSERI: Yeah, yeah, no, that's good. Thanks.

MR. WALLER: All right, so this table kind of breaks down the, how often we're tracking various things that are part of the continuing training program. Like I said, we plan on doing licensed operator continuing training quarterly.

This doesn't take the place of we have the ability to do just in time training for any special evolutions that come up in the plant, but for any one cycle of training, we would cover any facility design changes, procedure changes, or license changes that are applicable to a licensed operator.

We'll do training lectures every quarter. We check and make sure documentation of proficiency is accomplished every quarter. We do abnormal and emergency procedure reviews once per annual cycle, and we verify that all reactivity significant control manipulations are complete once per annual cycle.

We administer an operating test once per annual cycle. A written exam, the NRC written exam is administered once per biennial cycle, and then the medical exam is independent of the biennial training cycle, but that occurs every two years in accordance

with COC 54 2016.

As far as the content for the continuing training program goes, it lines up very close with the initial training program, so the applicable parts of 10 CFR Part 55, any facility modifications, procedure changes, topics that are identified by the systematic approach to training, relevant industry experience, and then any identified operator weaknesses, gaps, anything observed on shift would also be covered.

The program is reviewed via two methods. We have the systems approach to training which has a built-in feedback mechanism and we also have an assessment by the review and audit committee every 24 months. And that's the last slide for the operator training program presentation.

CHAIRMAN BALLINGER: Thank you. Questions, additional questions from the members or consultants? Thanks again. Can we switch over to the NRC side? There we go. Thank you.

MR. TATE: Good morning. Can you hear me okay?

CHAIRMAN BALLINGER: Very well.

MR. TATE: Thank you. So, good morning. My name is Travis Tate and I am the Branch Chief of the Non-Power Production and Utilization Facility

Oversight Branch or UNPO. UNPO is conducting the review of FSAR Chapter 12.10, SHINE operator training and requalification program.

I think it is important to note that there are no specific regulations for operator licensing of a facility such as SHINE. However, SHINE has provided the requalification training program as part of their application.

The staff is conducting a review of the program based upon specific application of the applicable portions of Part 50 of regulations to SHINE's operations. Next slide, please?

So, the SHINE facility is under NRC review for licensing in accordance with the applicable requirements under Part 50. In accordance with Paragraph B8 of 10 CFR 50.34, an applicant for a facility operator license is required to submit a description and plans for implementation of an operator requalification program that meets the requirements in 10 CFR 55.59.

The operator requalification program is intended to ensure that operators are competent to operate and safely shutdown the facility. Additionally, SHINE submitted an initial training program. However, there are no applicable regulatory

requirements or guidance associated with an initial training program.

The only regulatory requirements that exist for training and qualification of licensed personnel are contained in 10 CFR 50.120 and applies to the training and qualification of nuclear power plant personnel.

So, none of the requirements in 50.120 apply to SHINE, which is being reviewed for licensing as a production and utilization facility. Therefore, the NRC staff will not render a sufficiency determination on the initial training program. Next slide, please?

So, just an overview of the government regulations for this review. They are 10 CFR 50.34 which is the contents of applications and technical information, 50.54 which is conditions of licenses, and 50.59, which is requalification. Next slide, please?

The NRC staff evaluated the sufficiency of the SHINE requalification training program using the guidance and acceptance criteria from Section 1210 in NUREG 1537, Parts 1 and 2, and the ISG augmenting NUREG 1537, Parts 1 and 2.

Part 1 gives guidance to non-power reactor

licensees and applicants on the format and content of applications to the NRC for licensing actions and Part 2 gives guidance on the conduct of licensing action reviews to NRC staff who review non-power reactor licensing applications. Next slide, please?

The requalification program elements evaluated by the staff include the schedule, the preplanned lectures, on-the-job training activities, operator evaluations, and the required recordkeeping. Next slide?

So, the SHINE continuing training program describes how the applicant's program for operators and senior operators will meet the requalification program requirements in 55.59.

The NRC notes that SHINE also commits to following industry guidance in ANSI Standard 15.4, the 2016 version, related to the selection and training of personnel for research reactors.

SHINE's two-year requalification program cycle meets the acceptance criteria for program duration contained in the NUREG and is consistent with the guidance in Section 6.2 of the ANSI standard.

The program must include preplanned lectures on a regular and continuing basis throughout the license period in those areas where operator and

senior operator written examinations and facility experience indicate that emphasis in scope and depth of coverage is needed. SHINE's preplanned lectures are based on topics related specifically to the operations of a SHINE facility.

The program must include on-the-job training such so that the licensed operator manipulates the plant controls and each licensed senior operator either manipulates the controls or directs the activities of individuals during plant control manipulations during the time of the operator's license. The SHINE program requires ten reactivity manipulations per annual requalification cycle.

The program must include on-the-job training so that each licensed operator is cognizant of facility design changes, procedure changes, and facility license changes.

So, SHINE's program includes document reviews that will be conducted to ensure that licensed individuals are cognizant of all design, procedure, and license changes.

The program also must include evaluations of the licensed operators and SHINE's program includes abnormal and emergency procedure reviews that will be

performed once per annual qualification cycle.

Specific content of training sessions is based on an observation of operator performance and items identified as weaknesses in the training program or operator knowledge as determined by operating events, examination results, and crew and individual performance gaps. Next slide, please?

The program includes license conditions, license condition information for licensed operators. Under the proposed program, licensed operators are to perform four hours of license duties on a quarterly basis consistent with the requirement for research and test reactors.

For licensed operators who have not met the proficiency requirements, will perform a minimum of six hours of license duties under the direction of a qualified individual holding the same or higher level license prior to being reinstated consistent with the requirements of research and test reactors.

I note that SHINE, in this area, SHINE is not considered a research reactor or a test reactor, and as such, the research and test reactor provisions of 55.53(e) and F2 are not applicable to SHINE.

Following the staff request for information, SHINE submitted an exemption request from

the requirements of 55.53(e) and F to modify the minimum number of requirements required for licensed operators to maintain active status and to restore active status. That exemption request is still, review is still ongoing.

The program also implements a drug and alcohol testing program for licensed operators that is consistent with the requirements of 55.53 and consistent with the guidance of Section 8 of the ANSI standard.

Audits for the retraining and requalification program for the operating staff are to be conducted at least once every other calendar year with the interval between audits not to exceed 30 months. Next slide, please?

So, evaluation findings and conclusions, SHINE's licensed operator continuing training program is in accordance with the applicable regulations for requalification contained in 55.59, it meets the acceptance criteria in NUREG 1537, and is consistent with the ANSI standard.

The licensed operator continuing training program provides reasonable assurance that requalification for licensed operators and licensed senior operators will be carried out in a manner that

ensures knowledge, skills, and proficiency will be maintained and is sufficient for issuance of an operator license. Next slide, please?

So, operator initial training is intended to ensure that applicants will be prepared for a license under Part 55 and the facility will be operated by competent operators.

Again, Section 5120 of 10 CFR Part 50 does not apply. An applicant is permitted to follow the industry guidance and ANSI Standard 15.4 for selection and training of personnel. Next slide, please?

The training program for SHINE is described in the licensed operator initial training program. SHINE's licensed operator initial training program includes the commitment that trainees will only operate controls under direct supervision of a licensed operator, reactivity manipulation plans for licensed operator candidates, plans to account for previous experience and training, training program scope and topics for operators, the scope and topics for senior operators as well, the medical certification and fitness for duty, licensed operator candidate selection and qualifications, the evaluation of the licensed operator candidates, periodic program review and recordkeeping. Next slide?

SHINE's licensed operator continued training program is consistent with the guidance contained in industry standard ANSI 15.4, and that's my last slide.

MEMBER HALNON: Hey, Travis, this is Greg Halnon. It looks pretty good from an operator training perspective. Have you guys thought through how the NRC staff licensing folks will be educated and trained on this so that they can ensure the operators are competent?

MR. TATE: Yes, we have -- you know, we are, I would say -- oops, did I -- can you still hear me?

MEMBER HALNON: Yeah, we're good.

MR. TATE: Okay, I heard a click. I thought I had muted. So, yes, we are looking at their operations and trying to understand and making sure that we understand, you know, how the facility will be operated and, you know, how we would go about putting together the examination of those operators.

MEMBER HALNON: Okay, there's still some time, but you're working through that, okay, thanks.

MR. TATE: Correct.

MEMBER BIER: Hi, this is Vicki Bier again, and I apologize. My questions are actually

follow-ups for the SHINE people, so if I could do that now. I just have more questions about the shift work. One is do you anticipate that teams will stay together and rotate through the shifts so that the same people are working together?

MR. RUETZ: Yes, this is Kris Ruetz, the operations manager. So, that is our intention at this time. Again, that is subject to change, but our plan is to generally keep the same shift complement, same group of people together --

MEMBER BIER: Okay.

MR. RUETZ: -- in a given shift.

MEMBER BIER: Yeah, and, of course, I realize, you know, that may change with absences or whatever, but that's the normal situation. Do you anticipate that -- I guess one question is I don't really have a good visualization of how busy or active a typical shift will be, and this is towards the question of is 12 hours going to be really fatiguing or is operations going to be in steady state much of the time where 12 hours is not that long?

MR. RUETZ: So, the amount of activities during a shift will vary based on our planned schedule such that we've kind of identified the fact that the way our operational tempo will work will give us the

ability to potentially identify high activity shifts, and if it's necessary, allow us to provide additional personnel to that shift, such as if we had a Monday day shift that was particularly busy for the schedule, we could accommodate that ahead of time and plan for additional operators as necessary.

MEMBER BIER: Okay, so that people still get their breaks and et cetera. The one additional question I have is did you give consideration to a slower rotating schedule and was that not done because it doesn't fit the operational needs or, you know, what was the consideration in going with the DuPont schedule?

MR. RUETZ: So, is your question like a longer period of time before the schedule repeats and starts over or is it relating to the 12 versus eight hours or something else?

MEMBER BIER: No, I'm asking like if somebody is assigned to days versus nights, there are shift schedules were somebody might be on a night shift for like a whole month and then day shift for a whole month for example. It just switches less often.

MR. RUETZ: Yeah, I understand, so we did look at schedule alternatives, but just based on our experience here with the personnel that work at SHINE,

most of us do have the commercial reactor experience. We felt that the DuPont schedule would be best for our current operational tempo.

And again, like I said previously, it is subject to change, so if we find out that, you know, potentially another shift work schedule would be better, then we could make that change later on.

MEMBER BIER: Yeah, I am far from an expert on shift work, but I did look into it some many, many years ago and my understanding is that just from a physical health point of view of like sleep hygiene and things like that, that slower rotations are easier on the employees, but I'm not an expert on how to fit that into, you know, an organization's needs, et cetera, so I just wanted to raise that, okay.

MEMBER HALNON: Yeah, this is Greg. I just have kind of a follow-up. Actually, I lost my train of thought.

MEMBER BIER: Oops, maybe you didn't get enough sleep.

MEMBER HALNON: Yeah, I think I was going to address your questions, Vicki. The four shift rotation is pretty well established, and when we put the fatigue rule in place, there was a tremendous

amount of work by Dr. Desaulniers and the NRC staff on working with the industry on the best way to do that rotation, so I'm pretty confident in the four shift. If it was a three shift rotation, I'd be a little bit more concerned, but four shift is decent.

The question I had was whether or not there will be a union contract. Is this a union facility or a non-union facility?

MR. RUETZ: It's currently a non-union facility.

MEMBER HALNON: Okay, so you'll have a little bit more flexibility in adjusting first of a kind technology to the human factors piece of this then.

MR. RUETZ: That's correct.

MEMBER HALNON: Okay, thank you.

CHAIRMAN BALLINGER: Does that complete the questions? Okay, let me -- I may be assuming facts not in evidence, but we're going pretty quick, and my question to the SHINE folks is if we have an opportunity to move some of the afternoon presentations into the morning, can that be done? The staff has already said that they're fine, but I need to be sure that the SHINE folks can do it.

MR. BARTELME: This is Jeff Bartelme. We

got considerable flexibility today. We should be able to do that. We should be able to support that.

CHAIRMAN BALLINGER: Good, I've probably condemned us by even asking the question, but okay. So, let's -- now we have the section on human factors, so the SHINE folks are up. I guess can we get the SHINE presentation up?

MR. RUETZ: Can you guys see the --

CHAIRMAN BALLINGER: Ah.

MR. RUETZ: Can everyone see the slides?

CHAIRMAN BALLINGER: Yes, now we can. Thank you.

MR. RUETZ: All right, good morning, everybody. This is Kris Ruetz, the operations manager at SHINE and I'll be talking about human factors engineering today.

So, just an outline of the slides I'll be covering today, so I'm going to give a brief overview of our human factors engineering, our HFE program, talk about our HFE design guidelines, our HFE design checklist, how we evaluate alarm hierarchy, some additional information on equipment labeling, and then finish off with a discussion about how we validate our operating procedures.

So, to begin an overview of our HFE

program, so SHINE incorporates HFE principles into the design of the facility control room, the display screens, and the operator interfaces. The SHINE operations department works with the engineering department to ensure that human factors are considered throughout the design process.

So, SHINE evaluates HFE as part of kind of three different phases. We evaluate it as part of initial design, which I call the paper designs. So, before anything is built and implemented into the facility, we evaluate the intended design.

We evaluate it from actual design implementation. Once the facility is being built and equipment is installed, we confirm the as-built design to the initial design. And then we also evaluate it from the future modification aspect, so that includes both permanent and temporary modifications.

So, how we evaluate HFE factors, we perform a checklist that compares the design to the recommended design guidelines that we have in our HFE design guidelines that I'll cover briefly. HFE evaluations of those checklists are maintained as official records.

So, for our HFE design guidelines, again this is implemented through the use of that checklist

that I just mentioned. The design guidelines are all recommendations. There are no requirements.

So, our design guidelines are kind of split into four different categories. We have instrumentation and control panel layout, main control room layout, human system interface design criteria, and alarm system criteria.

The design guidelines are provided to the vendors that are working on the SHINE HSIs, so they get a chance to look at them and review them, and make comments on them prior to them beginning work on the SHINE HSIs.

And then the design guidelines themselves are derived from the relevant industry standards, the majority of which are the NUREG-0700, the human system interface design review guidelines.

MEMBER HALNON: Hey, Kris, this is Greg Halnon. On this control room layout, was part of the criteria to limit the distractions to the operators?

MR. RUETZ: In a way, yes. The holistic view of implementing the HFE design guidelines is to ensure that operators are able to efficiently perform the duties and activities that are required of them, so that would include elimination of distractions.

MEMBER HALNON: In the documentation, the

two entry doors to the control room, every time somebody enters, it will drive the attention of the operators to the door rather than the control board because the operators are looking at the control board, but in their peripheral vision would be the two doors.

Is that a set design or do you have some other plans to limit the distraction every time somebody comes into a control room to take the attention of the operators away from the control board?

MR. RUETZ: Yeah, so the design of people, personnel entering the control room, that is a set design. Our intention is to limit normal access to and from the control room through a single door such that you're not looking back and forth between the two doors, so normal personnel access will be through a single door.

MEMBER HALNON: Okay, so the operators will just look to the left instead of to the right, but still, it distracts every time somebody comes in that door. The operators -- it's going to have some kind of attention distraction regardless of whether you're using two doors or just one.

So, I guess my point, if it's already a

set design, consider that because during critical evolution surveillances or other types of evolutions, you know, the industry has worked extremely hard on making sure that the distraction of the operators is limited to only what's necessary, and that most of the entry doors to the control rooms that we've seen are behind and they require permission to enter and those types of things, so consider that in your protocols for getting people into the control room.

MS. KOLB: So, thank you for those comments. This is Catherine Kolb. One additional thing to consider is, you know, we do have access controls on the various rooms such that we can limit the people that have the ability to enter the control room. We don't expect random staff to be wandering into the control room at any given time.

MEMBER HALNON: Okay, yeah, that's good and I think that's consistent with what we see in the industry. However, we don't normally see a door where the only place to come in and out of the control room is in the eyesight of the operators of the control board at the same time, so just consider that, maybe some partitions or some other type of controls to prevent the operators from being distracted.

MR. RUETZ: I appreciate the comments.

Thank you. Any other comments or questions before moving on?

DR. BLEY: This is Dennis Bley. In your human factors engineering program, you don't seem to do something that is done typically in power reactors and that is try to identify critical human actions which become important to think about as you design your procedures and in your safety analysis. Have you done some of that or is that done somewhere else?

MR. RUETZ: So, it is important to note that SHINE does not rely on the operator actions to respond to an event. So, when we discuss human critical actions, we don't have specific timed actions, whereas a nuclear power plant does have those.

DR. BLEY: Yeah, but some of the ones we find for a nuclear power plant don't come up unless you have an abnormal condition that requires the operator to get involved, which isn't your normal operations and in the plan, so the things that --

If you're in the middle of an event that leads to an accident, there are things that operators need to do, and perhaps some of those are very important, and this is where typically they get identified. I guess if I understand you right, they

only get identified in the safety analysis if somebody thinks of them there.

MS. KOLB: Yes, this is Catherine Kolb. That is the place where we would have identified any important human actions of those kind that are required to mitigate accidents, but as discussed in our safety analysis presentation, we did not identify any human actions that were required to respond to mitigate an event, so we didn't include that in our human factors engineering program because there weren't any of those actions identified.

DR. BLEY: Okay, we have a little bit of a hole here since we don't have another facility like this out there, but operating experience may teach us we missed something here. I don't know how hard we've thought about that aspect.

MR. RUETZ: So, I am going to discuss in a little bit the way we do our procedure validation and that might shed some more light on what your comments and questions are.

DR. BLEY: I'm sure it will help.

MEMBER BIER: Hi, I have one other follow-up. Is the checklist that's used for the human factors design, is that available to us somewhere or can that be shared or --

(Simultaneous speaking.)

MEMBER BIER: -- maybe it's been shared and I haven't found it.

MR. RUETZ: I don't believe we've made those available. Those are something that we can -- we can make those available.

MEMBER BIER: That would be super. And a follow-up question, a checklist seems like a very good tool for making sure that things are not missed, but it also kind of focuses attention on the things that are on the checklist and it may be useful to have kind of an additional holistic review of just a sanity check.

You know, what strengths and weaknesses do we see in this design separate from the checklist and can you talk about whether that kind of more holistic review has taken place?

MR. RUETZ: Yeah, I think what you might be referring to again might be covered when I talk about procedure validation, just I guess I can kind of hint at it now, but essentially for procedure validation, we're going to take our procedures that we've written and do an actual walkthrough in the facility hand over hand to ensure the procedure can be performed as written, so I think that would alleviate

some of the issues that you might be referring to.

MEMBER BIER: Yeah, that's part of it, but also I think even before construction of the equipment, it just, you know, an additional walkthrough of, you know, is everybody comfortable with this design, you know, maybe getting an outside expert to review it who wasn't involved in the design process or whatever.

Because I know for the commercial power plants, you know, we had an experience where a lot of control rooms had major redesigns after they were implemented, and obviously some of that is now in lessons learned that anybody would know about before doing their design, but it's a lot easier to change designs before they're in hardware.

MR. RUETZ: I understand your comment and I think one thing that kind of helps us out in that aspect is the fact that the operations department is incredibly involved in the whole human factors engineering process and HSI design such that we work with the vendors that are developing the HSI software and interfaces on a nearly daily basis just as operators, so we are the end users of it, so it's extremely helpful for us to be involved in essentially the design process of those.

MEMBER BIER: Okay, thank you.

MR. RUETZ: All right, so moving on, more discussion on the human factors engineering design checklist. So, those checklists are used to compare the design to the recommended design guidelines.

The checklists are filled out by the operations department and are used, again, during those three phases I discussed, during initial design, after installation, and as part of equipment modifications, and again, the checklists are kept as records.

Any issues that are identified during performance of the checklists are tracked via the SHINE issues management process which is our corrective actions program.

All right, so next I'll cover alarm hierarchy. So, most of our facility alarms will be received in the control room via the process integrated control system, the PICS. PICS displays alarms on a consolidated alarm page on the control room HSIs.

We also have stack lights in the control room that alert operators to current facility alarm status. These stack lights provide operators with high level facility alarm status, and they're broken

out such that each irradiation unit has its own alarm light and then there's additional alarm light for common alarms that aren't specific to an individual irradiation unit.

So, we have four different categories of alarms. We have high, which is a red light and audible alarm, medium, a yellow light, and low, a blue light, and then informational alarms, which there's no stack light indication for, only a PICS alarm display.

MEMBER HALNON: Before you go on, could you go back and just give us a sense of what a high alarm would be?

MR. RUETZ: Yeah, so high alarms would be generally things that related to safety-related equipment or parameters that might lead operators into tech spec space, LCO entries, things like that.

MEMBER HALNON: Okay, largely operator reaction required to address the alarm?

MR. RUETZ: That's correct.

MEMBER HALNON: Okay, and that gets back to Dennis's earlier question that even though no license basis event requires operator action, there's a tremendous amount of important operations that do require operator response. Just a comment, thanks.

MR. RUETZ: Thank you. For equipment

labeling, equipment and pipe labels are included within the scope of the HFE program. Equipment labels include a descriptive name and equipment designator, which is our unique equipment identifier.

Equipment labeling includes components such as valves, pumps, and tanks. Pipe labels include the system name and the arrow showing direction of flow.

During facility construction and commissioning process, equipment and pipe label verification is performed as part of turning over systems to operations and here I have some pictures of example labels.

And finally, I'll just talk about operating procedure validation. So, operating procedures, including abnormal and emergency procedures, are validated prior to being issued for use.

The process for procedure validation varies based on the type and the content of the procedure. However, most validations will consist of a step by step facility walkthrough of a procedure after the related equipment has been installed.

So, alternate methods may be used for a procedure validation on a case by case basis. An

example would be a tabletop discussion which might be more, might be easier to perform for something like an emergency procedure that kind of has several branching steps in it, but the majority of validations will be the walkthrough of the facility.

So, the point of the procedure validation is to ensure that the operators can physically perform the procedures and provides a diverse method of checking for necessary equipment labels, kind of a last stop to make sure that we have all of our labels in place.

So, that's all I have for the presentation portion. Any questions or comments from anybody?

CHAIRMAN BALLINGER: Hearing none, thank you very much. Can we get the NRC folks up?

MR. SEYMOUR: This is Jesse Seymour from the human factors and operator licensing branch. Michael, could we go ahead and just get my first slide up there?

CHAIRMAN BALLINGER: Got it. Thank you.

MR. SEYMOUR: Thanks a lot. I appreciate it. My name is Jesse Seymour, and I'm a human factors technical reviewer in NRR's Operator Licensing and Human Factors Branch. I was the primary reviewer for the human factors engineering portion of the SHINE

operating license application.

I will be providing an overview of the regulatory basis for the review. The guidance and criteria I used for it are audit activities, a basis for how we scope and graded our review approach, our technical evaluation, and, lastly, our conclusions and findings.

Next slide, please?

Okay. So, in general, we conduct human factors engineering reviews of operating license applications in order to verify that applicants are incorporating practices and applying guidelines that are acceptable. It's important to note that the SHINE FSAR follows the format used by non-power reactor facilities, such as research and test reactors. That format does not include a dedicated human factors engineering chapter as would be the case with a power reactor facility.

As a result, the areas covered by the HFE area review span various portions of Chapters 3, 7, 12, and 13, and focus on whether the HFE-related design and programmatic aspects of the application are sufficient.

Next slide, please?

The specific regulatory basis associated

with the SHINE application was key to the discussion of the HFE area review approach that was used. Here we have a description of the regulations that serve as the basis for the review. These regulations come into play whether we are talking about irradiation facility or the radioisotope production facility portions of the SHINE facility.

Design Criteria 6 addresses the SHINE control room and certain actions that it is required to be able to support. Later in the presentation we will discuss what the staff review identified concerning the nature and scope of those actions.

Importantly, it must be recognized that no HFE programmatic requirement exists for SHINE due to their specific regulatory basis.

Next slide, please?

Now I will discuss the guidelines and associated acceptance criteria that we used for the HFE area review of the SHINE application. As noted throughout the meeting so far, NUREG-1537 and its associated interim staff guidance served as the overall review plan for the SHINE application. Consistent with how I noted that the SHINE regulatory basis does not mandate an HFE program, NUREG-1537 does not contain any specific review criteria for human

factors engineering.

However, NUREG-1537's Chapter 7 for instrumentation and control, more specifically Section 7.6, which addresses the control console and display instruments, does contain certain criteria that have HFE-related implications. These criteria include those for the observability of outputs and display devices, the accessibility and understandability of important controls and displays, and for control console, enunciators, and alarms.

Since these criteria are written in terms of a non-power reactor facility, we adapted them, as appropriate, using the guidance of the NUREG-1537 interim staff guidance as interpreted according to SHINE-specific systems.

Next slide, please?

While SHINE is not a Part 70 facility applicant, the application still contains certain features that have similarities to those types of facilities. Centrally, SHINE conducted a safety analysis that identifies administrative controls that are used to reduce the likelihood and consequences of events in order to achieve acceptable levels of risk, as well as certain programmatic measures that serve to support the reliability of those administrative

controls.

On account of this, we used guidance from both the NUREG-1537 interim staff guidance and also from NUREG-1520, which is referenced by the NUREG-1537 ISG, to consider these specific areas. We noted that these administrative controls consisted of a variety of procedurally directed and prohibited actions that occurred throughout the facility, and that, in general, those controls were supported by programmatic measures in the areas of training and procedures.

Based upon that, we focused the HFE area review on that particular aspect of the SHINE application on procedure management, verification and validation, as well as on the training and qualification of the relevant facility personnel.

Next slide, please?

MEMBER HALNON: Jesse, it's Greg Halnon. Given all of the review criteria that you just went through, did you identify lessons learned that might make the next review more I guess efficient relative to finding the right guidance to review against?

MR. SEYMOUR: That's a great point. And in my Part 53 discussions that I've had with the -- with the committee, we've been talking about how we're developing guidance going forward for scalable human

factors engineering reviews.

And one of the things that we've done is try to take lessons learned from this review, where we've had to, you know, really help pull apart what the facility is and figure out what the relevant guidance should be, and to apply that to that scalable HFE guidance development going forward.

MEMBER HALNON: Okay. That makes sense. So in the future something under Part 50 such as this, which is sort of a one off, you can refer to the new guidance that you're doing.

MR. SEYMOUR: That's correct. Yeah. We're trying to -- you know, we're trying to take those lessons and use them to build a better product that we can use down the road.

MEMBER HALNON: Okay. Thanks.

MR. SEYMOUR: Okay. Let's see, Slide 6? 7?

Okay. So in order to scope and grade the human factors engineering area review and to clarify areas in which we have questions, we conducted an audit. A central focus of this audit was to better understand the specific role that SHINE facility operators will play in facility safety as this was in turn necessary for identifying what would be needed to

meet Design Criteria Number 6.

The overall audit included the areas of the limited human factors engineering program that SHINE elected to implement, the design of the facility control room, the role of SHINE operators in maintaining both facility safety and in providing for defense-in-depth, administrative controls, operations staffing, and portions of the operator training programs.

The documents that we reviewed in the course of this audit included, among others, the SHINE safety analysis summary report, the SHINE human factors engineering program, the SHINE human factors engineering style guide, and the SHINE human factors engineering design checklist.

Additionally, we also looked at SHINE's operations procedure development program and portions of the licensed operator initial and continuing training programs. This audit report has been issued and is available. However, I should note that a portion of the audit that covers some of these materials is proprietary in nature.

Next slide, please?

From the audit we gained certain insights that served to inform our approach and acted as a

means of scoping and grading our review of the application. These insights included that operators are not credited to take mitigative actions in response to facility events.

We did note the operators who were identified as providing manual actuations of safety-related TRPS and ESFAS systems for the purposes of defense-in-depth. It should be noted, though, that this is the sting from the operator's being credited to do so.

They also noted that operators were credited with the implementation of administrative controls that are taken prior to the occurrence of events. Operator actions were noted to not be credited in response to events assigned from the need to evacuate the facility control room within a specific timeframe under certain circumstances.

Additionally, we identified through our audit that SHINE had incorporated a human factors engineering program of a limited nature. This program consists of a human factors engineering programmatic document, a style guide that is based in part on the human system interface design guidelines of NUREG-0700, and a human factors engineering checklist that is used both during the human system interface

design and installation phases.

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Okay. So before we get into the details of the technical evaluation, this graphic serves to summarize the material that has been covered thus far and to illustrate once more how the review, scope, and focus was arrived at.

SHINE is applying under Part 50 but is not a power reactor. Because of this, there is no regulatory requirement for applying the state of the art in human factors engineering to the control room design. Similarly, the NUREG-1537 review plan does not have any specific human factors engineering criteria.

However, that being said, Design Criteria 6 does address the need to have a control room from where actions can be taken to operate the facility safely and to perform any required acts and actions. And NUREG-1537 has certain I&C criteria for the control room that have related human factors engineering aspects.

By way of our audit, we noted that the accident response doesn't rely on operators taking actions, and that the operator role under such circumstances is to essentially serve as an added

layer of defense-in-depth and to evacuate the control room if necessary.

We also noted that SHINE applies a limited human factors engineering program to their control room. And that while not mandated by regulation, this program applies guidelines that are derived from, in part, NUREG-0700, and that the application of such guidelines as these generally supports those NUREG-1537 control console and display criteria that have human factors -- human factors engineering implications.

Finally, we also noted that SHINE credits operators' implementation of administrative controls and that these administrative controls are, in turn, supported by specific programs. So taken together, this information established the focus and scope of our HFE review.

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As noted earlier, the NUREG-1537 Section 7.6 criteria selected for the review were adapted for use within the context of the SHINE application using the guidance of the NUREG-1537 interim staff guidance, as interpreted, based on SHINE-specific systems.

Under the first of these criteria, we

evaluated whether displays showing parameters related to facility safety would be readily observable by the operator while positioned at SHINE's facility control room operator workstations and the main control board.

In conducting this evaluation, we focused on the PICS and NDAS workstations used by the operators as well as on the main control board locations TRPS and ESFAS relative indications are provided. This included considerations of factors such as accessibility and visibility.

We noted that the control room displays and operator interfaces incorporate human factors engineering principles and that the associated human factors engineering guidelines used by SHINE included those associated with the readability, content, and arrangement of displays.

We found that this criteria is satisfied because outputs and displays showing parameters related to SHINE facility systems that are related to safety are readily observable by the operator while positioned at both the SHINE facility control room PICS and NDAS workstations as well as at the main control board, TRPS and ESFAS manual actuation controls, and that this is in turn supported by SHINE's HFE program.

Next slide, please?

Next, we evaluated whether controls and displays of other important parameters, such as for reactivity, would be readily accessible and understandable to the operator. In conducting this evaluation, we divided the associated displays and controls up into two groups for consideration.

The first group was more general in nature and focused on displays and controls other than those associated with the manual actuation of the safety-related protection systems. This included the operator workstations and their associated PICS and NDAS interfaces, the super workstation, and the features of the main control board.

The manner in which radiation monitoring information is conveyed to the operators was also considered. The digital interfaces used at the workstations and the main control board were noted to incorporate human factors engineering principles within their designs.

The second group focused on the specific displays and controls associated with the manual actuation of the TRPS and ESFAS systems, since these are integral to the ability of the operator to implement manual protective actions as a means of

providing defense-in-depth.

This evaluation included both the manual controls on the main control board that are used to actuate the systems, as well as the displays that would provide information to the operators to cue them that such actions are warranted.

We found that the human system interface will be capable of supporting the manual actuation of protective actions because displays and controls will be available in the SHINE facility control room for the manual system level actuation of safety functions and for monitoring those parameters that support them.

Overall, we found that this criterion is satisfied because the facility control room controls and displays are both readily accessible and understandable to the operator.

Next slide, please?

The third criteria of NUREG-1537 Section 7.6 that we evaluated was whether enunciators and alarms on the control console clearly show the status of systems, such as those associated with TRPS, ESFAS, and radiation monitoring. We noted that alarms are integrated into the PICS displays, that alarm-like and audible sounds are also provided for irradiation unit and non-irradiation unit-related alarms, and that

human factors engineering principles are applied to the design of the alarm systems.

Additionally, we noted that further alarm systems were also provided to alert operators to both criticality accident and fire conditions. We found that this criteria is satisfied because enunciators and alarms on the control console clearly show the status of systems such as operating systems, interlocks, TRPS and ESFAS initiation, radiation fields, and concentration and confinement, and that this is further supported by SHINE's human factors engineering program.

Next slide, please?

MEMBER BROWN: This is Charlie Brown. Could you backtrack a slide?

MR. SEYMOUR: Sure.

MEMBER BROWN: Okay. You talk about evaluating displays. Are these the specific displays that they are going to be using on their panels? Have they provided those to you all, or is this just what the -- what you all would typically look at?

MR. SEYMOUR: So what we've -- what we've looked at at this stage consists of the description of those displays that's provided in the FSAR and via audit. We have also looked at the guidelines that we

apply to those displays.

And an example of that that I will give you is that SHINE's human factors engineering design guidelines include guidelines that are related to the observability, content, readability, and arrangement of those displays.

So what we have seen via audit is that SHINE intends to apply those guidelines during the design and during the installation phase of those displays, and then to subsequently track any discrepancies that are identified.

MEMBER BROWN: Are they specific as to the type of displays? Like are they touchscreens? Are they screens that require pushbuttons or switch manipulation in order to call up various screens or functions on a screen?

MR. SEYMOUR: So all displays at the workstations and the main control board are described as being digital displays. In terms of if any are touchscreens, I would have to -- I would have to defer that question back to SHINE in order to clarify that.

My understanding is that the control interfaces are not touchscreen in nature. However, I would -- I would have to defer that question back to them in the event that there has been any changes to

their intention.

MR. RUETZ: Yeah. This is Kris Ruetz, Operations Manager at SHINE. So Jesse is correct. In the control room, at least for the PICS interface there is no touchscreen capability. It's keyboard and house interface. However, I do want to point out with the remote PICS stations we do have touchscreen capability, the ones that are outside of the control room.

MEMBER BROWN: Okay. I was looking at the -- I didn't pull up -- where is my stupid drawing? When you talk about the remote, I was thinking that there's a facility control room where you have your basic controls. There's a production facility space also. Is that in the facility control room?

MR. SEYMOUR: So is that question directed at me or at SHINE?

MEMBER BROWN: At SHINE I guess, now that they're on.

MR. RUETZ: Yeah. Sorry. Could you repeat that question again?

MEMBER BROWN: Yeah. I was looking at my overall I&C architecture diagram that you gave when we were talking yesterday. And there -- it shows that you have what's called a facility control room human

interface -- human system interface, and then another box which talked about a production facility interface. Are they separate locations, or are they all in the same space?

MS. KOLB: So this is Catherine Kolb. The control room includes interfaces and displays for the entire facility. So that is the irradiation units and for instruments that provide indication of processes in the radioisotope production facility as well.

What Kris is talking about as having touchscreens -- so in addition to the main control room where the operator sits and we can see on their trays in front of them, you know, indications throughout the facilities, there are also some local control stations for specific processes.

So, for example, there is -- for the tritium purification system, in the tritium purification room there is a limited function display screen with limited control specific to that system located in that room and not in the control room.

All of the PICS displays are a networked system, so the control room operators can see information from all of the processes that are connected in the facility, but the local displays are -- the control is limited for those local displays,

the touchscreens.

MEMBER BROWN: Are the local displays used for the normal operations, or is that just for some specific things while the main control is under the main control room?

MR. RUETZ: Yeah. So there won't be specific evolutions and procedures. The normal station will be the local stations, like Catherine had mentioned in the tritium purification system room.

However, there is -- there is nothing that is able to be performed at those local stations that cannot also be performed in the main control room as we're --

MEMBER BROWN: Okay.

MR. RUETZ: -- doing that.

MEMBER BROWN: So those would be -- typically, you would be looking at the main control room operator controlling all of the processes. That's what I understood basically from yesterday's discussion.

MR. RUETZ: That is correct.

MEMBER BROWN: Okay. Is there an emergency control screen of any kind, an emergency screen?

MR. RUETZ: Can you describe what you mean

by "emergency screen"?

MEMBER BROWN: Something that says, "Hold it. I've got a big problem going on." Something -- that there's a failure, irradiation alarm failure. Is there something that coordinates or evaluates the specific problems you might have to face such that you don't have to start dealing with multiple process screens when something goes on.

I don't know whether I'm asking the question right or not. This -- you all have -- the last time I counted the process integrated control system and counted the number of different systems you've got, there's a lot. So, which is understandable based on what you're doing.

So when I looked at that, it's difficult to control some problems if you -- that you may be evaluating, you've analyzed for, if you have to be cognizant of, you know, three, four, five, six different screens in the main control room.

That may be the wrong question. I have no idea how that applies to the overall processes. But you have a lot of different process stations from the IUs into the process -- the tritium processes, the purge systems, et cetera. So that's why I asked the question, is there an emergency control screen based

on certain analyzed accidents or other type things where you may have to have consolidated information to do an evaluation as opposed to having multiple -- or trying to get to multiple screens while you're dealing with it.

MR. RUETZ: Yes. So I can provide some clarification on that I think. So the operator workstations that are in the control room, there are two operator workstations and one supervisor station. So three stations in total that are part of that PICS network that we mentioned.

Each of those stations has three screens on it. One of those three screens is designated specifically as an alarm response screen, such that that screen cannot be used for manipulating components and equipment in the facility. And if an alarm comes in, then that -- that screen will be designated to show the alarm page.

So it -- the alarm page and currently activated alarms will always be available to the operator who is performing equipment manipulations at the operator stations.

MEMBER BROWN: So that is continuously -- that was continuously open, the alarm screen.

MR. RUETZ: The alarm screen is not

continuously open. However, it -- it automatically goes to the alarm screen if an alarm comes in, such that you can't perform a process using the PICS on that screen. You have to use one of the other monitors to start an automated sequence, for instance.

Then, if an alarm comes in, that third screen, which can be used for just monitoring purposes only, will automatically populate with the alarm page to bring that to the attention of the operators.

MEMBER BROWN: Okay. Let me -- let me track back to the screen popping up. You've got, I understand, three screens like you say. So if an operator is controlling something and he is utilizing one of the screens, would that screen all of a sudden start populating with alarms and the rest of it disappear and he'd have to shift screens in order to complete his operations? Or has that even been considered?

MR. RUETZ: No. No. So the screens that are used for equipment manipulation are the other two screens, so not the alarm designated screen.

MEMBER BROWN: Okay.

MR. RUETZ: So the alarm designated screen is -- can only be used for monitoring purposes and then it will automatically switch to the alarm page if

an alarm comes in.

MEMBER BROWN: Okay. But the -- but the process information -- temperatures, pressures, whatever you need, nuclear indications, what have you -- they would not be blanked out if this thing starts -- you know, it's a monitoring screen. They would not be blanked out, and you'd have to look at something else, or would they be on some other screen already anyway?

MR. RUETZ: They would be on the other screen already anyway. The way that the screens will be set up is that they sort of drill down to lower level systems and components as you click through them, such that when you get to the screen that allows you to start a process or manipulate equipment you have the relevant information needed, the process parameters that you are talking about.

MEMBER BROWN: Okay. And the other question I wanted to ask -- several, rather -- are the -- take an operation you're starting up. What -- you know, you're going to start up the entire process for getting your moly-99. Do you -- how many screens do you have to access while you're doing a startup and going through the entire operation? Do you -- is that for normal ops startup, shutdown? Do you have to

switch screens in order to do that? Or can you accomplish -- can the operator accomplish that from one screen?

MR. RUETZ: So the operators will be able to see all of the necessary information to perform a startup from a single operator station. So between the three screens --

MEMBER BROWN: Okay.

MR. RUETZ: -- they are able to see everything they need to to essentially operate the facility.

MEMBER BROWN: But if the alarm screen came up, they wouldn't lose something. Is that -- that's what I was trying to get at. If they're doing the startup, they're using all three screens, and now these alarms come in, if they were using that screen, do they lose something and have to look somewhere else? That's -- it's a matter of taking your attention off of one thing and looking at something else.

MR. RUETZ: Yeah. I see your point and your comment. So the three screens that are available for the operators, they can switch between them, you know, at will and as necessary for the procedure that's being performed. So, you know, they may be --

to your point, they may be using that third monitor that's designated for alarm response to monitor components and equipment, and then that may temporarily switch to the alarm screen.

However, the operator can navigate back to that -- those indications as needed or switch one of the other two screens to those indications as needed.

MS. KOLB: This is Catherine Kolb. Perhaps it would help if -- so some of the times involved are proprietary, but in general starting up the facility isn't, you know, a five-minute evolution. It is --

MEMBER BROWN: I got that.

MS. KOLB: -- step-wise in accordance -- in accordance with procedures, such that the, you know, the step that the operator is on, they could set up the screens that they are using to show all of the parameters required for that step.

And then when a new step comes, you know, maybe the difference between billing the TSD versus, you know, starting the transfer for moly production, that is -- that is separated in time significantly, such that there would be ample time to set up your new set of screens, so that you could see all of the parameters you needed for that next evolution.

So that, you know, being able to see everything all at once isn't really necessary.

MEMBER BROWN: I'm sorry to beat this thing to death, but because of the number of systems you have -- I guess I faced this in the naval program as well when we were developing it -- our main control stations.

One of the things we worried about -- and I guess one of the things that fell out of the old TMI evaluation -- that so many alarms were going off in many cases that operators got distracted from what was a critical alarm and what was just a nuisance alarm, like an elevator failed or a door didn't open or something like that.

And I'm not saying you're going to have those types of alarms on these screens. That's not the point. It was just the nature of the operations. It's a complex operation you all are dealing with, and that's why I was -- I was asking these questions relative to that, relative to getting the operators distracted, from seeing something that all of a sudden became a critical problem.

So we don't need to go into proprietary stuff. That's just all I was trying to get a feel for. Let me --

MS. KOLB: So I think we had -- we attempted to address some of those concerns with the alarm prioritization, such that it will be clear which alarms require, you know, immediate attention.

And not to mitigate things, but, you know, the operator -- you know, the procedures would say to, you know, verify that the safety actuation -- that all of the components did arrive at their safe state, you know, for confirming that things reacted appropriately per the design.

And so those would have higher priority if there was an actual issue in the plant versus the yellow or the blue alarms and the ones that don't cause the stack lights to illuminate, such that the people will be trained on which -- which alarms are more important than others.

MEMBER BROWN: Okay. The other thing you said -- and I'm referring back to Section 7.1 as a matter of fact of the FSAR -- you mentioned multiple digital display space as well as what I call display screens. Are those discrete meter -- I don't know if -- meter style? Or are they just seven segment LEDs that spin up and down as something changes rapidly?

MR. RUETZ: So typically speaking, I think everything you're referring to on Figure 7.1, those

are just, you know, typical computer monitors that relay the information to the operators.

MEMBER BROWN: But let me find the thing I'm -- make sure I said this correctly to you. If I can get the right paragraph here.

MS. KOLB: We refer to the computer monitors that are in the front of the room as static display screens, but those are just a series of computer monitors. To distinguish them from the ones that are at the desk where the people are sitting, I think those are -- you know, could be control display screens. They are -- they are both just digital displays.

MEMBER BROWN: Okay. I mean, a typical example, like you've got to take your temperature. It's a digital display. You've got -- numbers come up. That's what you're talking about relative to a digital display.

MS. KOLB: Correct.

MEMBER BROWN: Okay. It's not like a meter in the old days, an analog meter that had a needle and it went from -- you know, from the lower left to -- around to the lower right.

MS. KOLB: No. We don't have any of those incorporated into the PICS.

MEMBER BROWN: Okay. That's fine. Now, would a single screen have more than one of these digital displays? I take it they are not discrete? These are digital displays of data that would be reflected on a single screen, not separate little digital displays themselves?

MS. KOLB: Correct.

MEMBER BROWN: Okay. All right. I might be almost finished and you'll be as happy as I am.

DR. BLEY: Charlie, can I --

MEMBER BROWN: Yeah.

DR. BLEY: -- jump in with something? I think what Charlie is getting at is on a needle display you can see what the reading is as it changes on a set of numbers, kind of digital display. They are spinning fast, and you might not be able to tell where they are. But people have implemented something akin to a meter in software, so you can follow the trend.

I think he is asking if you can see what an instrument reads if it's moving quickly.

MEMBER BROWN: Yeah. Let me -- thank you, Dennis. I didn't phrase it that way, so I'll be specific. In 1978, when we started developing these systems for the naval nuclear control stations

program, all the meters you used out with the operators were KX241 meter -- you know, analog meters.

When we started doing everything, all the vendors we went to, they were -- they loved designing displays. I mean, and everybody that came up wanted to design displays for their equipment that they got a contract for.

I ended up canceling contracts on five different -- portions of five different contracts because it would have been too expensive to live with so many multiple types of displays and how they work. So we stopped it and developed a standard digital meter that looked exactly like a KX241 meter, an old analog meter. It had flying dots around the outside and a large seven-segment readout in the middle.

So for the fast displays, you had something moving -- you know, either going up the meter or down the meter, so you could tell even if you couldn't read the specific value of the parameter that you were -- you were interested in.

Now I'm not saying you need something like that. I think what -- I mean, you could -- you could duplicate something like that on a -- on a screen, on a flight screen if you want to. That can be done. I'm just -- I was asking it in that context, and I

think Dennis knows I use more words than I normally need to get to the point. So that helped me out.

That's what I was asking about, what these types of digital displays are.

MR. RUETZ: Yeah. So I can appreciate your common background. I was a former reactor operator on a submarine as well. So I know exactly what standard digital meters you're talking about. So as far as -- as far as that goes, any parameter that is displayed on the PICS board for the operators can be clicked on. And if you click on it, it will have a type of bar graph histograph of the, you know, direction and trend that that parameter is going on.

MEMBER BROWN: Okay. All right. That's good. That answers my -- that's good enough.

The next question I did have was -- if I can count my paragraphs here -- they are -- in this early section also, it talked about the supervisor workstation is located at the rear of the facility control room and acts as an extension of the operator workstations.

The workstation is equipped with equipment display screens that allow the supervisor to monitor system status but not control facility components. So that -- so does the supervisor not have backup

capability? Or is he just somebody that sits there? That's what I got out of that paragraph.

MR. RUETZ: He is the boss. He is the engineering officer of the watch.

MS. KOLB: We're wondering if perhaps you have an older revision of the -- of 7.6 -- or looking for --

MEMBER BROWN: Rev 2 is what I'm looking at. It's Rev 2. I thought I incorporated -- I spent half a day incorporating the proposed changes and strikeouts. I've got Rev 2. That's the only copy I've got.

MR. RUETZ: Yeah. So the supervisor workstation is essentially identical to those operator workstations. The part you might be focusing on is the fact that the supervisor station does not have the neutron driver console capabilities.

MEMBER BROWN: I don't -- that detail I don't have. It just said the supervisor can monitor system status but not control facility components. So he can't shut something down if he thinks it's out of control and somebody missed it. That one sentence, that's all I was talking about.

MS. KOLB: This is Catherine Kolb. We did find that sentence there. We will have to go back and

look at that. But the current design of the PICS system is that the supervisor station is identical to the operator stations.

We discussed that if maintenance needed to be performed on one of the regulator operator stations, you know, switching out monitors or such, it was unusable, that's -- the supervisor could use the backup. I think the intent of that was that the supervisor wouldn't normally be responsible for controlling equipment, but we can -- we can look at our wording there and make sure that's consistent.

MEMBER BROWN: It's just my concern, after, you know, 35 years of -- a number of crew quizzes, trials, qualification tests, watching operators on shifts, submarines, and aircraft carriers, the engineering officer of the watch, or the propulsion night watch officer on the carriers, while they weren't the main operators, if they thought their guys were screwing up somewhere, they could do something.

And I'm not advocating -- it's not the same. The spaces are much smaller, much more compact. This is -- and there's other people throughout the plant in those plants to do things. It's just having the supervisor, who supposedly really knows what's

going on, if he sees something, can he shut the stuff down, can he scram the plant. That's the thought process.

I just --

MS. KOLB: No.

MEMBER BROWN: I would just -- that's what that sentence implied to me, and it seemed to me that that station ought to be as capable as the operator workstations. He may not do anything because he shouldn't be. He should be supervising. But that's -- that was my thought process.

MS. KOLB: No. We appreciate the comments. The intent is that the supervisor station is the same as the operator stations.

MEMBER BROWN: Okay. Well, I'm sorry to have slowed -- slowed everything down here. I didn't know whether to address this when we got to the PICS discussions, but it -- once we got into this thing and I was listening, it seems like this was as good a place as any to at least get something on the record in the transcript. I'll never remember all the answers.

But I think you answered my question satisfactorily, and I appreciate your taking the time to do that.

Dennis, did you think I missed anything? I mean, you have a lot of operator experience yourself. You understand what I was looking for I think.

DR. BLEY: Yeah, I did. And I've seen the commercial plants when they went digital run into some problems like that that you couldn't quite tell what was going on. And then they started getting the operators involved in the design of those systems.

And the only one that kind of comes to mind here is if there are multiple stations that all do the same things, command and control could get lost somewhere, people start expecting the Joe on the other panel is going to do something, and then somebody else comes in on shift because Joe is sick, and you end up having things happen in the plant that you weren't expecting.

So there is a possibility of loss of control, I would think, but you'll have to work out the procedures for how those crews interact.

MR. RUETZ: Something I would like to volunteer that I think will alleviate some of your concerns here is the fact that those local stations that we mentioned previously outside of the control room, those stations normally can only have monitoring

capabilities. It's not until they typically check out the system from the control room, such that a prompt appears in the control room on those workstations that such-and-such a person is trying to check out a system to perform local operations. And the control room has to grant permission to that local station before any control capabilities are allowed.

MEMBER BIER: So this is Vicki Bier. What you just said taps into a question which I was going to ask, which is, what happens in the event that there is not necessarily anything going wrong in the plant, but there is a computer malfunction in the control room? And, you know, that could be because of cyber hacking. It could be just because of a hardware failure, something didn't boot properly, whatever.

So a two-part question. One, you know, does control automatically revert to the local stations in that circumstance? Or does the fact that the computer is down make it impossible to grant local control?

MEMBER BROWN: Let me --

MS. KOLB: This is Catherine Kolb. I guess it would depend on the failure, but, you know, if the failure was such that the PICS, you know, server or the entire network was down, then none of

the PICS systems would function.

MEMBER BROWN: Vicki, can I amplify?

MEMBER BIER: Please.

MEMBER BROWN: Okay. How many times did you get on your computer and you move your mouse and the pointer doesn't move? That's -- that's my biggest concern when people say we're controlling with mouse and keypads.

On the control systems that we did for the Navy, for multiple systems in the plant, we always have positive switch actuations for on/off, stop/start, what were the critical things you needed to do, increase frequency, what -- it was not -- not done with a touchscreen, not done with a mouse, and not done with a keyboard.

I only throw that out in that, you know, this is a critical facility, subcritical facility. You're irradiating things. And you've got a number of very critical systems that deal with some pretty hazardous materials.

And the last thing you want is an operator trying to control a system, and all of a sudden -- this is stuff you're designing now with stuff that's out in the world. You're going to get stations, and you're using a mouse, and all of a sudden the sucker

locks up. Forget the hacking. They will just do it for no reason at all.

And it happens -- like when we're on Teams and all of a sudden nobody knows I'm here because Teams disappeared for me. Okay? So you've got to be plugged back in.

So I'm just -- I am always very, very leery. You're going to do what you want to do. I just think for critical controls functions you might want to rethink, are there places where we want positive switch operation to start, stop, change certain critical operations that we're doing.

So I'd just put that on the table to let you know somebody is thinking about that from that standpoint.

MS. KOLB: No. I -- this is Catherine Kolb. I appreciate and understand your concern. A little commentary there. The safety actuations are pushbuttons. They are located on the main control board, so those are independent of the PICS software. So if it was necessary to shut down a unit, those are -- those are physical buttons and switches that are not related to the PICS that we do have.

And as for the reliability, it is -- it is the distributed digital control system, but it is --

it is an industrial one that is used in other industrial facilities. And while it obviously can't fail, it is not safety-related, and it is not required to operate. But we've used, you know, reputable equipment in our -- in our design.

MEMBER BROWN: Yeah. I kind of gathered that, because I could see that at least for the TRPS and the ESFAS stuff we were looking at when you looked at the logic diagram and the words, there were literally on/off signals coming in via the hardware module and then over to the communication in order to do stuff.

But that is a system that is not a control system. You know, that's just the -- those two specifics. And I was thinking all of the other process systems as well. And if you -- if you're saying that you're using pushbuttons for -- I just -- it's just I would encourage looking at all of those processes. You would be able to turn it on and off.

Or if there's a critical thing as you're ramping something, or doing whatever else, there were certain things that would be better to be done with what I would call more hand-eye coordination, mechanical, more like the potentiometer-type operation.

I don't know how you would -- you know, in an old-time radio, which nobody even knows about anymore. I don't know why I said that.

DR. BLEY: Some of us do, Charlie.

MEMBER BROWN: Yeah.

DR. BLEY: But I'd mention something here. They've got the manual control -- direct manual control with the pushbutton switches on --

MEMBER BROWN: Yes.

DR. BLEY: -- key things. Now, a ship on the surface of the ocean and a submarine below the ocean, losing process control is a really, really bad thing. I think here, with the ability to shut down, shutting down is perfectly okay, and you don't put yourself in hazard because you tripped at all. But it's a little different.

MEMBER BROWN: No, I agree. It's -- they've got lots of processes, and the TRPS and the ESFAS shut stuff down. And you have -- as long as you can do those things manually as well, with a pushbutton, not with a mouse, I think they are going to be in fairly decent shape. But just -- this is a very complex setup, and so that's why I was asking the question.

There's other conversation in the

background. I don't know who it is, but it's coming through on my computer.

Anyway, that's -- I have exhausted my questions. So thank you very much.

MEMBER BIER: Okay. So getting back to my question, if there is a failure of a computer, is the expectation that everything would just be shut down or the control would revert to a local station?

MR. RUETZ: So, again, like Catherine mentioned, it would probably depend on the specific failure. So I will volunteer that the control room does have the ability to revoke those privileges that were previously granted to those local stations, such that -- it's always an issue with a local station or an operator at a local station. The control room could take back over control, so to speak.

MS. KOLB: Yes. And then to your question of --

MEMBER BIER: Yeah.

MS. KOLB: -- if the control room went dark and all of the screens went blank in some situation, so we would have procedures in place for what to do in that sense -- I don't have them in front of me, but my expectation would be that they would shut down the units because the operators wouldn't

have any indication of what was going on.

MEMBER BIER: Got it. And are there also access to physical instruments at the local station so that there is monitoring of physical properties that doesn't have to go through the computer?

MS. KOLB: Yes. There are some parameters in the fields that are -- that don't have to go through the PICS, like especially in some of the utility systems. There are parameters that aren't -- that you can walk up to locally.

MEMBER BIER: Yeah. Okay. Are there other questions for SHINE now? Because I also have a couple of questions for Jesse, but we've kind of gotten off track here.

MEMBER BROWN: I'm sorry. I'm --

MEMBER BIER: Well, that's okay. It's part of the job.

MEMBER BROWN: I'm sorry about that, Vicki.

MEMBER BIER: Okay. In that case, I'll offer my questions for Jesse. And if you want to postpone them or whatever, that's fine, too.

One, you said several times that SHINE is implementing what you called a limited human factors program. Can you talk about what some of the features

would be in a more elaborate program for a plant that was counting on human action as part of the licensing basis?

MR. SEYMOUR: Yes. Absolutely. And, again, this is Jesse Seymour. So typically what we would see -- and this is what would come into play if we were looking at a plant that was covered by, you know, 50.34 Foxtrot 2II, which requires the state of the art of human factors engineering to be applied -- we would see the application of NUREG, you know, 0711, right? So our human factors engineering guideline.

And what that would do is it would implement a process-based approach that consists of, you know, 12 individual steps, and that really -- it takes you through this full systems engineering-based design model where you -- you start with operating experience, task analysis, you know, functional requirements analysis, function and allocation, and you move through to the design of a human system interface.

And then from that step -- and, again, this takes into consideration factors like staffing, you know, training qualifications, and so forth.

And then once you've designed the human system interface, you move back through, you know,

sequentially verification and implementation work that culminates in integrated system validation. So typically, you know, you will put everything together and in a, you know, full scope simulator type of environment. You'll actually go through -- you know, put crews in there and make sure that things work, and then, you know, but there actually will be performance-based testing that does that.

So, again, for, you know, a facility that is obligated to apply the state of the art, that's what we -- we currently see as being the state of the art.

MEMBER BIER: Thanks. One other question. Oh, I guess two other parts. It sounds like from your description earlier that you have evaluated SHINE's human factors program, not the actual ergonomics engineering of specific displays.

So that if they implement their program properly, you have confidence that the displays will be reasonable and adequate, but that you haven't evaluated them specifically. Is that correct?

MR. SEYMOUR: That is correct. So in terms of, you know, doing a physical verification, that is not something that, you know, we have been able to do at this point.

MEMBER BIER: Right.

MR. SEYMOUR: What we have done is we have looked at, you know, the program and the process and the guidelines that are used. And provided that those guidelines are applied at the design and, you know, verify that the installation -- and that discrepancies are tracked, you know, that provides something that is akin to a design implementation and verification type of process that we would have seen with a more -- you know, a more developed human factors engineering program.

MEMBER BIER: Okay. And last question for you before at least I let you move on. You mentioned that you described the results of a quote/unquote "audit." And is that adequately captured in the SER, or is there a separate audit report that we should be trying to look at?

MR. SEYMOUR: So there is a separate audit report. And important thing to note is that there is a portion of the audit report that is proprietary, so there's a proprietary --

MEMBER BIER: Got it.

MR. SEYMOUR: -- attachment. And so we do -- we do touch upon, you know, a fair amount of that material, you know, within the SE, pointing to it.

But I would -- you know, what I would say is that if you really want to get into the details of what we looked at kind of on a criteria-by-criteria and a -- you know, what standards were being used specifically --

MEMBER BIER: Yep.

MR. SEYMOUR: -- you know, within their HFE design guidelines, we'll really have to give you a proprietary copy of that audit report, so that you can see the fine detail. And that will get into even discussing, you know, the individual accident analysis sequences that we, you know, verified going through this. So --

MEMBER BIER: Okay. Thank you.

MR. SEYMOUR: Yep.

MR. BALAZIK: This is Mike Balazik, NRC Project Manager for SHINE. I will send over the proprietary version to Chris Brown after this meeting.

MEMBER BIER: Super. Thank you.

MEMBER BROWN: Can I make one other observation, Vicki?

MEMBER BIER: Yeah.

MEMBER BROWN: Yeah. This is -- I just -- and I didn't think about this when SHINE went through their stuff. I wanted to give them some credit. I

like their categories of alarms where they show, you know, red light, yellow light, blue, and then kind of an information-type thing. So that's a good way to categorize stuff so as not to distract the operators. I mean, we did something similar relative to warnings as opposed to alarms in the program I worked in and Dennis observed on his ship.

The thing I would think about when you're doing that is don't have them show up in the same part of screens. There are -- all of the alarms ought to show up on the left, the mediums on the middle, and the -- you know, that's where I'm -- don't mix and match them in the same space, so that they don't get confused -- red, yellow, and blue.

So it's just a matter of how you lay out the screens. That's all. But it's a good idea to have a categorization, so you don't distract people with stuff that they can ignore for a while. That was just an observation. I wanted to give you credit. After beating you up, I thought I'd give you some credit for some good stuff.

MR. SEYMOUR: Okay.

MR. RUETZ: So I appreciate the credit, so thanks for that. One thing I will add to your comment is that one of the advantages of using this digital

interface that we have, as opposed to more analog-type alarms, is that our alarms are easily sortable, so we can sort by priority level, if necessary, or we can sort by time that the alarm has actuated. So those are different methods operators can use to diagnose the event that's in progress.

MEMBER BROWN: Got it. It certainly gives you capability. I agree with that. But many times the red light comes on and requires immediate action. You can't worry about sorting. You've got to go do something.

Okay. Thanks a lot. I appreciate it. Just wanted to say I wasn't trying to beat people up.

MR. SEYMOUR: Okay. Mike, could we move on to the next slide, please?

Okay. So in the next part of our technical evaluation we considered whether SHINE's administrative controls were adequately supported by their programmatic measures for the management of procedures.

We noted that specific administrative controls are incorporated into SHINE's procedures for implementation by facility staff. They noted that these procedures undergo review by management and are subject to provisions to ensure that they are

technically accurate.

We also noted that procedures undergo verification and validation prior to use by operators. We found that the combination of processes used for the preparation, use, and management control of written procedures, the methods used for verifying and validating procedures before use, and the methods used for ensuring that current procedures are available to the facility personnel collectively supports the ability of SHINE operators to reliably implement administrative controls.

Next slide, please?

Finally, we considered whether SHINE's administrative controls were adequately supported by the programmatic measures for the training and qualification of operators. In reviewing this area, we noted that the licensed operator training programs include topics on both criticality control and management measures.

Additionally, we further noted that the training program is based upon a systems approach to training. Based upon this, we found that the combination of provisions for the initial training of personnel, personnel qualifications, and the retraining of personnel, supports the ability of SHINE

operators to reliably implement administrative controls.

Next slide, please?

Based upon our review, we made the conclusions that are summarized here on this slide. First, we concluded that the human factors engineering-related aspects and programmatic considerations for the SHINE facility meet the human factors engineering-related aspects of Criterion 6, because within the specific context of the operator role and safety at the SHINE facility operators will reasonably be able to take actions to control the facility, be provided with controls designed to support safe actions, have sufficient knowledge about the status of the facility, be able to make decisions about the appropriate course of action given a particular operating circumstance, and be provided with the indications, displays, alarms, and controls that are designed to reflect their cognitive needs.

Second, we concluded that the human factors engineering design aspects of the SHINE facility control console and display instruments are acceptable because all nuclear and process parameters important to safe and effective operation of the SHINE facility will be displayed at the control console.

The display devices for these parameters are easily understood and readily observable by an operator positioned at the facility controls. The controls are readily accessible, and the enunciator and alarm panels on the control console provide assurance of the operability of systems important to safe facility operation.

Furthermore, within the specific context of the operator role and safety of the SHINE facility, we concluded that the human system interface supports the manual initiation of protective actions for safety systems and provides displays and controls for manual actuation of safety functions and for monitoring those parameters that support them.

Finally, we concluded that the programs for procedures management and training and qualification are acceptable within the context of the operator role at SHINE for safety of the facility, because they reasonably support the ability of SHINE operators to reliably implement administrative controls at the facility.

So this concludes the prepared part of my presentation. I'd now like to ask if there is any additional questions from the committee.

MEMBER BIER: One additional question for

SHINE. Which vendor is doing your control designs?

MR. RUETZ: So RoviSys is the vendor that is doing our PICS design.

CHAIRMAN BALLINGER: Did we lose Vicki?

MEMBER BIER: I'm here. I have some audio problems.

CHAIRMAN BALLINGER: Yeah. There's some weird background stuff going on from somebody.

MEMBER BROWN: She's getting -- you're getting it also. We're getting a lot of feedback.

MR. BALAZIK: Yeah. This is Mike Balazik, NRC Project Manager. I think the feedback is coming from the SHINE leaving their mic open. We're getting an echo, and there also -- there is some sort of static that seems to be coming from SHINE.

CHAIRMAN BALLINGER: Well, the static just stopped. Well, I guess not.

MR. BARTELME: So is it -- so is it whenever SHINE is speaking or --

MR. BALAZIK: Yeah. Jeff, this is Mike. It's almost constant when SHINE gets on. There's a lot of static coming over.

DR. BLEY: And it's loud enough -- I'm not sure if Vicki heard the answer to her question, but I couldn't hear it through the static.

MEMBER HALNON: I think SHINE needs to log off and log back in.

MEMBER BIER: I was able to hear the answer, Dennis. They said the contractor for the PICS system is NoviSys.

DR. BLEY: Good.

MEMBER REMPE: It does seem to be better now. So perhaps it's cleared up.

MR. BALAZIK: Well, Dr. Rempe, they're not on -- they're not -- they're on mute right now.

MEMBER REMPE: Oh. That's why the static --

MR. BALAZIK: I guess that's why it improved.

CHAIRMAN BALLINGER: Okay.

MR. BALAZIK: Jeff, do you want -- go ahead, Professor. Sorry.

CHAIRMAN BALLINGER: No, no. What's up?

MR. BALAZIK: No. I was going to ask SHINE to see if they could unmute to see if the static is still there. They might be trying to rejoin the meeting because now I don't see them on.

CHAIRMAN BALLINGER: Well, that's -- they might be trying to fix it, but in any -- in any case, as I mentioned this morning, I have probably condemned

myself to not being able to move faster when I said we were moving faster.

And so we now have a question to answer, and that is the next two presentations relate to the conduct of operations. And I'm hesitant to want to separate those two because I'm guessing that based on the questions and answers from the human factors part, I'm thinking that there is going to be a fair amount of crosstalk between those two. And so I'm not sure that it's a good idea to start the first presentation at 20 minutes 'til the hour and this go over and then have lunch.

So I'm proposing that we recess now until 1:00, so that we can have those two sessions back to back. So are there any objections to that from members or the staff or SHINE?

MR. BALAZIK: This is Mike Balazik, NRC staff. No objections.

MEMBER BROWN: Do it. Do it, Ron.

CHAIRMAN BALLINGER: Okay.

MEMBER BROWN: This is Charlie.

MR. BARTELME: No objections from SHINE either. We were able to hop back on on Catherine's account. Were those last questions -- are there any follow-ups or were the members able to hear SHINE's

response?

MR. BALAZIK: Yes. This is Mike Balazik. Can you just repeat the vendor for PICS one more time?

MS. KOLB: Yes. This is Catherine Kolb. So the vendor is RoviSys with an R. And that is a system integrator. The platform, the architecture, is an Allen-Bradley System.

MEMBER BROWN: By the way, your static and your reverberation has now gone away.

MS. KOLB: Excellent. We will use this computer going forward.

CHAIRMAN BALLINGER: I thought we might have had an electromagnetic block all of a sudden, or a pulse.

Okay. So we will now, assuming there are no other questions or comments from members, consultants, or others, we will recess until 1:00 Eastern.

(Whereupon, the above-entitled matter went off the record at 12:41 p.m. and resumed at 1:00 p.m.)

CHAIRMAN BALLINGER: Okay. It's 1:00 p.m. We will now go back in session.

And the first presentation is from the SHINE folks on the conduct of operations. So I can see the slides. So let's proceed.

MS. KOLB: Thank you. This is Catherine Kolb. I'm the Senior Director of Plant Operations for SHINE. And I will be discussing conduct of operations this afternoon.

So, in this presentation, we are going to cover the topics of Chapter 12 that are, have not already been covered in other ACRS presentations. So that includes the organization, the review and audit activities, procedures, required actions and reports, and records.

So, starting with organization, this is a depiction of the normal organization chart for SHINE. This is not all the people that work for SHINE. This is a subset of those who are most directly involved in the operation of the facility. And I wanted to show this just to depict that, the wide range of people that are involved in making our facility run.

The next slide is the organization chart that is found in Chapter 12 and in our technical specifications. This describes the levels of the operations organization as defined in ANSI/ANS 15.1.

So we have the CEO and the diagnostics general manager comprising our Level 1 management. Level 2 is director of plant operations and the operations manager.

Level 3 is the shift supervisor. So that is a senior licensed operator. And that person will be the most senior person at the facility, physically at the facility at any given time. That is not a single person. That is more of a role. So there will be a shift supervisor at the facility at all times. For example, we currently have four of them slated for that role. And they will rotate in that four-shift crew that we discussed previously.

The rest of the operators are comprising Level 4. So those are other senior licensed operators, licensed operators, and field operators, which is what we are calling our non-licensed operations individuals.

The philosophy for running the facility is that there will be one shift supervisor there at any given time. The licensed operators will be in the control room. And the non-licensed operators, field operators, or suitable technicians, those people will perform duties at the direction of licensed operators and under their cognizance.

The other organizations depicted on this slide are the review and audit committee, which we'll discuss in a little more detail in a couple of slides, and the radiation safety function, which is filled by

the radiation protection manager, who was shown on the previous slide, and the radiation protection staff that work for the radiation protection manager.

Are there any questions on our organizational structure?

MEMBER SUNSERI: Catherine, this is Matt Sunseri. Do you have the quality assurance manager or director or something equivalent, and is that under the review and audit function? And if it will be discussed later, I can wait.

MS. KOLB: We do have quality assurance personnel. I did not show those on the normal org chart. They report to the Vice President of Regulatory Affairs and Quality. And there is a quality assurance manager that reports to that person and quality assurance staff. So that's -- you know, it's not shown, but it is part of our facility.

MEMBER SUNSERI: And do they have a dotted line to the Chief Executive Officer or something direct, some kind of direct access if they have to report there?

MS. KOLB: Yes, that, the org chart showing that relationship is in our quality assurance program description document.

MEMBER SUNSERI: Okay. Thank you.

MS. KOLB: All right. The next slide shows the minimum staffing. So this slide presents both the technical specification required individuals. Those would be the first three. And I presented it this way to show that we have other documents that drive us to have additional people at the facility in addition to the technical specification required roles.

So the shift supervisor, who I mentioned earlier, would be a senior licensed operator. And they are filling that role required in our technical specifications for having a senior licensed operators present at the facility or readily on call. They also fill the role of the emergency director described by the emergency plan, which we presented in a previous ACRS meeting.

We'll have at least one accelerator operator, who is a licensed operator. They could also be a senior licensed operator per the technical specifications. But either a licensed operator or a second senior licensed operator must always be present in the control room.

And in addition to that, we have an additional designated person. We expect that to be filled by either a non-licensed or an additional

licensed individual. But it could be anyone who is designated for that role and that fulfills our technical specification requirements.

In addition to the technical specifications staffing, the emergency plan drives us to have an additional person. That's individual number two, which we expect to be filled by a non-licensed operator as an additional accelerator operator or other designated individual to fill the role of emergency communicator, which we discussed in a previous ACRS meeting.

The emergency plan also drives us to have some individual with radiation protection experience. We expect that to be normally be filled by a member of the radiation protection staff. But it could be anyone who is trained and qualified for that role to be able to fill that radiation safety coordinator role identified in the E plan.

And then finally, we can't get into any details here, but we do have a physical security plan that prescribes requirements for security personnel.

So this slide is depicting the minimum staff that we would expect at any given time at the facility.

DR. BLEY: I'd like to ask you, this is

Dennis Bley, a question about authority. Who out of this cast of characters, including security, can direct the SRO to carry out specific operations in the plant?

MS. KOLB: The shift supervisor, who is a senior licensed operator.

DR. BLEY: Who can direct him to carry out, or her to carry out specific actions in the plant?

MS. KOLB: So they report to the operations manager.

DR. BLEY: Will the operations manager be licensed?

MS. KOLB: The operations manager will not be licensed.

DR. BLEY: But the operations manager can direct actions in the plant?

MS. KOLB: No. Everyone has a supervisor in our organization structure, but the shift supervisor is the senior licensed individual.

DR. BLEY: Okay. And that individual can't be overruled by other people in the organization.

MS. KOLB: No, not in terms of actions that affect the technical specifications or the

operations of the facility.

DR. BLEY: I like that. Go ahead.

MS. KOLB: Were there any other questions about the minimum staffing for the facility?

All right. Moving on, this slide covers topics that are not in Chapter 12 but are topics that frequently come up when we discuss conduct of operations at a high level. So I just wanted to highlight a couple of topics that we do consider in that area.

So we have at SHINE a safety culture program, which emphasizes a commitment of safety over other competing goals and includes promoting a safety conscious work environment where people are encouraged to raise safety concerns, free to raise concerns without fear of retaliation.

We've defined in our internal programs a concept of operational authority, including who can manipulate controls, who can be present in the control area, which we've defined as the control room, and how to transfer operational authority between shifts during turnover. This ensures configuration control and awareness of the operations staff.

(Audio interference) look at conduct and professionalism for our operating staff. That

includes provisions for performance monitoring, guidance on assignment of duties in order to ensure the facility is safely and effectively operated.

We discussed training this morning. But that's -- and here is a bullet, because I wanted to reinforce the idea that training is not just the job of the training department. The operating staff owns their own training and participates with the training department to ensure people are qualified and able to do their jobs.

And then finally, procedures is discussed in a little more detail later. But procedures are just words. And without a commitment on how we're going to follow them, it doesn't mean much.

So our internal programs emphasize that procedure adherence is expected, that procedures will be complied with as written, with processes for what to do if a procedure cannot be executed as written.

And then operator aids aren't substitutes for poor procedures. But we do have provisions on how we will use and control them to ensure they're accurate and not detrimental to the staff.

DR. BLEY: Will the senior licensed people in the plant have a path through which they can deviate from a procedure if they believe it's

necessary for safety?

MS. KOLB: Yes, we have described that in our documents for procedure preparation and use on how to complete deviations and what is required in that process.

DR. BLEY: Okay. They don't need approval by more senior people outside of the plant?

MS. KOLB: No.

DR. BLEY: I know they'll have to defend themselves.

MS. KOLB: No, I believe we have, you know, rules for notifying and correcting the procedures after the fact. But, no, they will be able to deviate if necessary in accordance with our processes.

DR. BLEY: Thanks for that clarification.

MEMBER BIER: Yeah, I just wanted to emphasize that that's important, because, in fact, in many cases, verbatim compliance with written procedures can actually be used as a stop work mechanism. So it may not always be possible to follow the procedures as written.

MS. KOLB: Thank you for that. Yeah, we do have that, those provisions. But in absence of other direction, we do expect our staff to follow

procedures as written, but understand the concern there.

Moving on to the next slide, so we have established at SHINE a review and audit committee that is described in Chapter 12 and in our technical specifications. It defines the minimum membership.

The chair is the diagnostics general manager, one of our Level 1 individuals or designee. And then the membership of the committee includes people with experience in engineering, operations, and radiation protection.

The charter includes provisions where we can use non-SHINE employees, especially when the required expertise is not available from SHINE employees.

And it's a requirement that facility operations personnel, which would be people reporting up through the director of plant operations, which from the original org chart includes the operations department, the maintenance department, and the chemistry department, those people cannot constitute a majority on the review and audit committee.

MEMBER HALNON: So this is Greg. Given the facility's makeup of chemicals, why wouldn't that chemistry manager not be a required minimum

membership?

MS. KOLB: The engineering and the operations individuals are expected to have experience in our facility, which, as you mentioned, is, has the radioisotope production facility portion.

The chemistry manager is important. But they are mostly in charge of the lab reporting, specifically for doing testing and other required things, both technical specifications and for our product. But we believe that the engineering and the operations experience should encompass that.

MEMBER HALNON: Okay. I guess we'll agree to disagree. I think that the chemistry manager is integral to the facility such as this, being the unique nature of it. But I understand where you're coming from.

MS. KOLB: I mean, there are provisions in our charter for including people with expertise, especially if we were doing an audit of some area that had particular chemistry expertise that was required of being able to assign people to that. They would be able to perform that function and not be limited to just these three people.

DR. BLEY: Let me push a little bit on this if I can. I'm Dennis, again.

One of the things this committee might be reviewing is a change to the facility, come in, cut some parts out, put some new things in. Not having a chemical process engineer -- I mean, I'm sure you had them during the design of this system. And we've talked about that a long time ago. Not having a chemical process engineer to confirm that the changes aren't going to lead to some kind unexpected problem seems I would say shortsighted.

We've seen lots of incidents in nuclear plants and other facilities where changes to the system have led later to problems because the people involved in the change didn't fully understand the functions that could lead it into problem areas. So I guess I'll be like Greg and agree to disagree.

MS. RADEL: This is Tracy. I want to clarify, you know, the engineering team members is where the chemical process engineers would be. You know, the chemistry department is checking and verifying, you know, the parameters of the different streams, whether it be target solution or waste streams.

But as far as system design or changes to design or how you operate the equipment, engineering, including chemical process engineers, would be

involved in reviewing that and ensuring that it's appropriately considered in the system design, as well as the safety analysis.

DR. BLEY: That's what I was looking to hear. So they, the chemical process guys, folks show up under engineering and would participate depending on what kind of review you're doing.

MS. RADEL: Correct.

MS. KOLB: That is correct. And the -- this is Catherine. And the -- this is just the review and audit committee requirements here. SHINE has processes for preparing and reviewing and approving individual engineering documents in addition to this.

So we're viewing this as a check of, you know, other things. This isn't the only review of documents that come before them. There are other processes we have in place.

DR. BLEY: Okay. But this is a review, and sometimes those kinds of committees spot the problems that the people involved don't see because they're looking towards success of what they're designing. And these folks might be looking to find ways that might not work right. So you don't always get that in those reviews along the way.

MS. KOLB: Understand.

MEMBER SUNSERI: Hey, Catherine, this is Matt Sunseri. I had a question about this organization. I've been studying it a little bit here. To me, this review and audit role, function committee appears to be what I'm going to call a hybrid of two classical organizations.

One is a station review and oversight committee comprised of these kind of people like you described here to look at the things that we've been talking about. Some call them operations review committee, station operation committee. They come under a variety of names. The audit function appears to be a quality assurance part, performing audits independently.

So do I have that kind of straight, or can you clarify that for me?

MS. KOLB: Yes. You can move to the next slide, Jeff.

So this committee is following the model specified in Research Reactor Standards 15.1. But you're right on how we intend to implement it.

So the review function, you know, is similar in the way that we're envisioning it to, you know, and then an oversight committee responsible for these items listed in the first major bullet here.

The audit function, we do have quality assurance departments that we intend to use and take credit for as part of this to delegate to the actual performance of audits to them when possible, whenever we can. The -- but, yes, that is a QA function, as they both feed well to, in many if not all of the audits that we specified here.

MEMBER SUNSERI: So are the actual quality assurance audits performed by independent team members and this is, this committee is just providing an oversight of those audit results, or are these, is this committee someway involved in the production activity of performing the audit? My question is really trying to get at the independence of the quality assurance function from production activities.

MS. KOLB: The attempt is to not have to independently audit, you know, for example, the emergency plan by two different independent organizations.

So, if the quality group leads an audit of the emergency plan because they have no involvement in the emergency plan and they do it for their prescribed frequency, they would do it, you know, in conjunction with or at the direction of the review and audit committee as part of their required audit list and to

take credit for that, because they would also be independent of that program.

I don't know if that answers your question.

MEMBER SUNSERI: So just let me throw out a hypothetical situation as far as an example maybe.

So let's say that the quality, that you were performing an audit of the technical specifications. And we find some deficiency in the way the tech specs are being implemented or tested or whatever, right, the quality assurance finding. Can the operations member of this review and audit committee overrule that finding?

MS. KOLB: No, for a couple of reasons. They can't constitute a majority of the review and audit committee. So that member wouldn't have that power to overrule. And if we got to the end of an audit, the charter describes how audits work, that they would, you know, commission the audit, and then they review the results of.

So I'm not really seeing the opportunity to overrule the results of the audit when it's just being presented for a review I guess.

MEMBER SUNSERI: Okay. So, I mean, I understand what you're saying. I guess I just --

between this and my previous comment about where the QA manager reports, I just kind of see a lack of visibility of the importance of the quality assurance role.

I mean, the review and audit committee doesn't have a quality assurance member on it. The audit function is kind of mixed in with operational activities. The quality assurance manager doesn't show up on the organizational chart.

It just -- I know it's not the case. But it just appears to be a lack of high visibility of the importance of that function. So I'll just leave it as a comment.

MS. KOLB: I appreciate the comments. I mean, the org chart at the beginning of this presentation is a subset that is not actually in this document. I created it specifically for this presentation. The quality assurance people do exist in the formal org chart.

MEMBER BIER: So one other question. This is Vicki Bier. In terms of any major plant changes, upgrades, modification, et cetera, is there a procedure to document both the analysis that led to that and, you know, a committee review or whatever that approved the change?

MS. KOLB: The engineering department has procedures and requirements for documenting their engineering outputs, calculations and drawings and the packages, design packages. So that would be the documentation of the analysis there.

And then the documentation of this independent, this extra review by the review and audit committee, that is documented by memos that are distributed within three months of the meeting where it was reviewed.

MEMBER BIER: Okay. So, for instance, if engineering made a recommendation and it was decided to depart from that or engineering put forward three options and they decided to go with number two or whatever, that would be documented someplace, the reasoning for that.

MS. KOLB: Yes.

MEMBER BIER: Thanks.

MS. KOLB: All right. So we've discussed the function of the committee a little bit. But just to reiterate they have a review function, which is based on the topics that are provided in research reactor ANSI standards, in some cases modified slightly to be applicable to SHINE.

And the audit function, they will audit

facility operation for conformance to technical specifications, training programs, or resulted corrective actions, and various facility programs and plans, including the emergency plan, radiation protection plan, the physical security plan, nuclear criticality safety program, and a few others.

Next slide. On this slide, we're talking about procedures. So Kris covered earlier in the day a process for verifying, validating them. But just to reiterate, we have a defined process for preparing, reviewing, approving, verifying, and validating procedures that provide direction for normal, abnormal, and emergency situations.

The topics that must be covered by procedures are included in this list. This list is based on one that is found in ANS 50.1, modified slightly to be applicable to the SHINE facility. That list was very reactor based, so we changed some of the terminology there.

Next slide. So this next slide combined required actions and reports. The -- a little bit of an echo there. But to put it in context, I've listed the safety limits there.

So we have defined safety limits in our technical specifications. And the required actions to

be taken in the event of a violation of a safety limit are to shut down facility operations immediately, and operations shall not be resumed until authorized by the NRC.

Reporting such event to Level 2 management, which is the operations manager or the director of plant operations and the NRC. And there is a report that is prepared, reviewed by the review and audit committee, and submitted.

Other required actions on the next slide relate to other special reports. So those are also defined in our Chapter 12 and in our technical specifications, so events such as release of radioactivity above limits, operations with the safety system settings less conservative than required, violation of LCOs established in our technical specifications, and other events listed here.

Actions that we would take on the occurrence of an event that requires a special report would be to shut down the affected areas for the processes, and operations shall not be resumed until authorized by Level 2 management. And it should be reported to Level 2 management and the NRC, the occurrence reviewed by the review and audit committee.

So these activities here, these events

that might occur require a special report as shown in Chapter 12.

We also, on the next slide, identify a couple of other reports. So we have operator reports that are required, including operating experience for future radiation units, any unscheduled shutdowns or corrective actions, tabulation of major changes, summary of affluence and other environmental surveys, and individual monitoring results required by 10 CFR 20.1502.

There are other special reports defined, including permanent changes in Level 1 or Level 2 management and any significant changes in our transient or accident analysis described in the FSAR.

We've also identified additional event recording as required by 10 CFR 70.50 and 52 and a set of requirements that are specific to SHINE but that meet the intent of Appendix A to 10 CFR Part 70.

And finally, after the completion of the startup testing, we specify that we will submit a startup report.

And the next slide, final slide, is records. So we've defined in Chapter 12 and in the technical specifications a number of records that the SHINE facility will maintain.

We have lifetime records related to affluence, environmental surveys, radiation exposure, drawings of the facility, and records of reportable occurrences as listed there.

We've defined a number of five-year records related to facility operations, maintenance, other reportable occurrences, and the list as shown. And finally, records that are only required to be retained for one rated survey (audio interference) radiation cycle related to training of licensed operators.

And this is the end of my prepared slides. Are there any additional questions?

CHAIRMAN BALLINGER: Yeah, this is Ron Ballinger. So the ultimate authority during the normal operation of the plant is the shift supervisor, right?

MS. KOLB: Correct.

CHAIRMAN BALLINGER: So, if an abnormal occurrence occurs, it doesn't necessarily have to be an alarm or, something which fits into one of your categories which would require the plant to be shut down or returned to a normal, if you want to call it that, condition right away, is there a set of conditions where you don't have to go through the

shift supervisor to shut the plant down?

MS. KOLB: Yes. Any licensed operator has the authority to shut down the facility in accordance with their license if they believe that it is unsafe.

CHAIRMAN BALLINGER: Okay. So they don't have to track down the shift supervisor every, if something, if it's a bad hair day.

MS. KOLB: Hopefully they won't be shutting down the facility for a bad hair day. But, yes, they have, per their training and their license, the authority to shut down the facility if they deem it necessary.

CHAIRMAN BALLINGER: Thank you. Other questions from members or consultants?

Thank you, then. So can we shift over to the staff side?

MR. LYNCH: Good afternoon. I just want to -- this is Steve Lynch, the Chief of the Advanced Reactor Policy Branch. Before I begin with the NRC staff remarks, I just want to confirm that everyone can see my first slide on the screen.

MR. LYNCH: Okay then, I will get started. So this is the NRC staff's review of SHINE's conduct of operations looking at Chapter 12, Sections 12.1-12.6.

This is largely an administrative portion of our review as we look at the levels of organization within the SHINE facility, including reporting the communication lines, review and audit activities, procedures, required actions, reports, and maintenance of records.

So as we conducted this review, there are a core set of regulatory requirements that we looked at to ensure that SHINE was meeting necessary requirements. 10 CFR 50.34 and paragraph B6 includes the requirements for describing the organizations of the facility.

Requirements 10 CFR 50.40 and 50.57 provide general findings for the NRC staff to make regarding the technical qualifications of the applicant to be able to carry out activities within the facility.

The conditions of licenses paragraphs in 10 CFR 50.54, specifically paragraphs I, J, K, L, and M-1 discuss minimum staffing requirements at the facility. And 10 CFR Part 20 provides requirements for the standards for protection against radiation.

So in implementing these regulatory requirements, the NRC staff starts with NUREG 1537, our standard review plan for non-power reactors, as

augmented by our interim staff guidance to include aqueous homogeneous reactors and radioisotope production facilities. So that is the main guidance that is applicable to SHINE.

And within this there are two ANSI standards that we primarily evaluated the information in SHINE's application against for these sections, and that is ANSI/ANS 15.1, the development of technical specifications for research reactors. And ANSI/ANS 15.4, selection and training of personnel for research reactors.

So in comparing the information SHINE provided in the FSAR, as they described in their presentation a few minutes ago, they generally followed the guidance in both ANSI/ANS 15.1 and 15.4, which is consistent with the information needs that the NRC staff has in NUREG 1537 to satisfy those applicable regulatory requirements that I just mentioned.

For this presentation, since largely SHINE adopted the direct language from the ANSI standards, I do want to just highlight some of the exceptions that SHINE took to the -- to the standards that the NRC staff found to be acceptable on account of its specific design considerations or operations of the

SHINE facility that are different from being a research or test reactor.

Primarily, this looks at how SHINE has the irradiation units containing an aqueous target solution, the commercial nature of the facility, and the production facility that SHINE is operating.

So over the next two slides I'll just quickly go over some of the exceptions that SHINE took to the ANSI standards and why the NRC staff found these to be acceptable. And looking at Section 12.2 in the review function and audit function paragraphs, SHINE had excluded looking at the review of experiments at the facility.

So experiments are included in these ANSI standards because at research reactors there are often in-core experiments being conducted that are separate from standard operations of the reactor.

Since SHINE is a commercial medical radioisotope facility and not a research reactor, they will not be conducting any of these experiments as a research reactor would. So it is acceptable in this section and in other sections that I'll highlight that SHINE has excluded experiments from consideration.

Also, with the audit function, SHINE has included additional elements within it audit function

that go beyond the minimum provided in the ANSI standard.

So in its audit function, SHINE has included its quality assurance program description, its physical security plan, and nuclear criticality safety program within the scope of items that may be audited. So since this goes beyond the minimum, the NRC staff finds that acceptable.

So again, when we're looking at Section 12.3, SHINE did modify what it looks at for topics for which written procedures are prepared, reviewed, and approved. They modified the language in here slightly to deviate from the reactor-centric language to follow closely with the technology that they have for irradiation units and the associated target solution in place of a reactor fuel that they would have.

Again, this was another example of an area where SHINE will not have any written procedures associated with this experiments since they will not be conducted at the facility.

And in Section 12.4, SHINE again, as in op (phonetic) being a reactor, used broader language to encompass looking at operations and processes both within the irradiation facility and the radioisotope production facility as being within the scope of

reportable events and actions to be taken should a reportable event occur.

And with this section, I'll just note that SHINE did highlight for the radioisotope production facility in their presentation that they are looking at the requirements for reporting in 10 CFR Part 70 as appropriate for events that affect a licensed material.

And then in the final two sections of Chapter 12 covered in this portion of the presentation, for annual operating reports, they were -- there were two deviations that I wanted to highlight that the NRC staff found acceptable. This is the exclusion of tests or experiments from reporting to the NRC as SHINE does not have these.

And then also SHINE did have a more conservative approach to providing results of individual monitoring carried out for individuals for whom monitoring is required by 10 CFR 20.1502. By following -- by reporting the monitoring results in alignment with this regulatory requirement, it is more conservative than what the ANSI standard requires.

According to the ANSI standard, reports would only need to be prepared if the doses that are contained in Part 20 are exceeded by greater than 25%.

So SHINE has done away with that threshold and is reporting down at just the regulatory requirements for monitoring. It will report out on those. So because that is more conservative, the NRC found that acceptable.

And then in Section 12.6, for records to be maintained at the facility, again, only two exceptions for experiments, and then also SHINE has modified the language to be more broad. It's in place of heterogeneous reactor fuel, they will have radioactive material inventories associated with the target solution they will have at the facility.

So they have used that appropriate language to be all-encompassing of records that need to be maintained related to that material.

So these next few slides just are a summary of the findings that the NRC staff has made. In general, because SHINE closely followed the information in ANSI standards 15.1 and 15.4, the NRC staff was able to make all of the necessary findings that were in NUREG 1537, Vol. 2, as augmented by the interim staff guidance to satisfy appropriate regulatory requirements.

So the organizational structure. As SHINE had presented on their slide, that is consistent with

what is in the ANSI standard and it gave the NRC staff confidence that there is a complete organization of -- all the way down from the operations staff up to the ultimate license holder.

More detailed descriptions of each of these positions were provided in the FSAR such that the NRC staff could understand their responsibilities in relationship to one another.

This has also given us confidence that the responsibility for the safe operation of the facility and for the protection of the health and safety of both the SHINE staff and members of the public have been demonstrably shown.

SHINE went over their staffing for minimum staffing at the facility, from shift supervisors that also serve the function of a senior reactor operator and other licensed operators at the facility. All of that satisfies the requirements in 10 CFR 50.4 for minimum staffing. And also then supports the review that the NRC staff did separately on meeting the operator requirements in 10 CFR Part 55.

For each of the personnel that are described, SHINE has provided a list of the necessary experience, education, and training that needs to be provided for each of those individuals. And also

SHINE has made a commitment within the FSAR to follow the radiation training requirements that are in 10 CFR 19.12. This is also consistent with expectations that are set in the ANSI standards.

SHINE has also described the radiation safety organization that is acceptable. As we saw in their pictorial organization graph, the organization has direct access to upper management in the review and audit committee to express concerns if necessary. As we saw, that was highlighted by some of the audit communication lines to ensure that there is access outside of direct reporting.

And we also have confidence that the radiation safety staff has the authority to interdict and terminate activities to ensure safety.

So additional findings that the NRC staff made. The Review and Audit Committee members appear to be well-qualified, with a wide spectrum of expertise. The Committee membership includes provisions for including persons from outside.

To follow up on the conversation that we had during SHINE's presentation of this, the NRC staff is comfortable with the minimum staffing provided for the Review and Audit Committee and that there is sufficient flexibility and commitment to bring in the

necessary technical expertise out of those minimum staffing to address specific issues on an as-needed basis.

And the general descriptions, for example with engineering, are broad enough to encompass various disciplines such as chemical processing to address review and audit needs for the facility.

SHINE has proposed a charter and rules that describe the number of times the Committee meets, the way the Committee conducts business, the requirements for a forum when voting, and the way the Committee distributes its reports and reviews.

SHINE has proposed a comprehensive acceptable list of items that the Committee will review and audit. As I mentioned earlier, SHINE has gone beyond the minimum suggestions in ANSI 15.1 on the items that are included within the review and audit list of document.

SHINE has proposed a set of required procedures as appropriate to operation of the facility, and that the process and method described by SHINE will ensure proper management control and proper review of procedures.

And then for our last slide here, SHINE has defined a group of incidents as reportable events

and has described the required actions it will take if the reportable events occur. The definition of reportable events gives reasonable assurance that safety-significant events will be reported by the applicant.

I think this is especially true since SHINE taking into consideration the production facility that they will be operating has looked to 10 CFR Part 70 for licensed material reportable events that are separate that they might see at the irradiation units and has included this as part of their reportable events.

So I believe that they have taken the necessary look and been comprehensive in defining what reportable events need to be included for the facility.

SHINE has proposed actions to be taken if the safety limit is violated or a reportable event occurs. The NRC staff has determined that SHINE will take whatever actions are necessary to protect the health and safety of the public.

So this goes back to what SHINE had said, that operators and senior operators at the facility are able to take the actions that are necessary to ensure the safe operation or shutdown of the facility.

We had briefly touched on deviations, you know, if an operator needs to make decisions that are outside of what might be prescribed. ANS 15.1 does provide for temporary deviations from procedures that may be made by the responsible senior operator or higher individual present in order to deal with special or unusual circumstances or conditions.

Such deviations shall be documented and reported within 24 hours or the next working day to a level 2 or designated alternates. That is what is included in ANSI 15.1 for deviations that may be made by operators and SHINE has committed to implementing that in the FSAR.

SHINE has described the content, the timing of submittal, and the distribution of reports to ensure that important information will be provided to the NRC in a timely manner.

And finally, SHINE has described the types of records that will be retained by the facility and the period of retention to ensure that important records will be retained for an appropriate time.

And in SHINE's presentation they provided some lists of these documents and reports. And all of that is consistent with what is found in ANSI 15.1.

So that concludes my prepared remarks, and

I'm happy to address any questions that the members may have.

DR. BLEY: Yeah, Steve, this is Dennis Bley. I was unhappy with the way you began this presentation, saying this stuff was all primarily administrative. Well, there's lots of administrative requirements here.

But if you don't think the things we were talking about earlier, such as what can licensed operators do, who can overrule licensed operators, that sort of thing is important to safety, you and your colleagues simply haven't read enough reports of bad events in plants. I really wish you didn't introduce it that way.

MR. LYNCH: I appreciate that. I will be more careful with my word choice in the future.

MEMBER BIER: One question or comment, Vicki Bier here. You mentioned that there was no need to report experiments because this is not a research reactor, which is certainly the case.

But it occurs to me that there may still be still be experiments broadly defined if the plant is considering, for example, a change in operating procedures or chemistry parameters or whatever.

There may be some out-of-normal operation

that's undertaken deliberately before making a final change or whatever. And I assume there is a mechanism of reporting of that, even though it's not a formal scientific experiment. But can you comment on that briefly?

MR. LYNCH: Yeah. So as we're talking about -- you know, SHINE would need to make -- would need to report on that unless whatever -- I don't want to use the word experiments since they said they wouldn't be doing that.

But if there are some sort of processes or operations that they're doing, they would need to report that to the NRC and possibly look at 10 CFR 50.59 to see if it fits with any change that is being made to the facility that can be done without a license amendment, or is it a change to the facility that they would need to come into the NRC for us to review and approve before they conduct that.

MEMBER BIER: I guess I'm thinking of things that may not even require a 50.59 approval but may still be kind of outside of, you know, deviation from normal operating procedure or something. And is there a mechanism or is that entirely within their own -- it doesn't require an approval for the change?

MR. LYNCH: Sure. So there are some --

there are some descriptions within the -- within the deviations covered for procedures that SHINE has at the facility. And as part of our review, we did look at how -- does SHINE have a mechanism in place to appropriately modify or deviate from procedures and how that is reported. So they do have that mechanism in place.

Also, should there be changes in procedures, the NRC staff does have the opportunity as we conduct our oversight program and inspections to look at procedures when we are on -- we are on site to see how they have been carried out and if it's been done appropriately at the facility.

MEMBER BIER: Okay, thank you.

CHAIRMAN BALLINGER: Other questions from members or consultants? Well, thank you then.

Our last subject for the day will be the startup plan and so can we -- let's transition over to the SHINE folks, please.

MR. DRURY: Can everyone see the slides?

CHAIRMAN BALLINGER: Loud and clear.

MR. DRURY: Hello, everybody, this is Tom Drury, the Commissioning Coordinator for SHINE. I'll talk to you about the startup plan.

We'll start with the purpose of the plan,

how we're going to administer the plan, a description of the facility tests, and then the radiation unit tests.

So the startup testing is conducted to ensure that the as-built facility confirms to the design and that the specified safety functions of systems, structures, and components are achieved.

To do this, we're going to verify key parameters that are necessary for the safe operation of an irradiation unit, and also the key parameters necessary for the safe handling of special nuclear material outside of an IU.

We will also be ensuring that the operating characteristics of the facility are well understood, including confirming calculational parameters and also establishing operational parameters, including set points.

We will do this to ensure that the safety of the plant is not dependent on the performance of untested SSCs during normal operation. And we will also structure the testing in such a way that during testing, we're never testing with untested SSCs. Next slide.

The administration of the testing. So we will perform testing in accordance with approved test

procedures and test plans. Within those plans, we have predetermined acceptance criteria. The execution of each of these tests will be led by a qualified test lead and additional test personnel.

During the testing, deficiencies will be documented and dispositioned. And following testing, a startup test report will be written.

For each test, we'll outline the methods and objectives of the test, have a comparison with acceptance criteria, discuss design and construction deficiencies and how to address those, justification for any of the nonconformances, a summary of the results of the test. And overall that report will be submitted within six months of the completion of testing activities.

So turning to the facility tests. These are tests that are conducted to verify operation of systems outside of IU cells. There are many tests, this is just a representative list.

We verified the ability to handle uranium and produce target solution via the FERC performance of target solution preparation. We'll be testing and balancing process vessel vent system flow rates to ensure adequate sweep gas flow, for action mitigation.

We'll be verifying the operation of that

transfer system's ability to move target solution between storage locations. We will ensure the functionality of the tritium purification system. And also test the ability of the standby generator to automatically start and take on load. Next slide.

MEMBER PETTI: This is Dave. I had a question, go back. I understand, you know, at some point you'll actually, you know, use uranium and tritium.

But will you do tests before that with just the sulfuric acid or watered down, you know, without the radioactive material going in first to, you know, to sort of SO test without, you know, jumping straight to the radioactive material?

MR. DRURY: Absolutely, yeah, as much as possible.

MEMBER PETTI: All right.

MR. DRURY: We are currently doing much of what's in that first bullet point with depleted uranium in a -- in a R&D facility. The verification of the vacuum transfer system's ability to transfer. The plan is to do that entirely with water throughout the entire facility or at least as much as possible.

And the ability of the tritium purification system to function, that is planned to be

tested with protium and deuterium prior to ever involving tritium.

MEMBER PETTI: Great, great. And I would assume the same is true of the -- the actual accelerator stuff, that you guys have done testing, so you kind of know how it should work before it's actually in the facility.

MR. DRURY: Yeah, I'll get to that in a little bit. But yes, absolutely, we've run very similar accelerators. We're running the exact same model of accelerator right now with deuterium, and do deuterium. So there's been extensive testing on the accelerators without much of the risk of radioactive materials.

MEMBER PETTI: Okay, great, thanks.

MR. DRURY: So other facility tests are done to verify design parameters. One thing we'll be doing throughout the facility is, a little jumping ahead to use of radioactive materials, we'll be doing direct dose measurements throughout the facility and comparing them to our chilling calculations.

We will also be testing the operability of the uninterruptable power supply system. And testing all the I&C systems, both safety-related and non-safety-related control systems.

Moving into each individual irradiation unit, all these tests will be done for each unit, so eight times on at least -- at least eight times on these. We'll be verifying filling and drain rates conform to design specifications.

I've already touched on that next bullet point. The driver is extensively tested for leakage operability, stability, and yield, both what we've already tested in an R&D environment. Also in the facility, it will be tested with deuterium and do deuterium prior to introduction to tritium.

The -- offgas system will be tested to determine the amount of water it holds up, leak tightness, sweep gas flow rates, and its iodine removal capabilities. The primary close loop to the cooling system will be tested to make that it can automatically maintain a temperature, tested for flow characteristics. And its integrity will be periodically tested via sampling for radioisotopes to indicate leakage between the TSV and the PCLS. Next slide.

We'll be testing a variety of nuclear physics parameters as well. One of the first and key parameters is determining through measurements what the optimum concentration of solution is. We have

calculations that say what it should be and it will be very close.

But we will start by filling the TSV with a solution below what we expect to be optimum concentration and fill it multiple times, leading to a concentration above the expected optimum concentration, and interpolate between the results to find a measured optimum concentration.

Once that is found, either with data from finding the optimum concentration or additional fills with greater-than-optimum concentration solution, we will create a curve of critical height versus concentration, which has also been calculated, so we can make more comparisons calculated and measured values.

And with the data gathered in these first two tests of optimum concentration and critical height, we'll be able to determine our calculational bias both in terms of uranium concentration and in terms of reactivity.

MEMBER MARCH-LEUBA: Hey, this is Jose --

MEMBER PETTI: Go ahead, Jose.

MEMBER MARCH-LEUBA: Yeah, do you guys -- have you guys have draft of procedures or draft of plans for these tests, or is this just requirements?

Because what I'm thinking, this is not going to take a couple of hours, this is going to take a couple of months.

MR. DRURY: Yes, I think we've scheduled about two to three months for all this work. From at least the hot commissioning portion I believe is about two to three months. And we do have draft procedures for the top level bullet point of these three, plus about another 15 or so IU-specific procedures and a few other procedures throughout the plant.

MEMBER MARCH-LEUBA: And do they know this test, you will never reach criticality, you will always stay subcritical? Because --

MR. DRURY: Correct.

MEMBER MARCH-LEUBA: The nominal condition, I don't remember if the number is proprietary, is pretty close to k effective 1. So when you go 5% above optimal, you might be above 1. What happens then? You don't fill the time to the nominal level?

MR. DRURY: No, the -- these fills are stopped once we are a -- I'm choosing my words carefully because it's an open session. But we -- whenever we fill the TSV, we are constantly estimating what critical is through an extrapolation of the last

two count rates. And in all cases, we always stop at the same percentage below critical in terms of volume.

So even when we do increase the concentration above what is optimum, that just reduces the volume of solution in the TSV.

MEMBER MARCH-LEUBA: Okay.

MEMBER PETTI: So this Dave, I had a question. I'm assuming you're going to do these curves for each radiation unit because there's -- may be small changes in volumes, you know, given tolerances on the geometries and the like, so that they could be difference from one TSV to another TSV.

MR. DRURY: Yes, I think it's understood that maybe as data is gathered, as you can see in the second open bullet point, I say to be filled four times. Maybe as time goes on, that becomes only three as we get a better idea of where we should start.

But at least for the first one and the second one probably, we'll start quite a bit below what we would consider it to be optimum. Or what calculations we chose to be optimum.

Yeah, there is some manufacturing tolerances on each TSV, and I wouldn't expect each one to have the exact same concentration within our ability to measure concentration.

MEMBER BROWN: You done, Dave?

MEMBER PETTI: Yes.

MEMBER BROWN: Yeah, it's Charlie Brown. Interesting as you went through all the slides and everything else, you -- and all the testing that you plan on doing, curiously you left out the ESFAS and TRPS. There are a lot of things that are going to trigger those particular systems in terms of a shutdown, either facility-wise or IU-wise.

And yet there's no mention of a test of how that's going to be tested to ensure that all the various parameters, etc., will result in the satisfactory shutdown if necessary automatically.

It's just a curious leave-out that it's not even mentioned in your testing program, neither one of the systems. And those are the overall protection systems for the overall facility and the IUs.

MR. DRURY: I said on slides 5 and 6 that these are just a representative sampling of facility test. That there's a lot more to our facility than can be put on just a couple of slides. I was hoping to capture that in that last bullet point, a functionality of instrumentation, both safety-related and non-safety, is tested.

Yeah, it's understood that there'll be many days to weeks of testing every input and output and actuation to both ESFAS and TRPS.

MEMBER BROWN: The reason I asked the question was because if you look at what the TRPS and the ESFAS are supposed to respond to, those are, you know, they're not all that easy to generate how you generate the inputs that result in that, the simulation of those. That just seemed to a bigger -- a larger scale test.

I understand testing on a representative sample. It's still just it was an explanation of how you were going to go about making sure that the overall safety system tests were actually conducted and worked, like they were. It just seemed to be a loose end. That's just my observation.

I presume the staff will make sure something's going on with those, other than just the slides here. I'll ask them the same question, or they can answer it if they know what it's going to be.

MR. BALAZIK: Well this is Mike Balazik, NRC staff. I will add that, you know, even though we haven't presented the tech specs with ACRS at this point, you know, the ESFAS and TRPS do have surveillance requirements prior to being considered

operable. So that's one thing we can point to now.

MEMBER BROWN: Okay. It just seems to me these are -- if you look at all the various systems that are installed, there's all the operational, how do you produce the stuff, and then there's these two top-level systems which are for the overall safety of the facility, as well as the performance of the irradiation unit.

So it just (audio interference.) test is one thing but making sure they're operational and you've got, kind of a qualifying that they actually work based on inputs seems to me to be something that ought to be laid on the table, in terms of a little bit more attention to the detail in how that was done.

The surveillance testing is not necessarily -- it's almost like an operational set of testing before the facility can go into operation, after they've done all the other operating system tests.

Just an observation based on about several hundred test programs I've participated in for shipboard systems, and submarine systems. That's just an observation I'm just giving you.

MR. BALAZIK: No, I understand the observation, I appreciate it, Charlie.

MR. DRURY: Thank you for the comment. Jeff, if you could move to slide nine, it's the next slide.

So after we've done the other irradiation unit tests from that previous slide we'll be looking at through measurements determining a few reactivity coefficients, including the worth of PCLS somehow draining, the worth of the TOGS holdup -- the water holdup within TOGS, temperature coefficients reactivity, and also the void coefficient reactivity.

MEMBER MARCH-LEUBA: Can I ask a few questions? You said PCLS reactivity worth is draining it or changing the temperature, or both?

(Simultaneous speaking.)

MR. DRURY: We will be changing the temperature while we find the temperature reactivity coefficient --

MEMBER MARCH-LEUBA: The temperature of PCLS without affecting the temperature of the TSV, which is difficulty to do, but, I mean, what do you mean by PCLS reactivity?

MR. DRURY: The worth of the water within PCLS existing or not.

MEMBER MARCH-LEUBA: So you will drain the PCLS and see how the reactivity changes?

MR. DRURY: Yes.

MEMBER MARCH-LEUBA: And you will measure reactivity by filling the tank and reaching the critical height, and see -- basically you will drain the PCLS and find out what the critical height is by measurement, and that will be your reactivity worth?

Because I don't know how you measure reactivity, very difficult to do.

MR. DRURY: We will measure -- we will fill the TSV with solution, with PCLS drained, measure the count rate on the startup -- on the source range detectors, and then fill PCLS. And a comparison of those two count rates will give us a reactivity worth of PCLS.

MEMBER MARCH-LEUBA: You will have the detectors calibrated by then?

MR. DRURY: It's a relative count rate between the two. It's a source range so it's counting pulses, the relative pulse wouldn't need to be calibrated.

MEMBER MARCH-LEUBA: So reactivity is the ratio of power -- yeah, I agree with that.

Okay, the TOGS holdup, are you planning to do different concentrations of solution and fill it up again, or run it at full power for however long it

takes the TOGS reach equilibrium? How do you plan to do that?

MR. DRURY: The plan is to run at two different concentrations, keeping the uranium mass the same. So you'd have different concentrations, different volumes that would be representative of --

MEMBER MARCH-LEUBA: Of losing water, holding water in the TOGS.

MR. DRURY: Yes.

MEMBER MARCH-LEUBA: Yeah, that's probably good.

And now, void reactivity, I saved the best for last. Measuring void is really hard, especially where the TSV has a 3D void distribution radial axial. Have you given any thought of how you're going to do that? Or is you going to do a power coefficient, you're going to change the power level?

MR. DRURY: We have a good idea now how to get a qualitative measurement of void, but I don't think we have a great handle on how much void is in a TSV at power. So the -- in the next few months or year before we do this, hopefully we can come up with -- perhaps we can come up with a more quantitative way of doing it.

But the qualitative way is that, as we

startup we expect hydrogen and oxygen not to release immediately and then, at first, hydrogen will bubble out and then followed by oxygen. So at, least qualitatively, we want to say that void coefficient is negative, and I would expect to be able to do that just by seeing two close two-step change drops in response from the wide and power range detectors.

MEMBER MARCH-LEUBA: So you're not really interested in the absolute magnitude of the coefficient but the fact that this negative is good enough for you?

MR. DRURY: For right now, yeah, strong and negative is good enough. If we can find a way to actually quantify it -- like you said, it might be very difficult or impossible -- that would be great. And it would be added to the plan -- strong and negative is good.

MEMBER MARCH-LEUBA: Yeah, the problem is that the void is a 3D environment, I mean, it's not to scale. The void at the bottom will be higher and there will be a radial distribution on the whole TSV, it will follow the flux, right?

So, yeah, I'm hoping you have final -- because the idea here is that you are going to verify that whichever void reactivity coefficient,

quote/unquote, you use for your safety analysis, you have either -- you have something safer than what you use. And I just don't see how we're to do that -- I can see how you can do a power reactivity coefficient, total power, that's relatively easy to do --

MS. RADEL: Jose, this is Tracy. You know, we have the ability to measure the volume of solution and tell the -- be able to measure the total void in the solution. But you're right, it's distributed and, you know, depending on bubble size and speed in the solution, and then, you know, power distribution aspects, you know, we will be comparing that total void to the models that we have and adjusting our models on the bubble size and speed, and those parameters to match as close as possible as we can to the unit as somewhat of a bias and confirmation of what we're seeing in all of the modeling. But, you know, we will not be able to measure void in each individual region within the TSV.

MEMBER MARCH-LEUBA: So let me ask you, do you have an actual level measurement? Not collapse level, but where the froth level is, where the actual boundary between the water and the gas on top is?

MS. RADEL: So the level measurement is done in a standpipe, kind of on the side of the TSV --

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: Yeah, that's collapse level, that doesn't give you the void. You will need some kind of -- I mean, some kind of level measurement that looks for the boundary between the liquid and the gas, and that will elevate as you get more voids.

Okay, that's not relevant, that would be a nice way to measure the void. But the positive thing you have is that you don't have any burn up or, in BWRs, your power distribution changes daily.

In SHINE you always have the same power distribution, there is no burn up. So day one of the cycle have the same flux distribution in the TSV as day seven or day 30, so you only have one void distribution always, and whichever it is, it is. As long as you can measure a reactivity coefficient for the one and only void distribution you have, that will be sufficient, I think. But anyway, I'm diverging here.

So I'm just saying, this is a difficult problem. We need to -- you need to figure out what is it that you need and don't do more than you need to demonstrate that you are within the safety analysis assumptions. Okay. All better now.

MR. DRURY: Next slide.

And this is our final slide, one of the last things to do during commissioning is the initial calibration of the wide and power range neutron flux, we will do a run where power is limited by limiting neutron production from the NDAS, from the neutron driver assembly system.

We will do a few hour run, somewhere in the four to 10 hour run, at approximately 10 percent power. From that the detectors will be calibrated the way they were described yesterday during the INC portion of this meeting, using a isotopic method, and then extrapolated to 100 percent power.

If it looks like we need to do another run before 100 percent power, we can do an intermediate power and then followed by another few hour run at full power to calibrate at the power conditions.

Then we will do a few more at higher concentrations and lower fill heights to investigate if there's any sensitivity to the detector calibration factors with solution geometry, the calculations currently show that there probably is a small sensitivity to that and we would like to confirm that.

And that's all I've got for startup testing.

MEMBER SUNSERI: This is Matt, I guess --

I'm going to make just a comment here, I suppose. But the title of this section is StartUp Plan, there really is not a startup plan has been presented. There's a list of activities here, some system level test, a real startup plan would have a definition of a controlled, systematic and progressive approach from the construction to full power operation.

It would start with prerequisite testing, such as wiring continuity checks, system flushes, instrument calibrations. Would proceed to system and component level testing, including performance tests and whatever technical specifications the plant conditions would allow, it would specify what conditions you want to test in pre-irradiation, post-irradiation, how the systems are (audio interference.) be, and ultimately some kind of integrated test to show all the systems working together work together as you intend.

The purpose of that would be, as you described earlier, would be to validate the construction against the design, validate the design itself. It's also an opportunity to exercise your operational procedures, which are newly developed and haven't been operated. It would identify some things that maybe your design was weak on, or you had design

deficiencies. And you could do this prior to either, irradiating material or introducing radioactive material to the system.

So, you know, a lot of the questions you got today were simply because we don't see those connections, and it's hard to tell whether or not those systems that are listed here and in the SAR are, you know, comprehensive.

And so I don't -- I think the staff is going to conclude that there's reasonable assurance, I probably could convince myself the same thing but without having to see the documented full-scope plan, it's really kind of hard to tell. I'll just leave it at that.

CHAIRMAN BALLINGER: Yeah. This is Ron Ballinger, I sort of had the same opinion since I've been involved in at least two startups like this. But I think it's all in there, it's just not organized in a way that I'm used to seeing it. What do you think, Matt?

MEMBER SUNSERI: Well certainly the SHINE facility isn't of the magnitude of a commercial power reactor. Reg Guide 1.68 describes the, you know, initial startup program for a reactor of that type. It would be a good example to look at it, at the

things that you would want to, you know, ensure that you're covered, on a smaller scale, as applicable to the SHINE facility.

But, I mean, you know, I suppose it's a given that whoever's building the place is going to do construction-level tests, they're going to flush the systems, they're going to do wiring continuity checks -- but without it being documented in a, you know -- what I'll say -- or prescribed, maybe not documented but prescribed in a plan, it's just hard to tell that all the pieces are going to add up to the total at the end.

MS. KOLB: This is Catherine Kolb, the examples of testing that you gave there, so we don't have the kind of plan that's, you know, lays out every test that we're going to do -- and I admit that maybe we struggled a little bit on the slides to convey the scope of the startup testing, and the commissioning.

But in our integrated schedule we have all the things that we mentioned, we have, you know, checking the continuity of wiring, system flushes, you know, performing all of the technical specification surveillances, individual component tests that then go into integrated system tests prior to the introduction of radioactive material. And then this series of

testing for -- nuclear physics testing and other things that we discussed in a little bit more detail.

We also have in our integrated schedule (audio interference.) line items to go and verify and validate all of the individual operating procedures that Chris mentioned earlier, so, yeah, we do lack a single document that lists all of these together. We're mostly relying on our project schedule to list out and coordinate all of the activities that we're going to do in order to ensure the facility will be operational.

MEMBER SUNSERI: Your required startup report would be halfway written if you had such a plan in place, because then all you would have to do is fill in the results when you get them done, so.

MS. KOLB: That is an excellent comment, thank you for that.

MEMBER PETTI: I had a question. I didn't hear a lot about -- because, again, it's not necessarily safety related, but the whole recovery of the moly-99, etcetera, you know, you've got eight units feeding, what is it, more than one tank. But there's, you know -- I suppose it's hard to do much in terms of quantifying yield, carryover issues, process variability until you get into it. Unless, you know,

someone's able to come up with a way to kind of do some of that with non-radioactive Moly, you know, and just do some other chemical analysis.

Are you guys doing, you know, thinking about anything on that end? I mean, are you going to, you know, gather data and do statistical process control on some of this stuff so that you, you know, you know where you sort of should be when something looks wrong? That sort of stuff.

Again, it's not a safety issue, it's more of a, you know, making sure you're meeting whatever the production targets you have.

MS. KOLB: Yeah, so this is Catherine again, we don't have plans to do statistical analysis of that type in this initial facility startup, you know, we may choose to do that as we, you know, run our first year or two of operation.

But your comment about, you know, doing some testing with cold materials, we have done that on a little bit of a scale. You could use natural moly and do some of the processes with non-irradiated material and get, you know, some amount of information from that, including, you know, varying different parameters and seeing the results. It's not quite the same as moly-99 but we do have a setup, using some

cold moly, that we're working on.

MEMBER PETTI: You know, just a point that, if you, you know, are going to go there eventually it just means, collect as much data as you can now, even on things that you might not think are important but could end up being important when one looks at it, you know, as a process, if you will. That data could be quite helpful in informing your decision on how you really want to look at things, you know, down the line.

MS. KOLB: Yes, that makes sense. Thank you.

CHAIRMAN BALLINGER: Additional questions from members or consultants?

(No audible response.)

CHAIRMAN BALLINGER: Well thank you again, let's switch over to the staff, please.

MR. BALAZIK: All right. Good afternoon, my name's Mike Balazik, I'm the project manager in the Office of Nuclear Reactor Regulation in the Non-Power Production and Utilization Facility Licensing branch, and I'll be presenting the NRC staff review of SHINE's startup plan, as described in FSAR chapter 12, section 11. Next slide, please.

Okay, big picture here, 5034 describes the

information required to be in a safety analysis report. Section B6, item three, talks about plans for pre-operational testing and initial operations, a couple other regulations that apply, and these, you know, provide reasonable assurance that the activities authorized by the operating license can be conducted without endangering the health and safety of the public, and that the activities will be conducted in compliance with the regulation and not be inimical to the common defense and security.

So 5040 and 5057 are some of the standard regulations we've been applying throughout the review. The 5034-B6 is specifically tied to the startup plan. Next slide, please.

All right, so guidance, same guidance that you've seen in some of the other reviews, NUREG 1537 part one and part two, and also the interim staff guidance for licensing radioisotope production facilities, and aqueous homogeneous reactors. Next slide, please.

Okay, I just wanted to first talk about the summary of the application in section 12.11, SHINE did identify at a high level, the tested measurements to verify safety-significant facility parameters for handling special nuclear material, and also validating

operating characteristics of the facility.

While we didn't receive acceptance criteria within the startup plan, you know, the NRC staff acknowledges that specific test plans will contain this acceptance criteria which will be developed by the design information in the FSAR.

Also in the tech specs, SHINE is required to submit the startup report which contains all of the startup information, this is required by tech spec 5.84 which requires, like I said, the submission of the information within six months after the completion of the startup activities.

Okay. So continuing on with the summary of the application, SHINE identified, again, at a high level, system testing for the facility and the individual IUs, they identified calibrations of equipment, system flow, fill, and drain rate, and leak rates to verify boundary integrity.

They also identified measuring certain nuclear parameters, such as uranium concentration, critical height, temperature and void coefficients, the TSV off-gas system and the primary closed loop cooling system reactivity worth, determining a neutronic bias, and also determining flux distribution, and also to be looking at radiation

measurements outside the biological shield.

One thing I do want to add here is that, I did go back and look at some of the startup testing programs we've reviewed in the past, specifically I looked at some of the HEU to LEU conversions that we did for the TRIGA reactors. For those SARs, the licensees did submit a startup plan which was at a high level.

I'll say that some of them did contain some acceptance criteria but it was, again, kind of qualitative. For example, I saw in there where, you know, they wanted to verify the temperature coefficient of reactivity was negative, or that they met the shutdown margin in their tech specs, or that their pulsing versus fuel temperature has a linear response.

But I will say that, with those startup reports that were submitted -- this was probably back in the mid to late 2000s -- I'll say that SHINE's startup plan is on par with the information that was provided in those startup plans --

MEMBER SUNSERI: This is Matt again, wouldn't you agree, though, that SHINE is significantly more sophisticated than a TRIGA reactor?

MR. BALAZIK: Yes, sir. I do agree with

that.

We've had quite a lot of operational experience with the TRIGA reactor, SHINE is a first of a kind, and, you know, at this (audio interference.) we'll have to move some of these activities to the oversights out of the house and inspect the testing that's going on with SHINE. I'll actually talk about that on the next slide here.

MEMBER SUNSERI: Okay.

MR. BALAZIK: So just evaluations and conclusions, you know, SHINE has identified plans to validate safety-significant parameters. They do plan on developing acceptance criteria based on FSAR design information to support their startup test procedures, they'll submit the information within six months of completion of startup activities.

And I'll conclude that the implementation of this startup plan -- again, it's a high level plan, I kind of call it a plan for, to support the test procedure, it provides reasonable assurance that the facility can operate as described in the FSAR. And I also want to add that the NRC will conduct inspection activities to confirm the readiness of the startup test program. Next slide, please.

So I do want to say that the Licensing

branch and the RTR Oversight branch are working closely together, we are developing a SHINE facility specific inspection plan that will include the SHINE startup test program. During those inspections we can verify the acceptance criteria for all the different tests and parameter measurements that SHINE discussed earlier.

Our main procedure that we plan on using is 69002, which is inspections of operational readiness during construction of non-power production and utilization facilities. Within that inspection procedure it talks about using other existing operational inspection procedures as guidance.

You know, this inspection procedure is technology-neutral, it is written at a high level but one inspection procedure that we can use information from is inspection procedure 72401, this talks about part 52, Inspection of StartUp Test Programs.

Within that procedure it talks about, you know, reviewing the acceptance criteria, you know, if the acceptance criteria wasn't met, you know, what were the corrective actions that the licensee implemented. It talks about lots of other inspection guidance related to startup activities.

That is my presentation, are there any

questions that I can answer?

MEMBER SUNSERI: Well this is Matt again, and I'm just one member as you know, and don't speak for the ACRS as a whole on this thing. I would give a lot of weight to this inspection program for validating the rigorousness -- rigor? Whatever -- the strength of their startup test program.

Because, as you mentioned, this is a first of a kind facility, it's got a unique operating requirement, as that it's going to be operating close to but not at critical. So, you know, you'd want to make sure that the plant is going to operate that way, and the only way -- the best way to do that is during the test program, to make sure that its been methodically tested, staged, incrementally progressed to the point of which you assured that it's going to operate below critical and not at or above, which is a safety limit, I think, for the unit, so.

The test program's very important and it just doesn't seem like it's gotten the attention that I would've expected it should've gotten for a licensing review. That's my opinion.

MR. BALAZIK: Yes, sir. No, one thing we have identified when we're -- in developing these inspection program is that we're going to need a lot

more technical expertise to support the inspections. I mean, for a TRIGA reactor you can have one person knowledgeable about the design of that facility, but for SHINE, from a MC&A, from a criticality standpoint, you know, we're going to need those experts, those additional experts to support the inspections of this facility.

And I'll also add that we have an ongoing construction inspection program, they're verifying the as-built facility, as-built now. It meets the information that's in the FSAR, so we're doing that and that's one place where we can also look at the digital INC that Mr. Brown was mentioning earlier.

MEMBER PETTI: Mike, could you -- this is Dave, could just go back a slide?

MR. BALAZIK: Yep, sure.

MEMBER PETTI: Yeah, so this last bullet, that's a hold point, they can't go forward until you give them an authorization or is it just something done in parallel?

MR. BALAZIK: Can you clarify what you mean by hold point?

MEMBER PETTI: They can't start a startup program until you do the inspection activities and --

MR. BALAZIK: Yes.

MEMBER PETTI: Okay.

MR. BALAZIK: The pre-operational readiness inspection supports the 5057 finding that the facility is substantially complete.

MEMBER PETTI: Okay. I just, you know -- I mean, I want to echo Matt's comments. The DOE facility is -- the DOE complex is replete with facilities that didn't do enough pre-op work and just, you know, ended up doing it when they were, quote, in operation. And of course the availability goes to hell, I mean, all this stuff happens -- this is really important stuff, and I'm sure SHINE appreciates. When they're ready they want to really be ready, and so the more you can do here, you're just, you know, saving yourself headaches down the line.

MR. BALAZIK: And one thing I'd like to add is that, you know, when SHINE informs the NRC that they're ready for certain inspections, we want to get those knocked out early so that this entire, I'll say, inspection program for pre-operational readiness can be done efficiently.

Any other questions?

MEMBER SUNSERI: This is Matt, I don't have any. Thanks for listening to us.

MR. BALAZIK: Thank you.

MEMBER SUNSERI: Ron, are you there? I think that's it for us.

CHAIRMAN BALLINGER: Yeah. No, I -- boy oh boy, I pulled a you know what and didn't unmute. Anyway, with this concludes the last presentation, and so, absent any questions from members or consultants, we need to go out for public comment.

So I might would say that, if there are members of the public that would like to make a comment please unmute yourself, and state your name and make your comment.

(No audible response.)

CHAIRMAN BALLINGER: Well, not hearing any, I think there are no public comments. Now we need to have the discussion -- I think I know the answer, but we had scheduled closed sessions after this, if needed, and my question to the members is -- or anybody else involved, actually -- whether you think we need a closed session?

MEMBER BROWN: None from me, I don't need --

(Simultaneous speaking.)

MEMBER SUNSERI: This is Matt, I don't see the need for any.

CHAIRMAN BALLINGER: Okay, so I'm going to

conclude that we don't need a closed session. And so I would like to be the first to thank the staff and the SHINE folks for presentations, they were, to my mind, complete. And I think we got most of our questions -- or all of our questions answered.

So are there any final -- excuse me, a train is about to go by. No, you didn't hear it -- are there any final questions from members or consultants?

(No audible response.)

CHAIRMAN BALLINGER: Okay. And once again I'd like to thank the staff and the SHINE folks for their presentations. And I think we are finished for the day, so thanks again.

(Whereupon, the above-entitled matter went off the record at 2:45 p.m.)

Operator Training and Requalification

BRENT WALLER, TRAINING MANAGER

Initial Training Program

- Candidate Selection
  - SHINE follows the guidance of ANSI/ANS-15.4-2016, “Selection And Training Of Personnel For Research Reactors,” for the selection of licensed operator candidates
  - Medical screening are conduction per the guidance of ANSI/ANS-15.4-2016
- Candidate Training
  - Combination of classroom, on-the-job, and computer-based training
  - Phases:
    - Fundamentals
    - Radiation Protection and Administrative Requirements
    - Systems
    - Plant Evolutions (including normal, abnormal, and emergency procedures)
    - Exam Preparation
    - Supervisory Training

SHINE

Initial Training Program

- Examinations
  - Written examination passing criteria is 70%
  - Remediation conducted and reexaminations administered for scores < 70%
  - On-the-job evaluations used for performance tasks
  - Oral exams used as-needed
- Program Content
  - 10 CFR Part 55 requirements, as applicable
  - ANSI/ANS-15.4-2016 guidance
  - Additional topics identified in Chapter 12.10 of the FSAR
  - Additional topics as determined by a systematic approach to training

SHINE

Initial Training Program

- Application
  - NRC Form 398 used for application
  - NRC Form 396 used for medical
  - Internal SHINE review of candidates conducted prior to sending to an NRC exam
- Program Review
  - Performance evaluation after training as part of the systematic approach to training process
  - Assessed by the Review and Audit Committee every three years

Continuing Training Program

- Starts within three months of receiving operator licenses
- Conforms to requirements of 10 CFR 55.59(c) and follows guidance of ANSI/ANS-15.4-2016
- Biennial Requalification Cycle
  - 24 months long
  - Divided into two, 12-month long annual cycles
  - The next cycle starts immediately after the previous
- Medical certifications conducted per the guidance of ANSI/ANS-15.4-2016
- Changes in operator license status per 10 CFR 50.74 communicated to NRC within 30 days

SHINE

Continuing Training Program

Continuing Training Program Requirements	Periodicity
Facility Design, Procedure, and License Changes	As Applicable
Training Lectures	Quarterly
Documentation of Proficiency	Quarterly
Abnormal and Emergency Procedure Reviews	Once per Annual Cycle
Reactivity Manipulations Completion	Once per Annual Cycle
Operating Test	Once per Annual Cycle
Written Exam	Once per Biennial Cycle
Medical Exam	Once every 2 years

Continuing Training Program

- Program Content
  - 10 CFR Part 55 requirements, as applicable
  - Facility modifications
  - Procedure changes
  - Topics as identified by the systematic approach to training
  - Relevant industry operating experience
  - Identified operator weaknesses
- Program Review
  - Assessments per the systematic approach to training
  - Assessed by the Review and Audit Committee every 24 months

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SHINE Medical Technologies, LLC Operating License Application

Chapter 12.10 - Operator Training and Requalification

Travis Tate
Branch Chief
Office of Nuclear Reactor Regulation

July 20, 2022

Operator Requalification

- Operator Requalification is intended to ensure that the facility will be operated by competent operators
- SHINE will be issued a Part 50 facility operating license
- Paragraph (b)(8) of 10 CFR 50.34 applies
- Applicant is required to submit a description and plans for implementation of an operator requalification program

Regulatory Basis

- Regulatory Requirements
  - 10 CFR 50.34, “Contents of applications; technical information”
  - 10 CFR 50.54, “Conditions of licenses”
  - 10 CFR 55.59, “Requalification”

Acceptance Criteria

- Chapter 12.10, “Operator Training and Requalification,” of NUREG-1537, Part 1, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,” (ADAMS Accession No. ML042430055)
- Chapter 12.10, “Operator Training and Requalification,” of NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria.” (ADAMS Accession No. ML042430048)

Review Areas and Technical Evaluation

- Requalification Program Elements
  - Requalification Schedule
  - Pre-planned Lectures
  - On-the-job Training
  - Operator Evaluations
  - Recordkeeping

Requalification Program

- Requalification program is described in the SHINE Licensed Operator Continuing Training Program
- Regulations for requalification are found in 10 CFR 55.59
- SHINE licensed operator continuing training program includes:
  - Two-year (biennial) requalification program cycle
  - Pre-planned lectures based on topics related to the SHINE facility
  - On-the-job training applicable to the SHINE facility design: reactivity manipulations, facility procedures, and facility changes
  - Evaluations of licensed operators: annual operating tests, comprehensive written examinations, systematic observations, simulation of abnormal or emergency conditions, and provisions for accelerated requalification
  - Recordkeeping and retention periods for program documentation

Requalification Program (cont'd)

- SHINE licensed operator continuing training program also includes:
  - Definitions specific or unique to the SHINE facility
  - Additional information specific to license conditions for Part 55 licensed operators: biennial medical examinations, maintaining a license in active status, fitness for duty, changes in license operator status
  - Periodic requalification program audit

Evaluation Findings and Conclusions

- SHINE's licensed operator continued training program is in accordance with the applicable regulations for requalification contained in 10 CFR 55.59, meets acceptance criteria in NUREG-1537, and consistent with the guidance contained in industry standard ANSI/ANS-15.4-2016

- The licensed operator continued training program provides reasonable assurance that requalification for licensed operators and licensed senior operators will be carried out in a manner that assures knowledge, skills, and proficiency will be maintained and is sufficient for the issuance of an operating license

Operator Initial Training

- Operator Initial Training is intended to ensure that applicants will be prepared for licensure under 10 CFR Part 55 and the facility will be operated by competent operators
- SHINE will be issued a Part 50 facility operating license
- Section 50.120 of 10 CFR Part 50 does not apply
- Applicant committed to follow industry guidance in ANSI/ANS-15.4-2016, “Selection and Training of Personnel for Research Reactors”

Training Program

- Training program is described in the SHINE Licensed Operator Initial Training Program
- SHINE licensed operator initial training program includes:
  - Commitment that trainees will only operate controls under direct supervision of a licensed operator
  - Reactivity manipulation plans for licensed operator candidates
  - Plans to account for previous experience and training
  - Training program scope and topics for operators
  - Training program scope and topics for senior operators
  - Medical certification and fitness for duty
  - Licensed operator candidate selection and qualifications
  - Evaluations of licensed operator candidates
  - Periodic program review
  - Recordkeeping

Evaluation Findings and Conclusions

- SHINE's licensed operator continued training program is consistent with the guidance contained in industry standard ANSI/ANS-15.4-2016

Human Factors Engineering

KRIS RUETZ, OPERATIONS MANAGER

Outline

- Human Factors Engineering (HFE) Overview
- HFE Design Guidelines
- HFE Design Checklist
- Alarm Hierarchy
- Equipment Labeling
- Operating Procedure Validation

Human Factors Engineering Overview

- SHINE incorporates HFE principles into the design of the facility control room, display screens, and operator interfaces
- SHINE Operations works with SHINE Engineering to ensure human factors are considered throughout the design process
- The SHINE HFE program describes evaluating HFE as part of the following phases:
  - Initial design
  - Design implementation (confirming as-built design)
  - Future modifications
- HFE evaluations are performed using a checklist that compares design to recommended design guidelines
- HFE evaluations are maintained as records

SHINE

Human Factors Engineering Design Guidelines

- HFE design guidelines are recommendations, not requirements
- Four Categories of design guidelines:
  - Instrumentation and control (I&C) panel layout
  - Main control room layout
  - Human-System Interface (HSI) design criteria
  - Alarm system criteria
- Design guidelines are provided to vendors developing the SHINE HSIs
- Design guidelines are derived from relevant industry standards, including NUREG-0700, Revision 2, “Human-System Interface Design Review Guidelines”

Human Factors Engineering Design Checklist

- HFE design checklists are used to compare design to the recommended design guidelines
  - Checklists are filled out by the Operations department
  - Checklists are used during initial design, after installation, and as part of equipment modifications
  - Checklists are kept as records
  - Issues identified that require corrective action are tracked via the SHINE Issues Management process (i.e., the SHINE corrective action program)

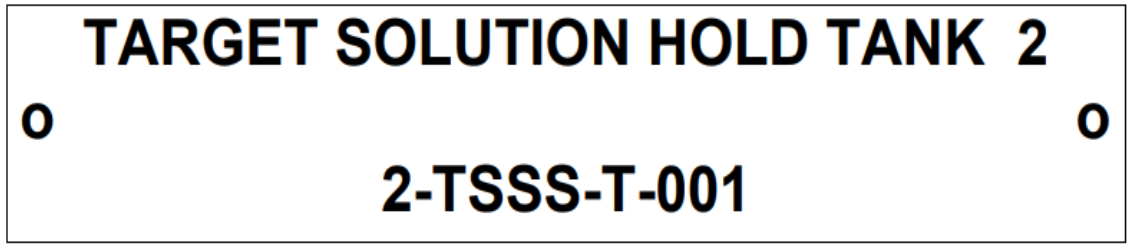
Alarm Hierarchy

- Most facility alarms will be received in the control room via the process integrated control system (PICS)
- The PICS displays alarms on a consolidated alarm page on the control room HSIs
- “Stacklights” in the control room alert operators to current facility alarm status
  - Provides operators with high-level facility alarm status
  - Each irradiation unit (IU) has its own alarm light
  - Additional alarm light for common alarms (non-IU specific alarms)
- Categories of alarms:
  - High (red light and audible alarm)
  - Medium (yellow light)
  - Low (blue light)
  - Information (no stacklight indication, PICS alarm page only)

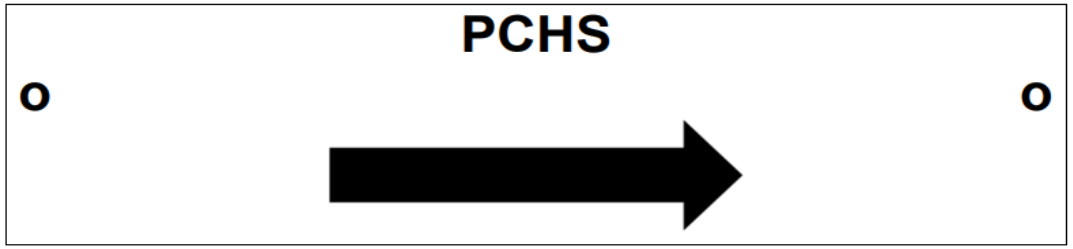
SHINE

Equipment Labeling

- Equipment and pipe labels are included within the scope of the HFE program
- Equipment labels include a descriptive name and equipment designator (unique identifier)
  - Equipment labeling includes components such as valves, pumps, and tanks
- Pipe labels include the system name and arrows showing direction of flow
- During the facility construction and commissioning process, equipment and pipe label verification is performed as part of turning over systems to Operations



Ex. Equipment Label



Ex. Pipe Label

Operating Procedure Validation

- Operating procedures (including abnormal and emergency procedures) are validated prior to being issued for use
  - Process for procedure validation varies based on type and content of procedure
    - Most validations will consist of step-by-step facility walkthrough of procedure after related equipment has been installed
    - Alternate methods used for validation may be tabletop discussion
- Procedure validation ensures that operators can physically perform procedures and provides a diverse method of checking for necessary equipment labels

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SHINE Medical Technologies, LLC Operating License Application

Chapter 7.4.9 - Human Factors Engineering (HFE)

Jesse Seymour
HFE Technical Reviewer
Office of Nuclear Reactor Regulation

July 19, 2022

Human Factors Engineering

- The NRC HFE staff evaluates applications for operating licenses
- These reviews support public health and safety by verifying that the applicants' HFE programs incorporate practices and guidelines that are acceptable to the NRC staff
- The NRC staff reviewed the HFE-related portions of SHINE FSAR Chapters 3, 7, 12, and 13 to assess the sufficiency of the HFE-related design aspects and programmatic considerations for the SHINE facility

Regulatory Basis

- 50.34(a)(3) requires the PSAR to include PDC
  - Design Criterion 6 states “a control room is provided from which actions can be taken to operate the irradiation units safely under normal conditions and to perform required operator actions under postulated accident conditions”
- 50.34(b) requires the FSAR to include a description and analysis of SSCs and the evaluations required to show that safety functions will be accomplished
- 50.57(a)(3) requires reasonable assurance that activities authorized by operating licenses will not endanger the health and safety of the public

Acceptance Criteria

- NUREG-1537 and its associated ISG provide primary source of review guidance as the relevant SRP
- There are no specific HFE criteria in NUREG-1537
- Certain I&C review criteria from NUREG-1537 section 7.6 have HFE-related aspects
  - These criteria cover the following areas:
    - outputs and display devices observability
    - accessibility/understandability of important controls and displays
    - control console annunciators and alarms

Acceptance Criteria (continued)

- Administrative controls and HFE-related management measures supporting their reliability were evaluated using applicable criteria of the NUREG-1537 ISG
- NUREG-1520, was also consulted for general guidance regarding appropriate areas for evaluation in the review of SHINE's administrative controls
  - Procedure management
  - Procedure verification & validation
  - Training of personnel
  - Personnel qualifications

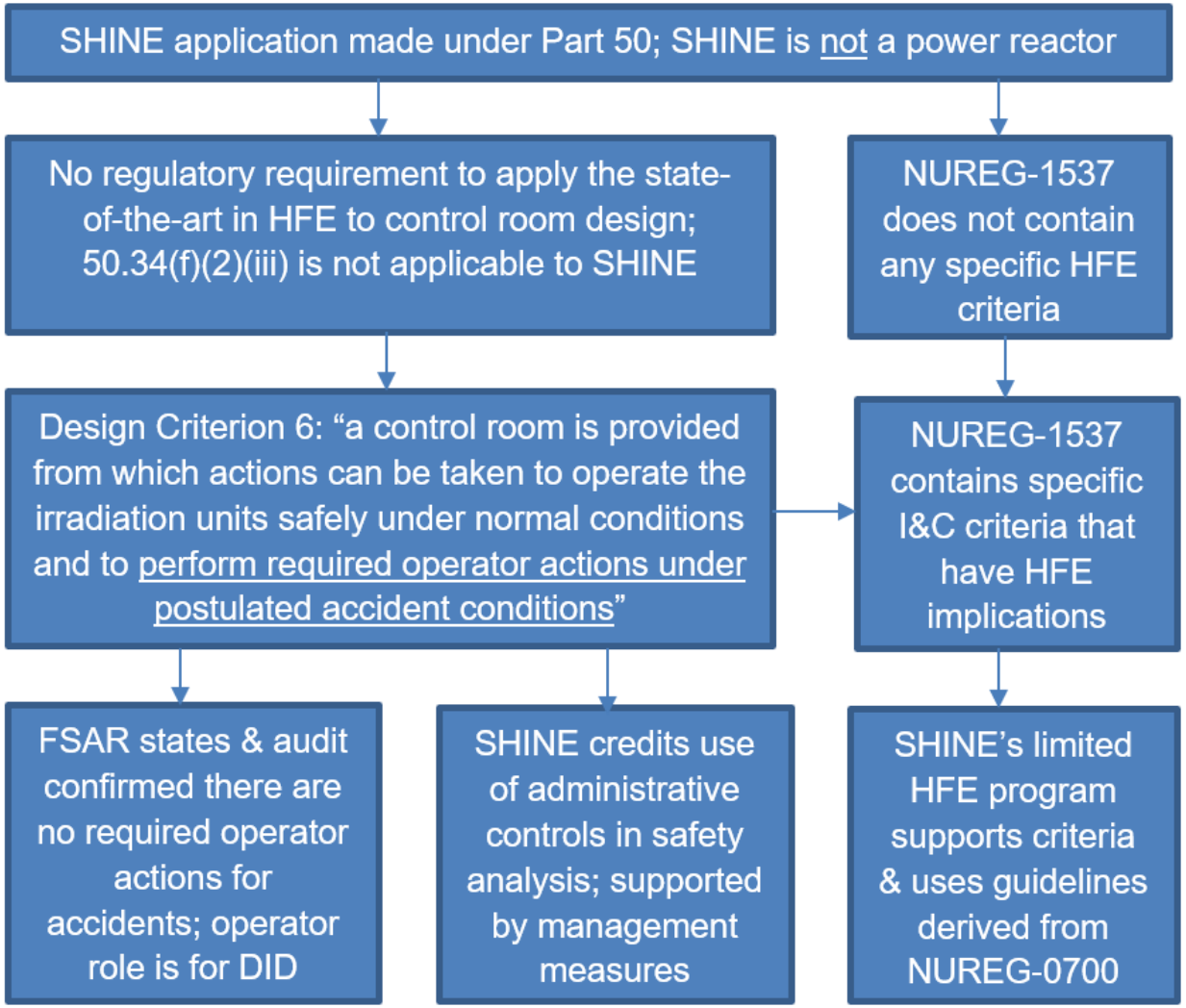
Regulatory Audit

- Used to scope review and understand operator role
- General topical areas covered included:
  - HFE program & control room design
  - operator role in facility safety & DID
  - operations staffing & training programs
  - administrative controls
- Reviewed documents included:
  - SHINE's Safety Analysis Summary Report
  - HFE program, style guide, & design checklist,
  - Operations Procedure Development
  - Licensed Operator Initial & Continuing Training Programs

Key Insights from Audit

- Role of operators with respect to safety at the SHINE facility is associated with:
  - DID actions (i.e., manual TRPS & ESFAS)
  - Implementation of administrative controls (note: there are no post-event mitigation actions)
    - This information was applied to scope the review used to make the regulatory findings
- HFE Program establishes design guidelines and implements a checklist for verifying HFE attributes during equipment design and following equipment installation; guidelines partly based on NUREG-0700

Overview of Review Approach & Basis



Technical Evaluation: Safety Displays
(NUREG-1537 Section 7.6)

The staff evaluated whether displays showing parameters related to facility safety would be readily observable by the operator while positioned at the SHINE facility control room operator workstations and the main control board

- Focus placed on workstations for PICS and NDAS, plus main control board TRPS and ESFAS indications
- Main control board accessibility & visibility considered
- Design of control room, display screens, and operator interfaces incorporates HFE principles
  - HFE guidelines include those for observability, content, readability, and arrangement of displays

Technical Evaluation: Controls and Displays (NUREG-1537 Section 7.6)

The staff evaluated whether other controls and displays of important parameters (including reactivity) are readily accessible and understandable to the operator.

- Evaluation focused on two sets of controls & displays:
  - Controls & displays unrelated to manual protection
  - Controls & displays for manual protective actions
- The displays used at operator workstations, supervisor workstation, and main control board are digital displays
- Display & interface design incorporates HFE principles
- Both TRPS and ESFAS indications and manual actuation controls are located at main control board

Technical Evaluation: Alarms
(NUREG-1537 Section 7.6)

The staff evaluated whether annunciators and alarms on the control console clearly show the status of systems (e.g., interlocks, TRPS & ESFAS initiation, and radiation)

- Alarms are integrated into the PICS display systems
- Stacklights produce audible alarm sounds and are programmed to represent both IU and non-IU alarms
- HFE design guidelines address the design of alarms
- Control room also contains a criticality accident alarm system and a panel for monitoring facility fire alarms

Technical Evaluation: Administrative Controls (NUREG-1537 ISG & NUREG-1520)

The staff evaluated whether the ability of SHINE operators to reliably implement administrative controls was adequately supported by SHINE's program for managing procedures

- SACs are incorporated into facility procedures
- Operating procedures are reviewed by management and controlled to ensure technical correctness
- Procedures are verified and validated prior to issuance for use within the facility

Technical Evaluation: Administrative Controls (NUREG-1537 ISG & NUREG-1520)

The staff evaluated whether the ability of SHINE operators to reliably implement administrative controls was supported by the training & qualification program

- Licensed operator training program contains topics on criticality control features and management measures
- Training is included within the areas of design features, reactivity, control systems, and uranium handling
- The operator training program utilizes a systems approach to training

Evaluation Findings and Conclusions

- HFE-related design and programmatic aspects for SHINE meet the HFE-related aspects of Criterion 6 within the specific context of the operator safety role
- HFE-related design aspects of control console and display instruments are acceptable because they:
  - meet the relevant NUREG-1537 criteria, and
  - are generally consistent with NUREG-0700
- HSI supports the manual initiation of safety systems
- Programmatic considerations are acceptable for:
  - procedures management
  - operator training & qualification

Note: backup slide(s) follow this point

Regulatory Basis: Additional Information

- SHINE is defined as a utilization facility under 50.2
  - 50.34(f) only applies to those applications either pending in 1982 or made under Part 52
    - 50.34(f)(2)(iii) for a control room design reflecting state-of-the-art HFE not applicable
  - 50.55a(h)(3) requires meeting the requirements for safety systems in IEEE Std. 603–1991; section 5.14 addresses HFE via IEEE 1023-1988
    - However, this applies only to power reactors
- Regulatory basis does **not** require an HFE program

Conduct of Operations

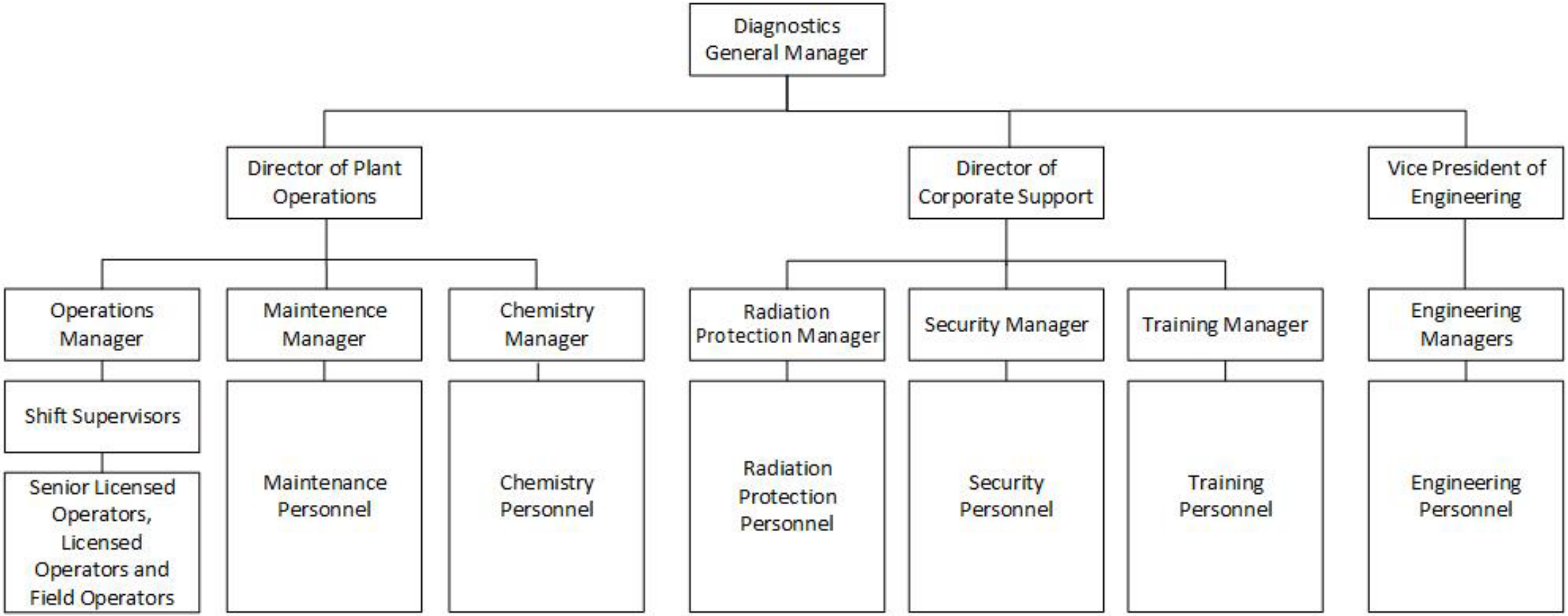
CATHERINE KOLB, SENIOR DIRECTOR OF PLANT OPERATIONS

Outline

- Organization
- Review and Audit Activities
- Procedures
- Required Actions and Reports
- Records

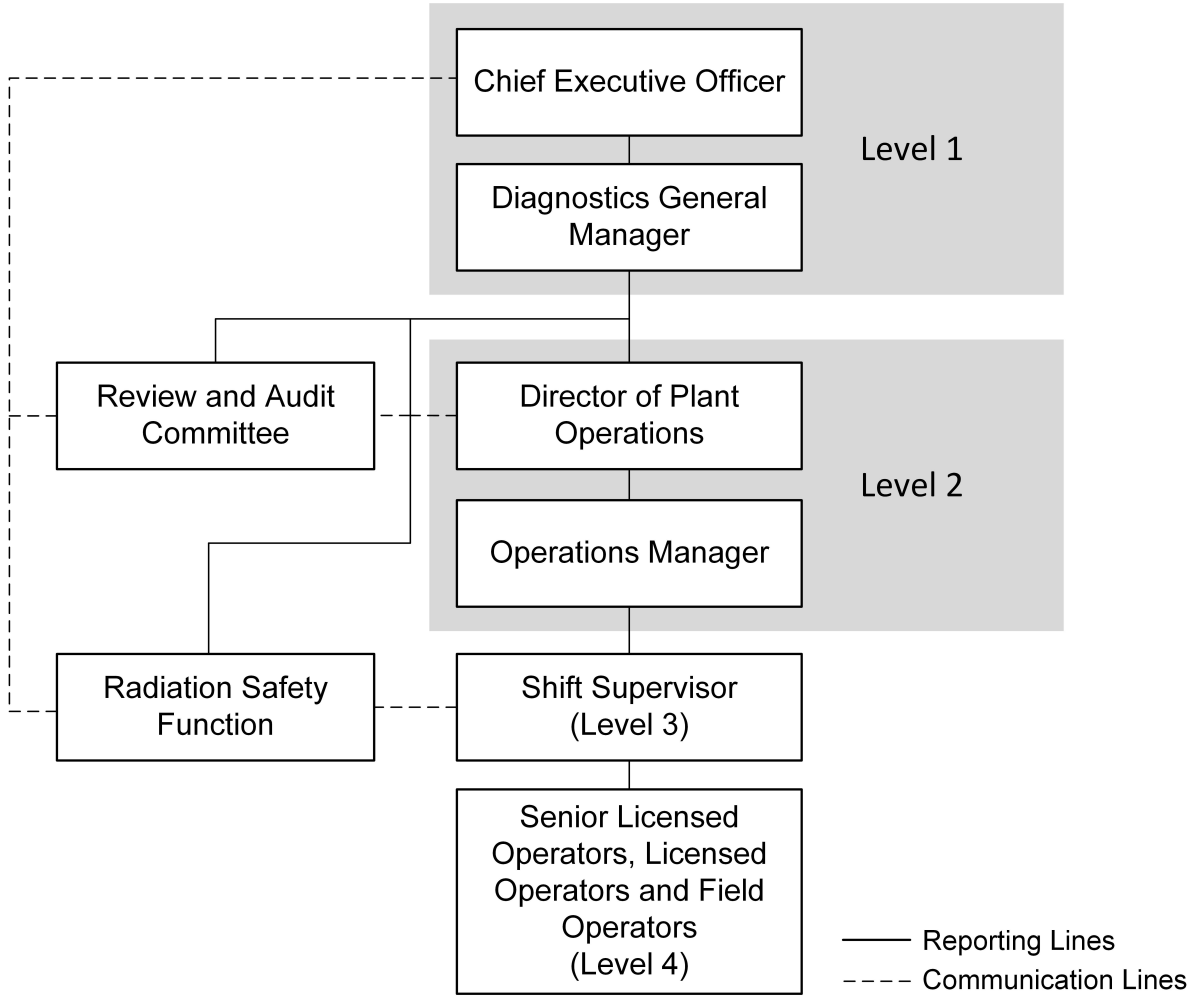
Organization

NORMAL ORGANIZATION CHART



Organization

TECHNICAL SPECIFICATION POSITIONS



Organization

MINIMUM STAFFING (PRESENT AT THE FACILITY)

- Shift Supervisor
  - Fills Technical Specification requirement for “Senior Licensed Operator”
  - Fills Emergency Plan requirement for initial “Emergency Director”
- Accelerator Operator
  - Must be present in the control room
  - Fills Technical Specification requirement for “Licensed Operator or second Senior Licensed Operator”
- Field Operator/Additional Accelerator Operator/Other Designated Individual (#1)
  - Fills Technical Specification requirement for “additional designated person”
- Field Operator/Additional Accelerator Operator/Other Designated Individual (#2)
  - Fills Emergency Plan requirement for initial “Emergency Communicator”
- Radiation Protection Individual/Other Designated Individual (#3)
  - Fills Emergency Plan requirement for initial “Radiation Safety Coordinator”
- Security Personnel
  - As required by the Physical Security Plan

SHINE

Organization

OPERATIONS CONDUCT

- Safety Culture
- Operational Authority
  - Only authorized individuals manipulate controls or are present in control areas
  - Turnover processes are defined
  - Configuration control of the facility is maintained
- Conduct and Professionalism
  - Performance monitoring of licensed personnel is conducted
  - Ancillary duties that may interfere with abilities to safety and effectively operate the facility are not assigned
- Training and Continuous Improvement
- Procedures and Operator Aids
  - Procedure adherence is expected
  - Operator aids shall be accurate and controlled, and are not used as a substitute for procedures

SHINE

Review and Audit Activities

- Review and Audit Committee Composition
  - Minimum Membership
    - Chair (Diagnostics General Manager or Designee)
    - Engineering
    - Operations
    - Radiation Protection
  - May include non-SHINE employees where required expertise is not available from SHINE employees
  - Facility operations personnel (reporting to the Director of Plant Operations) cannot constitute a majority

Review and Audit Activities

- Review Function
  - 10 CFR 50.59 safety reviews;
  - New procedures and major revisions having safety significance;
  - Proposed changes in facility equipment or systems having safety significance;
  - Proposed changes in, or violations of, technical specifications or License;
  - Violations of internal procedures or instructions having safety significance;
  - Operating abnormalities having safety significance;
  - Reportable occurrences; and
  - Audit/Assessment reports
- Audit Function
  - Facility operations for conformance to Technical Specifications;
  - Training and requalification program for operating staff;
  - Results of corrective actions affecting nuclear safety; and
  - Facility programs and plans

SHINE

Procedures

- Procedures provide direction for normal, abnormal and emergency situations
- Prepared, reviewed, approved, verified, and validated in accordance with document control processes and the Quality Assurance Program Description (QAPD)
- Procedure topics:
  - startup, operation, and shutdown of the irradiation unit;
  - target solution fill, draining, and movement within the SHINE Facility;
  - maintenance of major components of systems that may have an effect on nuclear safety;
  - surveillance checks, calibrations and inspections required by the technical specifications;
  - personnel radiation protection;
  - administrative controls for operations and maintenance and for the conduct of irradiations that could affect nuclear safety;
  - implementation of required plans (e.g., emergency, security); and
  - use, receipt, and transfer of byproduct material

SHINE

Required Actions and Reports

- Safety Limits
  - Pressure and temperature for the primary system boundary (irradiation units)
  - Pressure for process tanks containing irradiated uranyl sulfate (radioisotope production facility)
- Safety Limit Violation Required Actions
  - SHINE Facility operations shall be shut down immediately and operation shall not be resumed until authorized by the NRC
  - Reported to Level 2 management and the NRC
  - Safety limit violation report prepared, reviewed by the Review and Audit Committee, and submitted to the NRC

Required Actions and Reports

- Events Requiring a Special Report
  - Release of radioactivity from the site above allowed limits;
  - Operations with actual Safety System settings for required systems less conservative than the limiting safety system settings;
  - Operation in violation of limiting conditions for operation (LCO) established in Section 3, unless prompt remedial action is taken as permitted in accordance with the LCO actions;
  - A Safety System component malfunction that renders or could render the Safety System incapable of performing its intended safety function;
  - Abnormal and significant degradation of the primary system boundary;
  - Abnormal and significant degradation in the primary closed loop cooling system and the light water pool; and
  - Observed inadequacy in the implementation of administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition with regard to operations
- Actions for Occurrence of Events Requiring a Special Report
  - The affected processes or areas of the facility shall be returned to normal conditions or shut down
  - If shut down, operation shall not be resumed unless authorized by Level 2 management
  - Reported to Level 2 management and NRC
  - Occurrence reviewed by the Review and Audit Committee

Required Actions and Reports

- Operating Reports
  - Operating experience for each irradiation unit
  - Unscheduled shutdowns and corrective actions
  - Tabulations of major changes in the facility and procedures allowed under 10 CFR 50.59
  - Summary of radioactive effluents released
  - Summary of environmental surveys
  - Individual monitoring results required by 10 CFR 20.1502
- Other Special Reports
  - Permanent changes involving Level 1 or Level 2 management
  - Significant changes in the transient or accident analysis described in the FSAR
- Additional Event Reporting
  - 10 CFR 70.50 and 10 CFR 70.52, and SHINE-specific reporting requirements that meet the intent of Appendix A to 10 CFR Part 70
- Startup Report

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Records

- Lifetime Records
  - Gaseous and liquid radioactive effluents released to the environs;
  - Offsite environment-monitoring surveys required by the technical specifications;
  - Radiation exposure for all monitored personnel;
  - Drawings of the SHINE Facility; and
  - Records of reportable occurrences involving violations of safety limits, limiting safety system settings, and limiting conditions for operation
- Five Year Records
  - Normal SHINE Facility operation;
  - Principal maintenance operations;
  - Reportable occurrences;
  - Surveillance activities required by the technical specifications;
  - Facility radiation and contamination surveys where required by applicable regulations;
  - Radioactive material inventories, receipts, and shipments;
  - Approved changes in operating procedures; and
  - Records of meeting and audit reports of the review and audit committee
- One certification cycle
  - Records of retraining and requalification of licensed operations personnel

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Advisory Committee on Reactor Safeguards

SHINE Medical Technologies, LLC Operating License Application

Chapter 12 – Conduct of Operations

Steven Lynch
Chief, Advanced Reactor Policy Branch
Office of Nuclear Reactor Regulation

July 20, 2022

Scope of Review

- Section 12.1, “Organization”
  - Describes various levels of organization, including reporting and communication lines
- Section 12.2, “Review and Audit Activities”
  - Describes composition and qualifications; charter and rules; review functions
- Section 12.3, “Procedures”
  - Describes review and approval process for procedures, including changes to procedures
- Section 12.4, “Required Actions”
  - Describes the required actions, as provided in the technical specifications, to be taken
- Section 12.5, “Reports”
  - Provides the content and timing of submission of annual operating and special reports
- Section 12.6, “Records”
  - Describes the scope of record management program from identification to disposition

Regulatory and Guidance Framework Used

- The applicable regulatory requirements for the evaluation of SHINE's conduct of operations are as follows:
  - 10 CFR 50.34, "Contents of applications; technical information," paragraph (b)(6).
  - 10 CFR 50.40, "Common standards."
  - 10 CFR 50.54, "Conditions of licenses," paragraphs (i), (j), (k), (l), and (m)(1).
  - 10 CFR 50.57, "Issuance of operating license."
  - 10 CFR Part 20, "Standards for Protection Against Radiation."

- NUREG-1537, Interim Staff Guidance Augmenting (ISG) NUREG-1537, Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Standard Review Plan and Acceptance Criteria."
- ANSI/ANS 15.1-2007, "The Development of Technical Specifications for Research Reactors"
- ANSI/ANS 15.4-2016, "Selection and Training of Personnel for Research Reactors."

Evaluation of Final Safety Analysis Report

- SHINE generally followed the guidance in ANSI/ANS 15.1-2007 and ANSI/ANS 15.4-2016, which is consistent with the information needs described in the ISG Augmenting NUREG-1537 to satisfy applicable regulatory requirements

- SHINE took some exceptions were taken to the guidance documents to account for SHINE not being a research or test reactor; having irradiation units containing an aqueous target solution; and having a production facility

Summary of Exceptions

- In Section 12.2.3, “Review Function, the NRC staff finds it acceptable that SHINE has excluded experiments from its list of items to be reviewed since it will not be conducting experiments at its facility.

- In Section 12.2.4, “Audit Function,” the NRC staff finds it acceptable that SHINE has included its quality assurance program description, physical security plan, and nuclear criticality safety program within the scope of items to be audited as this goes beyond the minimum provided in ANSI/ANS 15.1-2007.

- In Section 12.3, Because SHINE is not a reactor, the NRC staff finds it acceptable that the topics for which written procedures will be prepared, reviewed, and approved, will include topics related to SHINE’s IUs and target solution. The NRC staff also finds that it is acceptable for SHINE to exclude topics related to experiments since it will not be conducting experiments at its facility.

- In Section 12.4, Because SHINE is not a reactor, the NRC staff finds it acceptable for SHINE to use language encompassing operations and processes within both its irradiation facility (IF) and radioisotope production facility (RPF) as being withing scope of reportable events and actions to be taken should a reportable event occur.

Summary of Exceptions

- In Section 12.5, for annual operating reports, the NRC staff finds the following deviations from ANSI/ANS 15.1-2007 acceptable:
  - Exclusion of the tabulation of new tests or experiments because SHINE will not be performing tests or experiments at its facility
  - Providing results of individual monitoring carried out by SHINE for each individual for whom monitoring is required by 10 CFR 20.1502, “Conditions Requiring Individual Monitoring of External and Internal Occupational Dose,” because this is more conservative than the criterion provided in ANSI/ANS 15.1-2007
- In Section 12.6, For the records to be maintained for five years or for the life of the component involved if less than five years, the NRC staff finds the following deviations from ANSI/ANS 15.1-2007 acceptable:
  - Exclusion of records for experiments because SHINE will not be performing experiments at its facility
  - Maintaining records for radioactive material inventories rather than fuel inventories because SHINE will have special nuclear material in the form of an aqueous target solution rather than heterogeneous fuel

Evaluation Findings

- SHINE has presented an organizational structure that reflects the complete facility organization from the license holder to the operations staff. All organizational relationships important to safety have been shown, including the review and audit function and the radiation safety function.
- The responsibility for the safe operation of the facility and for the protection of the health and safety of the SHINE staff and the public has been shown.
- Consistent with the requirements of 10 CFR 50.54, paragraphs (i), (j), (k), (l), and (m)(1), SHINE's minimum staffing ensures that manipulation of controls of the facility will be performed by licensed operators or senior operators as provided in 10 CFR Part 55
- SHINE describes the necessary experience, education, and training for each of the four qualifications levels and other technical personnel. SHINE also provides for radiation training consistent with the requirements in 10 CFR 19.12, "Instruction to Workers."
- SHINE has described a radiation safety organization that is acceptable. This organization has direct access to upper management and the review and audit committee to express concerns, if necessary. The radiation safety staff has the authority to interdict or terminate activities to ensure safety.

Evaluation Findings

- The review and audit committee members appear to be well qualified, with a wide spectrum of expertise. The committee membership includes provisions for including persons from outside the company.
- SHINE has proposed a charter and rules that describe the number of times the committee meets, the way the committee conducts business, the requirements for a quorum when voting, and the way the committee distributes its reports and reviews.
- SHINE has proposed a comprehensive and acceptable list of items that the committee will review and audit.
- SHINE has proposed a set of required procedures that is appropriate to operation of the facility, and that the process and method described by SHINE will ensure proper management control and proper review of procedures.

Evaluation Findings

- SHINE has defined a group of incidents as reportable events and has described the required actions it will take if the reportable event occurs. The definition of reportable events gives reasonable assurance that safety-significant events will be reported by the applicant.
- SHINE has proposed actions to be taken if a safety limit is violated or a reportable event occurs. The NRC staff has determined that SHINE will take whatever actions are necessary to protect the health and safety of the public.
- SHINE has described the content, the timing of the submittal, and the distribution of the reports to ensure that important information will be provided to the NRC in a timely manner.
- SHINE has described the types of records that will be retained by the facility and the period of retention to ensure that important records will be retained for an appropriate time.

Startup Plan

THOMAS DRURY, COMMISSIONING COORDINATOR

Overview

- Purpose
- Administration
- Facility Tests
- Irradiation Unit Tests

Purpose

- Startup Testing is conducted to ensure the as-built facility conforms to the design and that the specified safety functions of structures, systems, and components (SSCs) are achieved.
  - Verify key parameters necessary for the safe operation of an irradiation unit (IU)
  - Verify key parameters necessary for the safe handling of special nuclear material outside the IU
  - Ensure that operating characteristics are well understood
    - Confirm calculational parameters
    - Establish operational parameters including setpoints
  - Ensure the safety of the plant is not dependent on the performance of untested SSCs

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Administration

- Performance of tests
  - Startup testing is conducted in accordance with approved test procedures and test plans
    - Acceptance criteria predefined
  - Led by qualified personnel
  - Deficiencies documented and dispositioned
- Startup test report
  - Methods and objectives
  - Comparison with acceptance criteria
  - Design and construction deficiencies
  - Justification for acceptance of non-conformances
  - Results of test
  - Submitted within 6 months of the completion of all startup testing activities

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Facility Tests

- Facility tests conducted to verify operation of systems outside of the IUs
  - Verify ability to handle uranium and produce target solution via performance of the first evolution of target solution preparation
  - Test and balance process vessel vent system flowrates to ensure adequate sweep gas flow for hydrogen mitigation
  - Verify operation of the vacuum transfer system's ability to transfer target solution between storage locations
  - Ensure functionality of the tritium purification system
  - Standby generator automatic start and load capability

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Facility Tests

- Facility tests conducted to verify design parameters
  - Direct dose measurements are compared to expected dose rates in accordance with Radiation Shield Test Program.
  - Operability of uninterruptible electrical power supply system (UPSS) in accordance with technical specifications
    - Voltage and specific gravity
    - Charger and invertor voltages
    - Capacity
  - Functionality of instrumentation for both safety-related and nonsafety-related control systems

Irradiation Unit Tests

OPERATIONAL CHARACTERISTICS

- Verify target solution vessel (TSV) filling and drain rates conform to design specifications
- Neutron driver extensively tested for leakage, operability, stability, and yield
- TSV off-gas system (TOGS)
  - Water holdup
  - Primary boundary leakage
  - Sweep gas flow rate
  - Iodine removal
- Primary closed loop cooling system (PCLS)
  - PCLS ability to automatically maintain temperature tested
  - Flow characteristics tested
  - Integrity tested by periodically sampling for radioisotopes indicative of leakage

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Irradiation Unit Tests

SUBCRITICAL ASSEMBLY SYSTEM NUCLEAR PHYSICS PARAMETERS OPTIMUM CONCENTRATION, CRITICAL HEIGHT, AND CALCULATIONAL BIAS

- Optimum Concentration
  - Calculations predict an optimum concentration (OC)
  - TSV to be filled four times with solution approximately 5% below to 5% above calculated OC
  - Fill two more times with concentration determined from interpolation of previous results
  - OC based on interpolation of previous results
- Critical Height
  - TSV filled with optimum concentration OC+5% and OC+10%
  - Comparison of critical height vs. concentration calculations
- Calculational Bias
  - Bias estimated in terms of uranium concentration and reactivity based on results from OC and critical height startup plans

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Irradiation Unit Tests

SUBCRITICAL ASSEMBLY SYSTEM NUCLEAR PHYSICS PARAMETERS REACTIVITY COEFFICIENTS

- PCLS reactivity worth
- TOGS holdup reactivity worth
- Temperature reactivity coefficient
- Void reactivity coefficient

Irradiation Unit Tests

NEUTRON FLUX DETECTION SYSTEM CALIBRATION

- Initial calibration is similar to annual calibration
- Without calibrated power and wide range neutron flux detection system (NFDS) channels, power is limited by limiting neutron production
- Few hour run at approximately 10 percent power
- Potential for intermediate power run
- Few hour full power run
- Additional full power runs at higher concentration/lower fill height to investigate detector sensitivity to solution geometry

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Chapter 12.11 - Startup Plan

Michael Balazik
Project Manager/Inspector
Office of Nuclear Reactor Regulation

July 20, 2022

Regulatory Basis

- Regulatory Requirements
  - 10 CFR 50.34, “Contents of applications; technical information”
    - (b)(6)(iii) Plans for preoperational testing and initial operations
  - 10 CFR 50.40, “Common standards”
  - 10 CFR 50.57, “Issuance of operating license”

Guidance and Acceptance Criteria

- NUREG-1537, Part 1, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content,” issued February 1996;
- NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria,” issued February 1996;
- Final Interim Staff Guidance (ISG) Augmenting NUREG-1537, Part 1 and Part 2, for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors

Summary of Application (continued)

- Identified tests and measurements to
  - Verify safety significant facility parameters
  - Verify parameters for safe handling of special nuclear material
  - Validate operating characteristics of the facility

- Specific test plans will contain acceptance criteria

- Required to submit startup report
  - TS 5.8.4 requires startup report submission within 6 months of startup activities

Summary of Application (continued)

- Identified system testing for facility and IUs
  - Calibrations of equipment
  - System flow, fill, and drain rates
  - Leak rates (boundary integrity)
- Identified nuclear parameters:
  - Uranium concentration
  - Critical height
  - Temperature and void coefficients
  - TOGS/PCLS reactivity worth
  - Neutronic bias
  - Flux distribution
  - Radiation measurements

Evaluation Findings and Conclusions

- Identified plans to validate safety significant parameters
- Plan to develop acceptance criteria based on FSAR design information for the startup test procedures
- Submit startup report 6 months of completion of startup activities
- Implementation of the startup plan provides reasonable assurance the facility can operate as described in the FSAR
- NRC will conduct inspection activities to confirm readiness of the startup test program

Startup Test Program Inspection

- NRC staff is developing a SHINE facility specific inspection plan that includes inspection of the SHINE startup test program.
- Verification of acceptance criteria
- Inspection Procedure (IP) 69022, “Inspections of Operational Readiness During Construction of Non-Power Production and Utilization Facilities”
  - Operational Program Inspections – use existing operational IPs as guidance
- Apply certain guidance in IP 72401, “Part 52 Inspection of Startup Test Program”