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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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RESEARCH AND TEST REACTORS SUBCOMMITTEE

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WEDNESDAY, FEBRUARY 3, 2016

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Dana A. Powers, Chairman, presiding.

COMMITTEE MEMBERS:

DANA A. POWERS, Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR., Member

MICHAEL L. CORRADINI, Member

JOY REMPE, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

ACRS CONSULTANT:

WILLIAM SHACK

DESIGNATED FEDERAL OFFICIAL:

QUYNH NGUYEN

ALSO PRESENT:

ALEXANDER ADAMS, NRR

ROBERT BEALL, NRR

HOWARD BENOWITZ, OGC

TONY BOWERS, NRR

RICHARD CLEMENT, NRO

KEVIN FOLK, NRR

MIRELA GAVRILAS, NRR

ELIZABETH GORMSEN, ICF

DUANE HARDESTY, NRR

JERRY JENKINS, TRTR*

MARVIN LEWIS, Public Participant*

KOSMAS LOIS, NRR

MICHAEL MORLANG, NRR

*Present via telephone

A G E N D A

P R O C E E D I N G S

8:30 a.m.

CHAIRMAN POWERS: The meeting will now come to order, Mr. Brown, whether you're finished or not. This is a meeting of the Research and Test Reactor Subcommittee and Advisory Committee on Reactor Safeguards.

I'm Dana Powers, Chairman of the Subcommittee. ACRS members in attendance today are -- and I said only Mr. Look Around is here, but in fact we have the esteemed Dr. Joy Rempe, noted authority on reactors and reactor safety, and world traveler.

(Laughter)

CHAIRMAN POWERS: We have Mr. Brown, prestigious member of the technical community with expertise in digital I&C. We have the Chairman of the ACRS, Dennis Bley, who has graced us with -- actually just doesn't trust me chairing the Subcommittee so he's here overseeing to make sure I do it right. He has brought and marshaled with him the Vice Chairman of the ACRS, Dr. Michael Corradini, esteemed professor of the University of Wisconsin, a member of the National Academy of Engineering, noted abroad --

MEMBER CORRADINI: Useless stuff.

CHAIRMAN POWERS: Useless stuff.

(Laughter)

CHAIRMAN POWERS: We have John Stetkar, former Chairman of the ACRS who will be particularly interested in risk analysis. And Mr. Gordon Skillman, noted authority on the operations and maintenance of nuclear reactors, especially specialized reactors. And we have Professor Ron Ballinger from the Massachusetts Institute of Technology, one of the nation's premier institutions.

(Off mic comment and laughter)

CHAIRMAN POWERS: Located, however, in the People's Republic of Cambridge.

MEMBER BALLINGER: From which half the people on this Committee have come from.

CHAIRMAN POWERS: Which half?

MEMBER BALLINGER: Stetkar.

CHAIRMAN POWERS: Okay, those people from the People's Republic of Cambridge have lost their voting privileges here. Mr. Quynh Nguyen is the Designated Federal Official for this meeting and he tries to keep me on track and probably fails miserably, isn't that right?

As announced in the Federal Register on January 14th, 2016, and I'm sure everyone poured over that announcement in detail. The subject of today's briefing is the review of the proposed rulemaking regarding the streamlining of a non-power production or utilization facility license renewal process. The rules for participation in today's meeting were also announced in the Federal Register notice.

We have a telephone bridge line. We have tried to be inoculated for this but apparently vaccines failed to prevent one from having telephone bridge lines. The bridge line is there for the public and stakeholders to hear the deliberation. This line will not carry any signal from this end if we need to enter into a closed meeting. Also to minimize disturbance the line will be kept in a listen-in only mode until the end of the meeting when 10 minutes are allocated for public comments. At that time, any member of the public attending this meeting in person or through the bridge line can make statements or provide comments, if they desire. This is, indeed, a Subcommittee meeting and I would invite people in the audience if they have comments pertinent to the deliberations to feel free to get my attention and be recognized. We do have microphones distributed around the room.

The ground rule, of course, is that if you do make a comment you have to state your name clearly so that we get you on the public record because memories on the Committee are not too good and we sometimes have to go back to the record to remember what the hell was said.

The meeting is being transcribed and I request that participants in the meeting use the microphones located throughout this room when addressing the Subcommittee. Participants should first identify themselves and speak with sufficient clarity and volume so they can be readily heard. If you don't know it, please silence all cell phones. The consequences for failing to do that are draconian and horrific.

I think we are now -- I think I have drug this introduction out to the point that we are now ready to begin the meeting. So I'm going to ask Mirela if she'd like to make an opening comment.

MS. GAVRILAS: Thank you very much, Dr. Powers. I'm Mirela Gavrilas. I'm the Deputy for Research and Test Reactors in the Division of

Policy and Rulemaking in NRR and would like to set the context for what we're going to discuss today.

We had the benefit of interactions with Dr. Powers to lay out our presentation and you're going to see two things today. We'll devote most of the morning to hearing about the technology behind RTRs and the afternoon we'll get into the specifics of the rulemaking.

In terms of general background, the Atomic Energy Act singled out the research and test reactors for minimal regulation, so basically we acknowledged that the intent was for us to create as little of a regulatory burden as possible on our licensees in regulating them. And we think that this proposed rule is consistent with that tasking.

In terms of risk profile for research and test reactors they're unique. When we think risk in general we think about consequences to the public. As you'll see in the presentation this morning, much of the thinking that goes into protecting and provisioning RTRs for safety pertain to the workers because the main risk comes from the experiments that can be conducted there, and that's how the safety features are set up, and hence the regulatory framework.

One more important remark. I'm going to get into the nine aspects of the rulemaking. There's nine things that we're proposing to do. One was, as you all know we're going -- the Agency is going through a re-baselining effort so we're basically trying to shed those activities that have little contribution to our mission. And one of the things that was proposed was this rulemaking was proposed for shedding because it's a medium priority rulemaking because of the relatively low safety significance of RTR. However, the management of the Agency looked at it and realized that this rule is actually an efficiency, so in the name of creating efficiency this rulemaking was preserved because it does create, as you'll see from the regulatory analysis part, it does create efficiencies both for us and most especially for our licensees.

So there are nine aspects. There's no ornaments on this Christmas tree. The rulemaking is very -- is laid out to accomplish only that what we need to accomplish, and there are nine aspects to it. The first one is to create a definition for non-power production or utilization facility. The second one is to eliminate license terms for facilities other than test reactors of which there's one, to define license renewal under 10 CFR 50.22, to require all licenses to submit routine FSAR updates. RTRs are unique in regard to FSARs because unlike power reactors we don't have a regular required update to the FSAR and that can be problematic, so that's a problem that this rule is intending to address.

The next objective is to revise the current timely renewal provision because for RTRs they apply at the last minute, they're untimely with renewal, and that has traditionally caused significant problems to the Staff because we accept it rather than shutting them down. We accepted their applications, and in many cases that application needed significant revision, so you'll hear more about that I'm sure this morning.

Finally, we want to revise the accident dose criteria to 1 rem. We want to extend the applicability to 50.59 to RTRs regardless of decommissioning status, and we need to clarify meeting the provisions of 51.45 regarding the environmental report.

And finally, again consistent with the direction in which we're heading with power reactors we're aiming to remove the requirement for financial qualification.

So the gentlemen will introduce themselves but you have in front of you the people who were the core of this rulemaking, and with that I'm just going to turn it back to Dr. Powers.

CHAIRMAN POWERS: Thank you. Do any of the Members on the Committee want to have -- pose opening questions in light of that introduction?

MEMBER REMPE: Sure.

CHAIRMAN POWERS: Dr. Rempe.

MEMBER REMPE: Yes, okay. I'm familiar, not as much as Professor Ballinger but with the MIT reactor, and I'm not as familiar with the NIST reactor, but why is the NIST reactor separated -- yes, it has a higher power level but its mission to do testing is similar to the MIT reactor. And why is that one separated out other than it's a federal facility versus university or the higher power level?

MS. GAVRILAS: So I will answer a little bit, and then I'm going to turn it over to Al. But basically its not our sister regulation. The regulation sets the threshold for what's going to be a test reactor, and actually indeed for NIST it's based on the power level. They exceeded the threshold in the regulation that demarcates research reactors from test reactors, but there's other provisions, and Al will get into it. For example, you could have a large reactivity insertion because there's experimental work of a certain diameter that passes into test reactor, so -- and again, Al will talk more about it. It doesn't have to do with mission but the regulations are very specific what the thresholds are.

MEMBER REMPE: Okay.

MS. GAVRILAS: We question the threshold and we can tell you that we pulled that string and we're not clear on the rationale behind the threshold, but that's the threshold.

MEMBER REMPE: Okay, thank you.

MR. ADAMS: Would you like to hear more about it now or later?

MS. GAVRILAS: It's up to you.

CHAIRMAN POWERS: If you're going to cover it later, I think it's probably worthwhile to cover it later.

MR. HARDESTY: This is Duane Hardesty from Research and Test Reactors. The one thing I will say is that we tried very hard from the get-go to include all of them because of the similarity in their mission and the fact that when we regulate them they do have low consequence, but we were stymied by the regulations and how they classify testing facilities is what ended up happening; all the additional things that are required for NIST that aren't required for the other Class 104s.

MEMBER CORRADINI: Say that last part again.

MR. HARDESTY: The things that are required for NIST like meeting before you for license renewal, for mandatory hearings and things that are required of a testing facility just like they are for a Class 103 nuclear power reactor. Those stymied us from including them in this rulemaking in more ways than one.

MEMBER CORRADINI: Okay.

MR. ADAMS: I guess since Duane's talking about it, so back in the late '50s, you know, a threshold was determined where the regulatory process would become more rigorous, and you can assume that that was based on safety significance. And there's two ways to become a test reactor; one is pure power level, above 10 megawatts you're a test reactor. You can also become a test reactor above 1 megawatt if you have certain features, and those features are liquid fuel loading. And I think we touched upon that when we discussed the SHINE technology with the Committee, in core fuel testing loop, you know, akin to what you would see at the advanced test reactor, or a experimental facility in the core of the reactor greater than 16 square inches in cross section. And we believe -- you know, if you think about it we can come up with the safety reasons for that, you know, liquid fueled reactors, you know, the gaseous fission products are -- create a challenge in handling them unlike say solid fuel loadings. The fuel -- the circulating fuel test loop, again you're testing fuel in a circulating loop which creates a greater probability for a release of fission products.

The 16 square inches, that's kind of an interesting one. We traced that back to either dropping an MTR fuel element in the middle of an operating core which would be a very large reactivity insertion or I guess if you have really good aim the standard 4 inch by 4 inch graphite log. So there -- you know, if you think there are technical reasons for drawing a line.

Now what we tried to do is figure out if that line makes sense given what we know about fission product behavior and technology today, and because we could not clearly understand why the decision was made in 1957, for example, I think at the first meeting of this Committee that regulation was one of the things that was discussed. We can find indications of paperwork that there was a discussion between the Committee and the AEC regulatory licensing staff but the details of those discussions are not -- were not in any of the paperwork.

Given that, when you cross that threshold the regulatory process changes. Some examples Duane talked about that your application comes in front of the ACRS. You may recall that this Committee looked at and reviewed the license renewal for the NIST reactor, and this Committee was involved in the NIST reactor because it was a testing facility. Mandatory hearing in front of the Commission for your construction permits, again similar to SHINE. Environmental Impact Statement is required to be produced by NRC versus starting with an EA and seeing where that leads you.

Another important thing is the siting requirements of 10 CFR Part 100 apply to test reactors and not research reactors. So the regulations flow from that greater risk. And, indeed, you talk about the function of the reactor, a number of years ago we did have a petition for rulemaking to change the definition of test reactor based just on function; that hey, I'm not testing anything. I'm doing the functions of a research reactor. Even though I'm above 10 megawatts why should I be a test reactor? And we at that point, you know, we pulled the string a lot to figure out what the definition was, and ultimately we ended up rejecting that petition for rulemaking because if it would have -- if we would have granted it the way it was requested you could have a 2,000 megawatt research reactor, that threshold where risk increases, where the licensing process should become more rigorous would be lost. Although, you know, as what you said, that given today's facilities, you know, the activities that NIST does is not what you would think of the traditional testing reactor activities akin to what the advanced test reactor does. So sort of tried to fill in some of the gaps for that.

MEMBER REMPE: Thank you.

MEMBER BROWN: What was your power level

limit again? My brain hasn't awakened yet.

MR. ADAMS: It's 10 megawatts straight thermal power or 1 megawatt with additional design feature, the in core hole being liquid fuel loading or the circulating fuel test --

MEMBER BROWN: So if you're 10 megawatts exactly it's okay, but if you're 10,001 you're not.

MR. ADAMS: Yes. I mean, you know, you see that all over in the regulations that, you know, we draw lines all over the place where --

MEMBER BROWN: That's down to the line. The Missouri-Columbia one.

MR. ADAMS: Yes. Missouri is licensed at 10 megawatts and they're a research reactor. If they would be licensed at 10.001 megawatts they'd be a test reactor.

MEMBER SKILLMAN: Dana, replying to your--

CHAIRMAN POWERS: Yes, Mr. Skillman?

MEMBER SKILLMAN: -- question. I'm curious in the discussions today to hear about licensing burden and streamlining. It seems that a lot of what we're going to talk about today is being based on the issue of streamlining, but it seems to me there's a soft undercurrent here of licensing burden. I recognize that all of nuclear power is an expensive undertaking and it's particularly difficult for small operators with limited funds to meet burdensome requirements. On the other hand, some of the requirements have served the public and the people at the reactors very, very well, and has protected them. It seems to me that there is an exercise here to make sure that under the guise of streamlining we fail to provide the protections that are necessary particularly for the students and the workers at the small facilities, and also for the public.

MR. ADAMS: And I think you have hit the nail on the head as to what I think the fundamental question that we need to discuss with this Committee, is that given all the processes we have in place that we'll talk about today, given what this rulemaking will add to those processes, then the question becomes does what we do now every 20 years in some cases we haven't looked in 40 years, is that 20, 30, 40 year look that we call license renewal that we do today, does it significantly add to safety? And that's the question we asked ourselves over and over again. And again, given that the Atomic Energy Act doesn't require a term on these types of facilities, given minimum regulation, given our development of -- just in 1996 was the first time we had format and content guidance and a standard review plan that we are now in the set of license renewals we're doing today, and we've been doing for the past several years that included NIST that we're applying our guidance to these license renewals where we have a good safety base to build upon, given that, and then given these changes does every 20 years, every 30 years, every 40 years having this license renewal discussion, you know, enhance safety or contribute to safety? We've asked ourselves that question many times as we move forward on this and we've come to the conclusion that it really doesn't; that it basically consumes a lot of resources without a commensurate return on safety. So I think that's the basic question.

MEMBER SKILLMAN: I'll also be curious to hear how the proposed change in requirements affect daily scrutiny at these small facilities. A lesson from the Merchant Marine and a lesson from those who have gone to sea, and a lesson from all of us who have worked in the plants is that you must look carefully constantly. You don't walk away from one of these machines and ignore it for days, or weeks, or months. The devil is in the detail, and unless you're doing your rounds, unless you're keeping track it's possible that a very low threshold item grows into an item of such significance you now have a safety issues, where had you attended to it a week, or two weeks, or a month before that would have been of no consequence. So there is hiding within this streamlining the potential for a long time period of low vigilance and I believe that that's something that we need to hear about.

MR. ADAMS: And, you know, I think we need to have that conversation in that area, but that's another example where we did ask ourselves the question given the processes we have in place that are, you know, applied continuously what does, again showing up every 20, 30, 40 years and doing a license renewal add to that day to day vigilance, that day to day safety? And again, we came to the conclusion that it's not significant. So again, I think these are exactly the kind of things we want to talk about with the Committee.

CHAIRMAN POWERS: Any other comments that members of the Subcommittee would like to make? Hearing none, I will call on Mr. Hardesty to begin the presentation.

MR. HARDESTY: Okay. So we've gone over a few -- touched on a few things that I'm going to hopefully talk about in a little bit more detail. I'm here today before you guys for a new passionate project I've been involved with, and obviously it's a Navy project that I know most of you from, was something that was a great success and I come here to you today with equal vigor and belief in this project. I've been working on this since 2010. We took a little bit of hiatus for 18 months there to get the ford out, and we went through several iterations as Mirela alluded to about funding, not funding this rule. And, ultimately, this was deemed something that was the right way to go, and so with that I would like to start off by getting everyone up to speed on what the community of licensees that this rulemaking touches, will explain who they are, what they do, and we'll give you a little bit of categorization about how we view them, and why we think that they're -- essentially the risk profile will allow us to proceed with these non-expiring license, just like Mr. Skillman had mentioned. And then I'll turn over the presentation for a little bit deeper dive into the technical content, our technical aspects of the various types of reactors that we currently regulate. But the one thing I'm going to point out early on is this new name that we have, NPUF, for our facilities because everything you'll hear about will be in terms of NPUF, but regulatorily that doesn't exist. So I just want to caveat that, explain to everybody that term. But in general, the one thing that is important to know is that everything that exists now is categorized as a research or a testing facility, research reactor testing facility, and then of course we have the SHINE and Northwest Medical Isotope facilities, but I'll get into that as we go ahead with this.

So the regulatory authority for licensing both nuclear power reactors and our non-power facilities are contained in Section 101 of the Atomic Energy Act of 1954, as amended, which I'll just simply refer to as the AEA or the Act from hereon out. All of the --

MEMBER BLEY: Excuse me a second. Richard, would you watch your paper on that microphone? Thank you.

MR. CLEMENT: Thank you.

MR. HARDESTY: Okay. All of the power reactors and the non-power facilities --

MEMBER BROWN: Explain.

MR. HARDESTY: Pardon?

MEMBER BROWN: For the somewhat uninitiated since I'm not familiar with all the nuances of research vice test --

MR. HARDESTY: I will absolutely go over that.

MEMBER BROWN: You're going to discuss that during the --

MR. HARDESTY: Yes, sir.

MEMBER BROWN: Thank you.

MR. HARDESTY: I certainly will. So the framework I'm trying to establish right now is that we're all -- all of the facilities that are in Part 50 or Part 52 licensing, Part 52 being specific to the power reactors, come from 103 and 104 of the Atomic Energy Act. However, most of our facilities, those research and test reactors are in the 104, and so that's what I'm going to go into the detail of.

The Section 103 facilities are the commercial licenses. Now this is where all the power reactors lie, but it also contains our commercial facilities; for example, SHINE will be licensed as a Class 103. And then the Section 104 reactor is the research and testing facilities are classified under 104A and C of it.

Just to go into a little bit more of how those are divided up before we start concentrating only on the non-power facilities, I just wanted to point out some of the basic differences between a power versus a non-power facility. Obviously, the power reactors, their concentration is making electricity. They want the maximum possible heat and energy generation that they can have, very large core volumes, operating at maximum power density for long periods of time; whereas, the goal of a research facility, a non-power facility is to make radiation. They want to make neutrons, they want high flux in their beam traps, they want -- in their beam ports and their traps so that they can do experiments. They have very high irradiation flux positions so that they can get the highest fluence possible to do these experiments. And in contrast to a power reactor they want the lowest possible power fuel consumption and stored energy that they can have to accomplish that, so all of our facilities on the non-power side range from 5 watts to 20 megawatts, the 20 megawatt facility being the NIST, our testing facility; versus the power reactors which are all very high powered, greater than 1,000 megawatts and much higher than that typically. And those facilities operate at high temperature, high pressure saturation conditions; whereas, the non-power facilities generally operate at atmospheric pressure and very low temperatures. They have passive simple safety systems because that's all they need; whereas, we know that the power reactors have very complex safety systems.

And then finally the contrast between having this low peaking factor, low leakage core with a very high stored energy on the power reactor side versus a very high leakage core by design so that they can get that -- feed those beam tubes with those neutrons and a high peaking factor in the flux trap for experiments, and a compact core design, very small design.

So with that, I'll go into the specifics about the 104 type facilities. Again, we'll get into it later mostly in the rule where the license renewal that we're proposing for the commercial facilities and NIST is no different than it is now. It's just clarified. But generally the -- or in general rather the non-expiring license applies to these research and medical therapy license, the Class 104(a) and 104(c). For completeness, I've also included the 104(b) which is the commercial demonstration reactors. They are considered power reactors, they're not considered research facilities under our licensing branch, so all of our facilities are either licensed as -- well, actually they're all licensed as 104(c) for research and development, and one facility which is MIT also holds a Class 104(a) license for medical therapy.

MR. ADAMS: Can I step in for a second? When we say medical therapy we're not talking about the production of radioisotopes like we talked about for SHINE. It's -- medical therapy is the application of the reactor itself as the medical therapy device, boron neutron capture therapy in which neutrons from the reactor were used in conjunction with a boron-containing drug given to the patient to fission the boron at the cancer site within the body and apply the therapeutic results of that at that point. So it's a different type of medical therapy than the medical isotope production facilities that we are now actively pursuing for licenses. And for 104(b), the commercial -- those were the commercial power reactors, the demonstration power reactor project. If you look at a power reactor license and the license of the DPR license you'll see it's licensed under 104(c) versus a nuclear NPF license is a 103, so the early power reactors were considered partially research and development, and then there came a day I think in the 1970s where a decision was made that technology had matured to the point where it moved from licensing under 104(b) to 103. But none of the 104(b) facilities are within the scope of what we're talking about.

MR. HARDESTY: And so that's essentially what this slide was to talk about, was that the 104(a) are the medical therapy licenses, and these are excerpts straight out of the Act. The Class or Section 104(a) reactors are for medical therapy, as Al just described. Then the 104(c), there the Commission is directed to allow -- permit the most -- the highest conduct and widespread diverse research and development. And the two -- the common thread between both of them and why we're here before you today is that in each of those clauses the highlight of it is that the Commission is directed to impose the minimum amount of regulation consistent with their obligations, our obligations under this Act to promote the common defense, security, protect the health of the public while still allowing for this maximum medical therapy, and research and development. So we'll talk a little bit more about it, but we have a very different set of regulations that apply to the Class 104 facilities than they do at the 103 facilities, a much smaller subset of those requirements all in keeping with the -- consistent with the Act. Did you have a question?

MEMBER CORRADINI: No.

MR. HARDESTY: Okay.

MEMBER CORRADINI: I have a lot of questions. I'll get to them.

MR. HARDESTY: So these slides are --

MEMBER CORRADINI: Maybe since you give it to me, and you don't have to go back but under Al's thing where it's 104(b) is not part of this, what are some historic examples of a 104(b) license? I don't know.

MR. ADAMS: 104(b) licenses were power reactors that were developed under the

Demonstration Power Program.

MEMBER CORRADINI: Like Pathfinder, those sorts --

MR. ADAMS: Saxton.

MEMBER CORRADINI: Long, long ago.

MR. ADAMS: Right, and even reactors operating today. If you look at some of the older plants that are operating today, if you open up a power reactor license and, you know, like there's license numbers, if you see DPR-a number, DPR is Demonstration Power Reactor. If you go and dig through that license you'll see it was licensed under 104(b).

MEMBER CORRADINI: Then they get upgraded or moved to --

mR. ADAMS: They never -- it's still a 104(b) license. And then there was a date where it was decided that it was no longer a demonstration technology, that power reactors were commercialized. The newer plants are under 103, and those are NPF licenses. There's no more 104(b) licenses. You know, for advanced reactors or something like that we want-- MEMBER CORRADINI: But nobody -- of the new ones that we've been discussing about the this, and the that, and all these, historically this hasn't been used for decades.

MR. ADAMS: There hasn't been a 104(b) license since I think the '70s.

MEMBER CORRADINI: Okay.

MEMBER REMPE: Didn't you in another place tell us that that's no longer an option. And I thought that was why it was a different color.

MR. ADAMS: No.

MEMBER REMPE: On your slide earlier. Is it still a possible opportunity you go to the 104(b) path?

MR. ADAMS: We've had some of those discussions given advanced reactor designs and things like that. There would probably need to be some rulemaking or some Congressional --

MEMBER REMPE: To go back and do that again, because I thought that that was no longer an option. You were at that other place, too.

MEMBER CORRADINI: Then I misremember. I guess I don't remember Joy's -- the reason I asked about the 104(b) was for the advanced reactors as you're aware of DOE is going through this planning study.

MR. ADAMS: Right, and we've had

discussions --

MEMBER CORRADINI: The anticipation was, and my memory is wrong, Joy is maybe right, my thought was that they still have that option to go through the 104(b) path.

MR. ADAMS: You know, I don't know. I know we've had those discussions, but if you look in 50.21(b) which is where in 50 it talks about, you know, it talks about that. The activities under 104(b) are very specific. You know, there's federal regulations around them.

MEMBER CORRADINI: That's a -- well, I don't want to take --

CHAIRMAN POWERS: Well, if it's not too long.

MEMBER CORRADINI: Yes, go ahead.

MR. BENOWITZ: Howard Benowitz with OGC. 50.21(b)(1), a production or utilization facility, the construction of operation of which was licensed pursuant to Subsection 104(b) of the Act prior to December 19, 1970. That's what -- these are Class 104 licensees.

MEMBER CORRADINI: So anything after 1970 is not available to go through 104(b)? That's what I understand that to mean.

MR. BENOWITZ: That's how we read it, too. I'm not an expert on that section.

MEMBER CORRADINI: Okay.

MR. BENOWITZ: But that's in line with what Al is saying, you have to use this --

MEMBER CORRADINI: Thank you.

MR. ADAMS: This is one of the discussions we're having because we -- the research reactor group has been involved in some of these discussions.

MEMBER CORRADINI: Well, there is actually a webinar occurring as we speak where this is part of the discussion today, which is not just what are these potential demonstration reactors, but also how do they get through the regulatory process.

MR. HARDESTY: Okay.

MEMBER CORRADINI: Thank you.

MR. HARDESTY: So, Mr. Brown, this is the definitions that I was alluding to. Specifically, currently in the regulations we define a non-power reactor which is a research or test reactor licensed under 50.21(c), and that corresponds to Class 104(c), or 50.22 which corresponds to Class 103, it's the reverse, of this part for research and development, and that comes out of 10 CFR 50.2.

And then a research reactor is defined as a nuclear reactor licensed by the Commission under the authority of Section 104(c) of the Act. And that, as I said before, comes under Section 50.21(c) of the regulations. And then you see the exclusions there where the research reactor is defined not to go into the categorization of a testing facility, so it has to have a thermal power of 10 megawatts or less, and not be a testing facility as defined in Paragraph M of that same section. This comes from Part 170 -- yes, 170.3.

MEMBER BLEY: And from our recent experience with SHINE, your words "a nuclear reactor" somewhere else in the regulations means it produces power.

MR. HARDESTY: So what we did there is we didn't change the definitions for a research reactor and non-power reactor but because it's not a reactor, we added them, their docket number --

MEMBER BLEY: And it's not a reactor because it's zero power.

MR. HARDESTY: Right.

MR. ADAMS: Well, it's not -- in 10 CFR

50 a reactor has that chain reaction undergoing, so if there's no chain reaction there's no reactor which is why we needed to do the rulemaking for SHINE to make it a utilization facility because it was subcritical.

MEMBER BLEY: It was -- criticality makes it a reactor --

MR. ADAMS: Yes, criticality --

(Simultaneous speech)

MR. ADAMS: Criticality makes your reactor.

MR. HARDESTY: Which is an excellent segue into two slides from now, but before I get into that let me talk about the testing facility. These are -- Al already mentioned all of these, but here they are in front of you, the testing facilities and nuclear reactor which is licensed under 50.21(c), so it's specifically only a Class 104(c) reactor, has a thermal power of 10 megawatts, greater than 10 megawatts or 1 megawatt with the special conditions that we talked about.

MEMBER CORRADINI: And these guys fall outside of the realm of our discussion.

MR. HARDESTY: For most of it, not all of it.

MEMBER CORRADINI: Okay.

MR. HARDESTY: Because one of the things we're going to do is clarify license renewal to also streamline what those reactors have to do when they come in for license renewal.

MEMBER CORRADINI: Okay, thank you.

MEMBER REMPE: So -- okay, earlier when you said the 10 megawatt I thought oh, okay, MIT's reactor is less than 10 megawatt, but don't you have a circulating loop through the core where you can conduct fuel experiments, so how did you guys get away with this?

MEMBER BALLINGER: Lying and deceit, I don't know.

(Laughter)

CHAIRMAN POWERS: I wonder, Joy, if that is an issue pertinent to our discussion.

MEMBER REMPE: Well, I just --

MEMBER BALLINGER: No, there's a definition between a moveable and a non-moveable experiment, has to do with the amount of reactivity that you can insert all at once. This is a removable fixed -- a removable experiment that can't be -- yes, it's an insert that replaces a fuel element in the core. So it's a --

MEMBER REMPE: Okay.

MEMBER BALLINGER: It's not a loop that comes in from outside and goes through the core and around. It's a self-contained replacement of a package.

MR. ADAMS: Yes, it's a --

MEMBER CORRADINI: It could be a rabbit, a whale in a -- just a big version of it.

MR. ADAMS: You notice the words are experimental facility, not experiment.

MR. HARDESTY: Right.

MEMBER CORRADINI: Right.

MEMBER REMPE: Okay.

MEMBER CORRADINI: And this is anchored into the core, so it can't be, what do you want to call it, accidentally moved which would change the reactivity of the core. So there's another definition that's there.

MEMBER REMPE: Okay. And I appreciate what Dana said, but it just seems like it would be nice, and I know you guys have felt that way, too, that you could have put them all in there together and included NIST.

MR. ADAMS: And I think that that's part of our discussion with this group today, that obviously if you -- at the end of the day if you want to give us an opinion on that, you know, we can take it back and think about it.

CHAIRMAN POWERS: It seems to me that the exploration of these definitions is useful only to the extent that we see opportunities for people misusing the definitions or using them contrary to what the intent is.

(Off mic comment)

CHAIRMAN POWERS: Yes. Otherwise, I think the definitions are pretty much what they are.

MR. ADAMS: Yes, and they were historically developed, they were developed at different points in time for different reasonings. For example, the definition of non-power reactor, that definition came into the regulations when we were developing 50.64, the regulation on HU to LU conversion. The research reactor definition you can see it's not in Part 50. You can dig through Part 50 and you're not going to find research reactor defined. It's back in 170, which are the regulations for sending out bills, it's the fee regulation. So it's --

CHAIRMAN POWERS: That raises the

question, should any -- if you're going to go through and revise regulations, should you do it wholesale and get these definitions all squared away so that there are not lots of exceptions and not lots of things that you can't understand why the definition is such as it is? I mean, suppose we were to recommend to the Full Committee that we write a letter to the Commission, say gee, this regulatory action that Staff is proposing is just a really good idea, except we think we ought to add to it, get these definitions all squared away and sound. How would you welcome that?

MR. HARDESTY: Actually, the rule started out when the regulatory basis where we were going to do a lot of that, and we had -- Mirela, she's gone now, but Mirela referred to ornaments, and that's what we -- we coined that term based on a lot of these definitions that we wanted to make consistent, and fix, and get all in the right place for the purposes of our rule. And we have done a little bit of that as you'll see on the next slide, making this new definition for non-power production or utilization facilities to kind of capture it. And if you think about a VEN diagram you have this class of testing facility, and you have these class of research reactors, and then you have the one that takes in both of those as non-power reactors, and then drawing around all of that is non-power production or utilization facilities, which brings in SHINE.

CHAIRMAN POWERS: Well, my concern is that -- alluded to by Professor Corradini, who I have all these people running around proposing all kinds of new and novel designs for power reactors, but they don't want to go through the 103 licensing process because they don't fit very well. So they come and say gee, I'll put it in in 104 and locate it on a military reservation, and do all kinds of interesting things, and so my concern is that they use this regulation which you never intended, never thought about using it that way, but they've got lawyers, you've got lawyers, everybody's got lawyers, and they can figure out a way to do that. And I don't want to do that. Same time I've got a Commission that's very concerned about what they call the rationale basis of the regulations, and I'm wondering suppose the Subcommittee recommended to the Full ACRS to write a letter that says fix all this. You know, and -- I mean, do you guys slit your veins and say oh, my God, or do you come back and say oh, my goodness, you've added 10 years to this process and we want to get it done in the next six months? I mean, how do you respond to that?

MR. HARDESTY: That's the thing is the timeline.

MR. ADAMS: And where these -- you know, the ornaments on the tree, we are looking at other opportunities to address some of this, but there are inconsistencies in the regulations, and if you go back a slide or two back to the definition of non-power reactor, if you look at non-power reactor we see -- we say it's licensed under 50.21(c) or 50.22. If you look at the definition of research reactor, it only talks about 50.21(c). Well, again it's because this definition was actually created to address who pays fees and who doesn't, and at the time, you know, there was no commercial research reactors in existence, so this definition was written for what existed at the time. So there are inconsistencies that it would be good to fix, and frankly, we ran out of time given the timeline for this. And we didn't want to delay this rule given the budgetary situation within the NRC. You know, a window of opportunity has opened here and we wanted to get through that window before someone closed it on us, so the answer is yes, that you know, if you said that we should, you know, focus, that we should take a look at the various definitions and make sure they're consistent, and they harmonize, and they look forward to the future. You know, again, would we slit our wrists? No. And these are --

MEMBER CORRADINI: But would the window of opportunity close on you, too? That's -- the way you framed it is what I thought, and the way Dana asked the question was that if the window closes and you want to be comprehensive, but you've lost your opportunity, then --

mR. ADAMS: Right.

MEMBER CORRADINI: -- it sounds like you've made -- things aren't any better than they were.

MR. ADAMS: Right. And so we would have to look at do we do that here, or do we try to find another place to do it? And these discussions, again, you know, we're looking at advanced reactors but we have had a lot of internal discussions about 103, 104, research reactor, test reactor, and how those would relate to someone coming in the door and say hey, you know, I have an advanced concept I want to test, and I want to build this. You know, where would you end up licensing it? So we've had those discussions about what our understanding is, what's the waterfront given the current definitions.

CHAIRMAN POWERS: Recognize that I can just imagine Mr. Bley sitting in front of the Commission in March saying that the Subcommittee has looked at this regulation and they said yes, and now you've overlaid an already confusing definition with another set of definitions. Why did you allow that to happen, Mr. Bley? And I don't think they would be very kind to you.

MEMBER BLEY: They never are, are they?

CHAIRMAN POWERS: To you they're always kind. To Mr. Brown on the other hand, they are openly abusive.

MEMBER CORRADINI: But all kidding aside, I think we need to get an impression from you all that -- because I agree with Dana. This would be the time to clean it up, but if the opportunity of the window to clean up any of this disappears because you want to be comprehensive we need to know that from you guys because we can't judge that.

MR. ADAMS: Yes, I don't -- two things I don't want to do. I don't want to lose the window, and also I need to be, you know, consider the scope of what we're doing, that this was strictly a research reactor ruling. Believe me, a lot of folks came and said oh, here, here's a problem I've got, I'd like to fix. And that sort of leaked over into power reactor regulation, and we basically said no, go away. So the problem is if we're fixing these because of what we see in the future maybe advanced reactors and that area, I think that that should really be a discussion separate from this. For the purposes of regulating research and test reactors these definitions along with our NPUF definition we believe will work.

MR. BEALL: This is Rob Beall. I'm the Rulemaking PM for this activity. We do have a window of opportunity here to do this rulemaking, but as Mirela talked about in the beginning, this is a medium priority rulemaking. And with the Commission directions we've gotten lately on rulemaking, we wanted to keep this rulemaking moving along so we do have a certain time frame to get these regulations done with the resources the Commission has allotted us. So we would definitely have -- we'll definitely consider any recommendation that comes out of the Subcommittee, but we also have to consider --

CHAIRMAN POWERS: You'll get no recommendations from the Subcommittee.

MR. BEALL: Well, from the letter, excuse me.

CHAIRMAN POWERS: You will get -- a recommendation will come from the Full Committee, and I think I want to take you up on your offer. Let us focus on what you've got here now, and then once we've gotten through this let's meet again and say what would it take to do this more comprehensive work? Because I know the Commission is interested in this, that they have expressed to us, and I think they've even expressed to the EDO an interest in rationalizing the regulatory process so we don't have lots of inconsistencies and overlaps, and things like that. But let us put it on our to-do list to meet again in perhaps a more collegial format to understand what it takes to do that in this regard once we've gotten through this. I mean, I -- it won't be this year, but we might want to pencil it in on our 2017 calendars to say let's talk about this more. And let us as a

Subcommittee think about saying to the -- I'm concerned that the ACRS -- I know that it's personality somewhat might get into its idea to say no, no, let's do comprehensive now instead of later, and I'd like to defer them and say no, we've got a window on a medium priority. Let's take advantage of what we can do now and not try to do something more comprehensive. Anyway, I'd ask the Subcommittee to think about that, and then I ask that we move on.

MEMBER BROWN: Can we move on after I make one observation for the uninitiated?

CHAIRMAN POWERS: Because we desperately need your input.

MEMBER BROWN: I'll work on that one. As I went through all the stuff that we were presented or given to to review I kept -- particularly after I looked at the table of the range of power levels and think these are nuclear reactors, they produce radiation. People get hurt if they're overexposed, health and safety, and all that other kind of stuff, and what I've experienced over the last eight years in the power reactor world stuff we've been reviewing. How in the world can we -- and here I see all these definitions are based on configurations and nuances of what may or may not be done with the reactor, not so much as why is it safe? When I finally got to the part on the environmental assessment, you actually had some valid technical information as to why it appeared okay; 27 of 31 units you talked about, if you lose all your cooling you're just fine, air cool. I mean, in other words, why take this little nuanced approach to saying what is a test versa what's a research? Why shouldn't they be more associated with look, if you can turn off all the stuff that's necessary to in the old mind set to keep it safe and nobody cares because it's not going to be a problem, there's a different way -- I'm just scrambling a little bit.

MR. ADAMS: And you see -- there's another number that's not in the regulations, but is within our internal processes and that's -- it is in the regulations, 2 megawatts. And, for example, in the -- in 73.60(f), the Sabotage Rule that we had the option to consider sabotage for facilities 2 megawatts and greater, so there's a 2 megawatt number, and that sort of represents where aluminum clad plate fuel reactors in a loss of cooling accident if there's no ECCS probably are going to have some difficulty. So there are other safety thresholds, and that 2 megawatts you see in a couple of regulations, you see it in our inspection program, that's considered -- later in the slides you'll see it's a Class 1 reactor which has a more vigorous inspection program than the under 2 megawatt. So there are -- you know, there's a lot of ways to sort of chop up the world and present it. You know, this is what we have at the moment, but there are other, you know, break points. And, you know, and there's design features that make some designs more resistant to certain, you know, accident initiators and others, you know, TRIGA reactors, reactivity addition, for example the Pulstar reactor just loss of coolant.

MEMBER BROWN: Well, but you made an argument for those even when you talk about some of the other four because a couple of paragraphs later you talk about those that even though they had limited times when they could go like this, there was still plenty of relative time to go do such and such, and therefore you made the judgment that those still fell into the research reactor category and didn't require -- so allow like the elimination of all the licensing time, and re-licensing --

MR. ADAMS: Again, you know, we asked ourselves that question. And we went through that to understand, you know, what the risks and hazards were. But given that we have a good, you know, we have a good license renewal at this point, we have a good licensing basis and a good staff SER that supports that licensing basis, what's the safety gain doing this all over again in 20, 30, 40 years? So that's the question we kept coming back to.

MEMBER BROWN: I'm not disagreeing with you. I'm just saying you made a rationale argument --

MR. ADAMS: Yes.

MEMBER BROWN: -- for those that were outside the -- you don't -- you can walk away from it, ignore it for the next 60 years, and that's still okay.

MR. ADAMS: Right, and that's part of our basis along with all the things we talked about that, you know, in the scheme of things these facilities represent a lower level of risk to public health and safety say than high-power facilities. But the Staff realizes, and you'll see, we'll talk later on that if something is going to go wrong, and if it's going to have an impact, it's probably going to be internal to the facility versus external to the public health, you know, to members of the public.

MEMBER REMPE: One more quick comment I'd like to make based upon what Robert Beall and Dana said. You erroneously referred to meeting with us as the ACRS, and that error exists in the documentation that was issued, the draft letter from McCree, et cetera. Please correct those -- today you met with the Subcommittee, and that occurs several times in the documentation we were provided.

MR. ADAMS: Okay.

MEMBER REMPE: Thank you. Sorry. Go ahead.

MEMBER SKILLMAN: I was going to build on Charlie's comment, but kind of take the contrarian point of view. I understand for these 31 facilities the owners, particularly the universities and the folks who have the license would like to reduce as much as practical the burden. I understand that, and I understand there's incentive in the NRC to streamline the regulation because it reduces the burden inside this organization.

It wasn't so long ago I sent my two

sons off to college. I would hate to be a parent sending my son or daughter off to college to these highly respected institutions that have these licenses and have my son or daughter injured, in all candor, because people were sleeping at the switch or gaming the data. I would not want my son or daughter to be injured because of complacency that was bred into the organization because in 2016 folks said hey, school is out. We don't have to do this heavy duty reporting any more, we don't have to be as accountable as we previously had been on the material condition of these facilities, and now we have a young man or young woman who's been injured because of incompetence and because of complacency.

MR. ADAMS: Sure. And --

MEMBER SKILLMAN: Those two, incompetence and complacency, are the killers on this technology. If you're not on top of it, it'll bite you.

MR. ADAMS: And I'm going to argue that we believe that the changes we're making I think enhance safety because, for example, one of the things we're talking about is a requirement for these licensees to maintain their SAR. Right now they don't, there's no regulatory requirement for that. That, you know, literally as an NRC, you know, reviewer I see the full SAR when it comes in for license renewal, and some of the license renewals we're doing now were originally 40-year licenses. This is the first time, you know, the reviewers are doing those, this is the first time the Staff has seen this since, you know, since the 1960s, or 20 years ago, that it's 1980s. So, you know, I agree with you, and given the other things we'll talk about, the reporting requirements and the tech specs, the inspection program, annual reports, the data we get from the licensee that along with the fact that now the licensees will maintain their licensing basis and give it to us, and we will look at that licensing basis, I think enhances knowledge transfer both within the licensee, within the Staff, and requires the knowledge to be maintained and kept current versus once every 20 years it's like oh, license renewal again. Well, we better get out the pen and, you know, do something with the SAR, or in some cases, you know, they take the SAR from 20 years ago and put a new cover letter in and mail it to us. So I understand what you're saying, and I think that these additional -- that the requirements that we're adding in in lieu of the periodic license renewal I think enhances safety by requiring continuous maintenance of documentation.

Now as a regulator we do things for a lot of reasons, and at the end of the day if a decision is made that despite, you know, the safety significance of this, if there's a -- you know, if we do this because of, you know, perception reasons, then that's the answer.

MEMBER SKILLMAN: That's a great answer, and for that I'm going to change the location of my tie clip.

MR. ADAMS: Thank you.

MEMBER SKILLMAN: I thought you would appreciate that.

MEMBER BALLINGER: I can't follow that.

(Laughter)

MEMBER BALLINGER: But more along the -- I think along those lines, wasn't there recently one of these facilities cited for somebody literally being asleep at the switch and leaving the facility unattended, and it got a big fine?

MR. ADAMS: Well, the civil penalties at research reactors are relatively rare. They do happen. Later on we'll talk about violations that have occurred, you know, over the past several years. And they fall into some areas, you know, that we occasionally have an operator leave the control room and --

(Off mic comment)

MR. ADAMS: Yes. You know, we see it, you know, every couple of years it happens, and we take appropriate actions. You know, that's the inspection and enforcement program, and those things are, you know, reported by the licensees. You know, there's a certain -- you know, when you give these folks a license to run a nuclear reactor there's a certain level of trust but verify, and we do that, we do verify, but there's a certain level of trust that, you know, when a problem occurs you're going to tell us about it. The other areas you'll see is, you know, this internal that we haven't had over-exposures but we've had instances where radiation protection has broken down and someone got greater exposure than ALARA would dictate. And those tend to be when you pull that string it's an individual basically not following the established program. But we'll talk about those things. But yes, I mean, there's -- it's -- I'm not going to sit here and say this is a community that has zero violations of requirements, you know, that we do run into issues and we track them, we look for trends, and if we see something that looks like it's developing throughout the community then we start, you know, talking to the community about it. So every year we meet, you know, with TRTR which is the organization of the Research Reactors at their annual meeting and one of the things we talk about is the performance over the past year, you know, from the inspection program and what's been reported in. We encourage the licensees to give presentations at these meetings about, you know, here's a problem I had, here's a problem I got into, here's how I got into it, here's the Corrective Actions I've taken. So just like, you know, any other violation that we send -- you know, we run it through the enforcement program and take the appropriate steps, and part of that is Corrective Actions from the licensee. And you know when you see repeat violations then our attention and response, you know, escalates. That's the same for research reactors.

MEMBER BLEY: You forced me to ask a

question to get the answer on the record here. Is there anything in what you're proposing that in any way affects inspection and enforcement? And I guess I should ask is there anything in parallel you're aware of going on in cost-cutting measures that would affect inspection and enforcement for these kinds of facilities?

MR. HARDESTY: No, the inspection program is not changed. In fact, we have a very robust inspection program, although we don't have resident inspectors like the power reactors do. What we do have is dedicated inspectors here at headquarters, and I'll go into how -- what the inspection activities are. I'll also go into some of the recent findings for the last several years that show that we have a very robust program that is either allowing self-reporting or findings from the inspections. So that program is not going to be diminished at all. They are actually working in parallel with us to make some of their procedures a little bit more robust in terms of like 50.59 evaluations, that's one of the inspection modules, to -- it wasn't really part of this rule but they were doing it in parallel, so we worked together to make sure that we wouldn't diminish anything they were doing.

MR. ADAMS: So if you look at between license renewals, you know, this 20, 30, 40 year time period, a lot can change the license, a lot can change the licensing basis between those two, and there's two major areas. One is license amendments and, you know, those come in and the Staff obviously, you know, reviews them, sends them through, you know, the process against the standard review plan and the Staff makes a determination that what they're proposing is either safe or unsafe and approves it or doesn't approve it. The other area is 50.59 changes which 50.59 applies to research reactors just like it applies to power reactors that we get normally in the annual reports, we get a summation of those 50.59s. The inspectors out in the field look at the 50.59 process and look at the individual 50.59s. I think that's one area where if we move forward with this, that we will focus, we will enhance our focus on looking at individual 50.59 reviews that are done.

And, of course, the other thing is a change that, you know, doesn't fall into either of those. An example of that is say, you know, someone builds a building across the street from your reactor that changes your site description. It's not a 50.59 because it's not a change to the facility, it's something across the street, but right now we wouldn't know about something like that until, you know, that 20, 30, 40 year mark comes in and, you know, here's -- yes, I think we'd be aware of it because the inspector on site, the inspectors are looking around and there's continuity of inspectors. And I know our inspectors would go wait a minute, that building wasn't -- you know, what's this building that's getting built? But there's an example where a periodic 5-year update of the SAR that we would, you know, formally find out about that in the SAR update sooner than we would. And sometimes those changes around the site are significant. We talked about MIT, you know, years ago the Necco Wafer plant was across the street, and had one of the best Necco Wafer stores you can imagine but they changed their cooling process from a Freon base to an ammonia based and, you know, if that had failed it could impact the reactor. MIT, you know, ammonia alarms were put in the air intakes, you know, Scott air packs were available for the operators, so there's an example of change to the external environment that, you know, the operator took the -- you know, the licensee took the right steps to, but as far as the documentation, you know, it could be --

MEMBER BALLINGER: You might know that it's actually worse now because Novardis Research and Development Laboratory has replaced Necco. And not only that, the administration is about to convert that giant warehouse that's right next to the reactor across the tracks into what I would call a cell block, but they're calling it a dorm.

MR. ADAMS: I'm guessing the factory store is probably not as good as a Necco Wafer, so --

MR. HARDESTY: Anyway, to get back on track with the presentation --

(Laughter)

MEMBER SKILLMAN: Duane, let me just build on Dr. Bley's question. He asked about the inspection results. I have communicated with Quinn last week in my prep for this meeting that you would please present inspection data, and I'm hoping that you will do that sometime later.

MR. HARDESTY: Yes, sir.

MEMBER SKILLMAN: Thank you.

MR. HARDESTY: The definition that we

have was the -- is considered very carefully by the working group, went through the Steering Committee to insure that we did the best possible job of capturing all of the facilities that we want these rules to apply to, and the exceptions. And so this new definition, and you'll hear everyone is referred to an NPUF from now throughout the presentation. It doesn't exist as a regulatory definition yet. That is part of this rulemaking, but it is meant to capture the non-power reactors, the testing facilities, and any other production or utilization facility which brings in the SHINES and the Northwest. Licensed under 50.21(a) or (c), 104(a) or (c) clause of the Atomic Energy Act, and then 51.02 which corresponds to the 103s. That's a new acronym that we have.

MEMBER CORRADINI: Pardon?

MR. HARDESTY: A new acronym.

MEMBER CORRADINI: Yes. I was trying to figure out on your second slide what the hell is an NPUF but now --

MR. ADAMS: We struggled. Our basic rules were that you could use it in a public document and that when we said it, you know, no one broke into hysterical laughter, so we think we found one which, you know, NPUF, it's good.

MEMBER BLEY: Just for me, non-power reactor is still a reactor which means it --

mR. HARDESTY: Correct. And that was the finding --

MEMBER BLEY: So things like the old zero power reactors and subcritical multiplication facilities are not NPUFs, or they are?

MR. HARDESTY: So like, for example, RPI is considered a critical assembly, and we'll talk about their specific facility. They are licensed under 104(c), and they are considered a reactor.

MEMBER BLEY: Okay. I don't know if there's still any, there used to be some subcritical modification facilities called ZPR, Zero Power Reactors, and I don't see any of the list. Are they on or are they --

mR. ADAMS: They're gone. So, you know, we've expanded this, you know, production or utilization facility, you know, to capture the medical facilities, and also other facilities that would be under Part 50 that are not power reactors.

MEMBER BLEY: So if a university wanted to build one of those ZPRs in the past, they would come under this?

MR. ADAMS: If it truly does not reach criticality?

MEMBER BLEY: Truly does not.

MR. ADAMS: If it doesn't reach criticality, it's probably a fuel cycle facility.

MEMBER BLEY: Okay.

MR. ADAMS: Again, it depends on what they're doing here that, you know, just like for SHINE we considered the level of subcriticality and decided where it made the most sense. If someone actually came in and wanted to do that, we would have to look at it. I mean, I could tell you sub-crits, you know true sub-crits like many universities have your tank of water with uranium slugs, those are not Part 50. Those are state licensed or NRC materials license.

MR. HARDESTY: That's what I was going to add, is that a lot of the research reactors, university reactors have them but they're licensed on other material license. So anyway, moving on the -- this graphic is just meant to give you an idea of where the current license facilities are. There's actually 36 licensed research and test reactors, the graphic only shows the 31 that are operating in the 21 states. Five reactors are permanently shut down and in decommissioning, but I wanted to give you that as a frame of reference for the total number that the NRC is currently regulating.

MR. ADAMS: If I can add, you know, the Staff has a long history of regulating these machines. You know, some of the first reactors regulated by the AEC were research and test reactors. If you add all of them up there's probably -- there's been about 150 research reactor, test reactor, critical assembly licenses issued over time, so there is a large body of experience running these facilities, and regulating them.

MR. HARDESTY: I won't linger on the next two slides much. They're really just designed to give you a tabulation of these current U.S. research and test reactors, a test reactor. It's mostly here for reference, but in the next several slides I'm going to provide you various categorizations of those reactors to provide you a little bit more of an insight into how we categorize, and what we are currently regulating. So that's the list of them all.

The characterization of operating

non-power production utilization facilities by decade license, this was kind of just to show you an idea of how old they are, how long they've been around. The 31 represent the 1950s, '60s, '70s and '90s. The two at the bottom there are not currently licensed. That would represent our construction permit applications from SHINE and Northwest which are going to be Class 103 medical isotope facilities, but we wanted to include them so that you understood that they're coming in this current decade that we expect, anyway.

By power level we have four facilities that are less than 1 kilowatt thermal, 12 that are in the 1 kilowatt to 1 megawatt range, 10 that are in the 1 megawatt but less than 2 megawatt range, and then five that are over the 2 megawatts.

By fuel type we'll go a little bit more to what an AGN is. It's AeroJet General Nucleonics. It's a specific vendor. We have three of those currently. Again, we'll tell you who all they are a little bit more when we tell you about the reactors themselves. Eight plate-type fuel reactors, 16, the bulk of our licensees were TRIGA reactors, and then we have four what we consider unique reactors. But I will say that in fact all of these reactors are extremely unique. Despite having common designs, common manufacturers, no two are identical, and so that's always something that the Staff is very careful to consider, the differences. At one point in our history we had generic studies that we applied to the reactors for licensing, license renewal, and things. We have moved away from that because in most cases because the general analysis don't fully apply, we still leverage that information but we've also made them in this last license renewal go around update all their analysis so that we make sure that we have the most up-to-date and current licensing basis we can as part of that license renewal process, and that as you'll find out later is one of the entrance criteria to becoming a non-expiring license if this rulemaking goes through, is that we want to make sure that we have an absolute firm basis of their licensing -- firm licensing basis so that we can then maintain it rather than try to at some point rebuild it. So we want to make sure it's absolutely there, and then moving from that maintain it going forward.

MEMBER CORRADINI: So maybe I -- so I'm not sure -- so going back to Al's point and your point earlier, so that if in the past University X had a research reactor and had the SER, or the SAR, excuse me, their onsite safety analysis report, and then decades pass and they realize their licensing basis should have been kept. Are you saying it's hard to recreate it when they're coming in for renewal? That's how I interpreted what you were just saying, so that the 5-year updates make it easier for all of that. Am I understanding it?

MR. ADAMS: It's -- you're on the right track, and so, you know, I'll go back, you know, ancient history. You know, in my life, I was a licensee, we came up for license renewal. There was no NRC guidance document so, you know, first thing you did is you pulled out what worked 20 years ago and you looked around and you said well, here's some licensees are getting renewed and this seems to work, and you give it to the NRC and, you know, cross your fingers and wait to see what happens.

When I came to the NRC there was no standard review plan. You know, when I got here, you know, the gray beard sat me down and gave me the ancient knowledge and that was -- you know, it was very -- you know, it was not documented. And in the late '80s/early '90s when we started consolidating the research reactor regulatory program within NRC, one of the things we realized is that, you know, we needed documentation. And, indeed, Commissioner Remick, Commissioner Rogers were very helpful on that and gave us, you know, the go ahead to go ahead and develop what became NUREG-1537.

MEMBER CORRADINI: Okay.

MR. ADAMS: So what we want is the entrance into a non-expiring license that you have gotten a license renewal where your SAR was based on NUREG-1537 and the Staff's review was based on the standard review plan in 1537 so we have a common set of yardsticks that we've applied.

MEMBER CORRADINI: Got it, thank you.

MR. HARDESTY: But you're exactly correct, the idea is that 5071 for updating their FSARs or Final Safety Analysis Reports did not apply or does not apply currently. And we intend to make that apply as part of this rule so that we are getting those routine updates of the facility changes, as well as the already requirement for annual reports that lists their changes to the facility so that we can maintain the licensing basis, and if we see anything that requires further investigation that we can do so at that point.

MEMBER CORRADINI: And just a quick one. So even though you don't require it now but in the new format you would, a particular facility ought to be tracking this anyway if they're really keeping track of what's happening in their facility as it goes on whether it be a new fuel type, or change in facilities, or whatever. Right?

MR. HARDESTY: Absolutely.

MEMBER CORRADINI: Okay.

MR. ADAMS: And I think, you know, we see various levels of attention to that detail. You know, there's some facilities that I think, you know, there's some paper there that you can recreate. Some facilities do a good job. You know, they have, you know, what they call a training document which is an SAR that they keep up to date.

MEMBER CORRADINI: Okay.

MR. ADAMS: So what we've seen out in the field varies significantly depending on --

CHAIRMAN POWERS: You have --

MR. ADAMS: -- the licensee.

CHAIRMAN POWERS: You have quite a range of ownership on these facilities. It goes from private institutions to academia.

MR. ADAMS: Next slide.

MR. HARDESTY: Yes, next slide.

CHAIRMAN POWERS: Do you see differences across the spectrum of ownership and the attention which they pay to maintaining their license basis, or does this range that you describe work within each one of these categories as well?

MR. ADAMS: No, it's -- you know, I can't make a generality like the federal government does a superior job, you know, to academia. It's individual licensees. Probably, you know, the most extreme example is one facility at the beginning of license renewal came in and said you know what, you know, I don't know my licensing basis. However, you know, look at my reactor. You can tell, you know, it's running safe, and they actually came in and I think had a discussion with the Commission about do they really need to update their licensing basis? And the answer was yes.

(Laughter)

CHAIRMAN POWERS: I mean, what causes one pause?

MR. ADAMS: I think, you know, if I can state a generality, it's -- you know, obviously if you have a staff of two you're in a different situation, if you have a staff of 122.

MR. HARDESTY: We'll get to that, too.

MR. ADAMS: But on the other side the facility that's running with a staff of two, we find that that licensing basis is a lot more stable than the facility with a staff of 122 because they're doing a lot more stuff, and that license needs more sort of regulatory maintenance.

CHAIRMAN POWERS: Good. Thank you.

MR. HARDESTY: One of the important takeaways I would like you to have from that is that our yardstick to them doesn't change whether they have one staff or 200 staff, or whatever they might have. Probably the only thing we experience is maybe the response time in terms of getting to the point we want to be on that licensing basis, it's harder for the smaller staff at the reactors to respond to everything we need to do, and over the course of license renewal we've been given the ability to guide them towards getting DOE help, you know, to help them answer the questions that we've had, so we've gone through a very good process of getting them to where we want them to be in terms of their licensing basis.

Probably everyone has had a chance to

review this. Now you can see that most of the facilities are academic institutions. We do have three private industry ones, and three federal government ones. The private industry ones are Aerotest performing service radiograph services. They're currently not doing that, they're shut down, but we also have DOW and GE. And then we have three federal government facilities, AFRRI right down the street here in Bethesda, NIST up in Germantown, and of course USGS out in -- out west.

MR. ADAMS: I just want to add. Aerotest is not in operation at the moment. In fact, they're shut down under order, and that's being driven by an issue in foreign control and domination. There is -- we do -- we'll talk about it later but we have seen some issues with fuel at Aerotest but, you know, that would be a -- so that would be an issue that would have to be looked at if we get past the foreign control and domination issue, and we work to bring that license renewal back into an active status. So it's not a nuclear safety issue that has Aerotest shut down at the moment, it's a legal issue.

MR. HARDESTY: Thank you. Moving on more into the missions of our academia reactors. Their basic purpose is to have laboratory classes, do basic nuclear research, and then these other activities which they do at various different levels, neutron activation analysis, neutron radiography, scattering, irradiation, and then some actually do some isotope generation.

MEMBER BROWN: At the academic ones, I guess at any of them, since you've got students you're trying to illustrate stuff to students, you're trying to various things that I guess bring their knowledge level up, who operates the reactors, do the students do that, or is there a specific set of people licensed to run that reactor as part of the university?

MR. HARDESTY: So Part 55 requires that there is a licensed operator at the controls at all times. However, they are allowed to have under instruction people, so you will find unqualified people that are operating the controls but they're under the direct supervision of a qualified operator.

MEMBER BROWN: Okay.

MR. ADAMS: And it varies from facility to facility. Some places are -- it's strictly, you know, university employees that are running the reactor, and some places it's a mixture of employees and students, and some facilities it's -- you know, there's faculty and students.

MEMBER CORRADINI: That's the most dangerous.

(Laughter)

MR. ADAMS: What?

MEMBER CORRADINI: I said you don't want faculty touching anything.

MR. ADAMS: So one extreme example is Reid College, something like 1 or 2 percent of the population of the college holds a license to run the reactor, and it's a liberal arts college, no --

MEMBER CORRADINI: And it's a chemistry department, there's no nuclear engineer.

MR. ADAMS: Yes, there's no engineering, nuclear engineering or any engineering in sight.

MEMBER BROWN: 1 to 2 percent of the college itself?

MR. ADAMS: Of the student population of the college hold a license.

MEMBER BROWN: So 100 students and only two people, or is this 1,000 students and there's --

mR. ADAMS: It's a small college but

there's something like 30, 40, maybe 50 licensed operators. We give an enormous amount of exams there every year.

MEMBER BROWN: Okay.

MR. ADAMS: Basically, we dispatch several of our licensed operator examiners and they're there for several weeks giving exams.

MEMBER BROWN: Does that include operational demonstration of the skills --

MR. ADAMS: Yes, it's the -- it's basically the same requirements that the power reactor operators go through that they have to pass -- for an operator's license you pass a written exam and a demonstration of competence, oral exam for an upgrade to SRO. It's a demonstration of competence.

MEMBER BROWN: Okay.

MR. HARDESTY: All right. So this is just a brief summarization to give you an idea of their operation activities, so the bulk of the reactors operate a few hours per week. There are some that operate very infrequently, either a few hours per year for laboratory classes. Then there's a few facilities that operate higher activities, 20 to 40 hours per week. And then a couple that operate basically 24/7, that's the NIST, the MURS. It just depends on what they're doing, and they slip in and out of these categories depending on the activities that they've got and the contracts they've got for different types of experiments, people want to come in and do things. But the important thing to understand about the research or the non-power production utilization facilities that are predominantly doing these type of research activities is that there's no requirement for them to maintain power. You know, an experimenter may say I've got to have this much exposure time, but that never preempts the safety. So if there's a problem, they immediately shut down and they resolve it before they come back up, so there's never a problem with them trying to continue operations under these kind of activities. And, in fact, the activities that you'll -- or I guess the responses that the tech specs typically have for any kinds of actions or they don't meet the conditions of operation, essentially require that they immediately shut down.

MR. ADAMS: And in the 30 years I've been regulating at NRC I've only run across one research reactor where continuity of operation was important for what they were doing, and the facility doesn't exist any more, but they were doing long-term testing of thermionic devices for possible space propulsion application, and so running that experiment for several years straight without giving it the shock of scramming the reactor was important, so this was a reactor that had additional redundancy and diversity and systems to reduce the possibility of shutting down. So I've only seen that once in all the years I've been in NRC.

MR. HARDESTY: So moving into a little bit about their staffing, just to give you an idea. Most of the facilities have very small staffs. One or two is a generality, but there's a lot of them that have very small staffs, and so that consists of essentially the immediate reactor staff, the director, the reactor manager, reactor supervisor, and maybe some part-time grad students or something have qualified as a reactor operator. And then they have outside support from the Radiation Safety Office, clerical support, typical support they would get from the college itself.

Whereas, the larger organizations of which I've kind of categorized five of them, the

Texas A&M TRIGA, MUR, NIST, MIT, AFRRI, and Oregon State that have a larger staff. Is it Oregon or Ohio? I think Oregon, that have a larger staff. They have a built-in administration, and operations, and engineering as part of the reactor staff, so they have dedicated staff that's part of the reactor operations. That's just to give you a contrast. And with that I'm going to turn this over to -- I'm sorry, did you have a question?

MEMBER SKILLMAN: Just back up a slide.

MR. HARDESTY: Sure.

MEMBER SKILLMAN: I see those five, MUR, NIST, MIT, AFRRI, Ohio State and TAM.

MEMBER CORRADINI: That's Oregon State.

MEMBER SKILLMAN: Oregon State. If you go back for a second to slide 12, just stick with me on this, go back to 12 just for a second. Are there other reactors that are not NRC licensed but are somehow licensed under state or some other licensing organization which if shown on this graphic would double, triple, or quadruple the number --

mR. ADAMS: No, there's three places within U.S. law that you can regulate reactors, utilization facilities, and that's Section 91(b) of the Atomic Energy Act gives the Department of Defense the authority to regulate their own reactors. The clearest example is, you know, naval reactors. 91(b) has been used over the years for research reactors. For example, the reactor that's now at University of California Davis was built by the Air Force at McClellan Air Force Base and the Air Force made a conscious decision that they were going to regulate the reactor under 91(b). Interesting enough, when that base was lined up to be on the BRAC program the Air Force came to us and talked about transferring licensing authority to NRC, so it was still an Air Force reactor, but we regulated it. So 91(b) is a choice; for example, the AFRRI reactor down the street in Bethesda, we regulate that reactor; however, they can call us up tomorrow and say guess what, we're going 91(b), but nice being regulated by you. So Department of Defense has the authority to regulate their utilization facilities. DOE has the authority to regulate reactors within their space, and their space is -- there's not a lot of reactors, the HIFAR, ATR, ACR, Sandia. So, you know, again it's four or five facilities. You know, the old Army program that doesn't exist any more was also under

91(b). And the only other place is NRC, so if you're not within -- sitting on a DOE laboratory or within the confines of the military, then your reactor is regulated by NRC. You know, the idea of NRC regulating DOE's test reactors, research reactors does come up periodically. During my career I've been involved in, you know, doing evaluations of what it would take to regulate DOE's facilities. DOE has a program which looks a lot like what we do. So, you know, if we brought DOE's reactors on board, you know, we'd have four or five more reactors, but they would tend to be very high powered.

MEMBER SKILLMAN: So for all intents and purposes you're saying hey, these 31 are really the whole story at this point in the nation's history, and so the regulations that we're contemplating changing really do get to the bulk of the research and test facilities. Yes, there are a couple of more but they're not regulated by this body of regulation.

MR. ADAMS: Exactly.

MEMBER SKILLMAN: Copy that. Okay, back to 22. Thank you.

MEMBER BLEY: Al, for information, 91(b)

apparently isn't under Title 10. What's it under?

MR. ADAMS: It's 91(b) of the Atomic Energy Act.

MEMBER BLEY: Of the Atomic -- of the Act itself. Okay.

MR. ADAMS: I'm sorry, do I --

MR. HARDESTY: No. Okay. At this point I'm going to turn it over to Al to talk about specifics about each one of the reactors, the AGNs, the Argonauts, those are all unique designs, and Pulstar. We'll talk about coolant tank reactors because there's a couple in there that are -- you know like for example, a TRIGA reactor is a pool reactor, but they're categorized and described under TRIGA reactors not in the pool, so I don't want there to be any misconceptions on how I generated the slides. But Al's going to give this presentation.

MR. ADAMS: So I'm wondering, so it's sort of a background we're sort of switching here. You want to take a break now or do you want to wait until 10:30?

CHAIRMAN POWERS: We will take a break at 10:45.

MR. ADAMS: 10:45, okay. So it's -- I'm

going to go over the various types of research reactors, talk about some of their driving design features for safety. As Duane indicated, there's a lot of ways you can chop this world up and get to where you're going. You know, it's -- and you see a couple of ways here. You know, sometimes you see fuel type, sometimes you see are they in a pool or not in a pool, what's their power level? So there's a lot of ways to chop these up, but the way we normally do is what you see here.

So I'll start with the AGNs, named after the company that built them, Aerojet General Nucleonics. They were one of the two designs of homogenous reactors that were developed. This is a solid homogenous reactor. There was another company that produced a liquid homogenous reactor, L77s, L54s, all of those are gone. AGNs still exist, there's a couple of them. Compact, self-contained, portable. These reactors came off an assembly line in California and on the assembly line they became reactors, so the construction permit was actually for what was going on on the assembly line. I'm sorry we don't have the picture but we have an old picture of them just, you know, it looks like the Chevy plant, instead of Impalas it's, you know, AGN reactors in line. You know, they were very popular in the early days because they allow the university to get into the nuclear business relatively cheaply and have a compact, simple machine.

The fuel, it's enriched 20 percent, less than 20 percent enriched. It's a mixture of uranium oxide powder in a polyethylene moderator so that's the solid homogeneous aspect of it is that the moderator and the fuel are blended together. If the fuel was sitting on the table here it would look like, you know, plastic donuts. You can see it's not a big reactor, 10 inch diameter core. There's holes that enter into the core for insertion of control rods, and the control rods of these reactor are made out of fuel so to shut down the reactor you actually pull the control rods out of the -- the control rods drop out of the bottom of the core, so it's an interesting design.

It has a unique safety feature, you know, and besides its power level, it has what's called a thermal fuse. The donuts that make up the core are held together by this fuse and it's basically a piece of polyethylene that has a little higher density of uranium oxide powder mixed in. It's the hot spot in the core, and if the reactor runs over power that piece, the plastic melts, the core falls apart. So that's an interesting safety feature it has. It lives in a tank. There's a graphite lead water shield surrounds the core, and then there's a water tank. So here's a picture of one on the right there at Texas A&M. So, these are actually AGNM, 201Ms. M stands for modified. The modification is these are the supped up AGNs, they run at 5 watts. The original AGNs ran at a tenth of a watt. If you look at the reactor on the right there you see some cinder blocks around it, so when they up the power to 5 watts they had to put more shielding around the reactor. So you have 5 watts, three of them are still in existence, Texas A&M has one. That we're in the process of working on a license amendment to actually move it from the engineering building to a new facility that's going to be built. Idaho State has one, and University of New Mexico. You know, they're useful for teaching students, because they're homogeneous they're sort of pure -- purer from a nuclear power, nuclear engineering approach than say exogenous reactors. And these are all located in campus engineering buildings, and they're all Class 104.

Mainly used for teaching students. You

know, it's a laboratory tool for teaching students. It does have the ability to do some simple, you know, activation analysis. We're talking fluxes 10 to the 10th, 10 to the 11th, you know, nothing that -- it takes a long time to do anything in these reactors, but what they do well is they show the effects of reactivity coefficients, they show, you know, the -- going through criticality, you know, source critical versus real critical, you know, all those things that you teach in the classroom you can come and do as a lab.

Any questions about those? Again, they're portable. In the early days these things used to be hauled around from place to place.

MEMBER REMPE: Has anyone ever melted their fuse and do they still make the fuel for these reactors?

MR. ADAMS: As far as I know, my historic knowledge is that no, that the -- we've never -- there's never been one that has melted the fuel. No, it's a lifetime core. There is some spare fuel in existence. There's at least one facility I know of that decommissioned the reactor but still has the core, so there is some spare fuel around. I'm not sure how many spare thermal fuses are in existence, so DOE probably has some fuel in storage for these but again it was a lifetime core. And, you know, literally, you know, you shut down the reactor, you basically, you know, put gloves on and, you know, you put your lab coat on and after a certain period of time you can open up the reactor and you basically handle the fuel directly. Again it's -- there's not a lot of activation in these machines.

MEMBER SKILLMAN: Alex, what's interesting to me is that for every one of these small reactors the training programs breed a population of reactor operators and people who are interested in what the device is doing, but in order for that to occur they also have to breed an entire population of instrumentation and control people who are able to provide the instrumentation and calibrate it so that the people who are operating the reactor know what in the world they're doing. So you end up with a couple of different populations out of these activities.

MR. ADAMS: And we're at the point where the original I&C systems that came with the reactor, basic -- you had a reactor, you had a console, you plugged the console into the reactor, you plugged the console into the wall and, you know, you have a reactor. Texas A&M, for example, is working on designing a newer instrumentation and control system, and I think once they design that and we look at it, and pass -- you know, if we pass judgment on it, then I'm guessing that design will then move on to the other reactors. But, you know, it's basically we're at the point where there's a lot of -- you know, there's parts for these facilities that, you know, the spares are non-existent.

Next, Argonaut. Again, you know, there used to be -- you know, when I came to -- right now there's 31 reactors. When I came to NRC there was about 80 some licensees, so they've been slowly through the years, they've been dropping off. A lot of the AGNs have dropped off, and a lot of the Argonauts, so there's one Argonaut left named after Argonne National Laboratory which was the organization that invented it. It's a heterogeneous reactor. The fuel is MTR material test reactor type and that's basically your standard uranium dispersion fuel in aluminum cladding in plate form that then goes into fuel elements that then go into the reactor core. So it's your standard MTR plate fuel which a lot of the -- which is probably, you know, as common as TRIGA fuel.

It's a force flow reactor, reflector graphite, mineralized ice water graphite blocks, biological shield is unique. Why don't we go to the next slide, the picture. So it's basically a reactor core in a big monolith of shielding blocks, and can you kind of move the mouse pointer to where the core is? So the reactor core actually sits in two what's called core boxes, so it's two boxes that hold the fuel elements and not much more and water -- the coolant passes through the boxes, and because the core does not sit in the bottom of a pool the shielding is provided by as you can see this monolith that surrounds the core. It does have an interesting safety feature in that you can shut down the reactor by putting the control rods in. You can also drain the coolant out of the core boxes, so there's two ways to shut down the reactor.

The University of Florida, 100 kilowatts. There's a picture of what the monolith looks like. The -- can you point out where the control rod drive is. Control rod drive, it's a semaphore rod that puts itself in between the two core boxes. Again, relatively low power, used mainly for teaching nuclear engineering students. Florida does have a very vigorous nuclear engineering program with a lot of students, so it's again sort of like, you know, what we saw the AGN reactor doing, only there's a little bit more capability to do activation, you know, demonstrating some of the technologies, radiography and technologies on that.

I guess I probably should go back and I'll just quickly mention, you know, each of these reactors has what we consider the bounding accident that we look at as the staff. For the AGN reactor it's somehow you get a chunk of uranium fuel and you put it in the irradiation part and you create a large reactivity addition, that's the accident we look at there. In the case of this reactor, it's dropping one of the shielding blocks on the core. It's a mechanical core crushing disruption accident is what we look at.

CHAIRMAN POWERS: Is fire a consideration?

MR. ADAMS: Fire? Part of looking at these reactors, yes, we do look at fire. A number of years ago when stored energy, Wigner energy in graphite became a concern we went and looked at all graphite used in all of our research reactors wherever they are, and we did an -- the community did an evaluation that they then gave to us that we reviewed and we determined, for example, that the graphite fires were not an issue mainly because there just wasn't enough flux to build up a significant amount of stored energy. But as, you know, the accident scenarios we look at, you know, fire is one of those areas.

CHAIRMAN POWERS: Most of these are located in engineering facilities.

MR. ADAMS: Yes.

CHAIRMAN POWERS: And things unassociated with the reactor can produce fire. And that seems to me that those external events like that are at least as likely as inserting reactivity in a core.

MR. ADAMS: We look at these events. You know, we don't have -- you know, we have probabilistic insight so to speak. I mean, there's -- none of these facilities have PRAs or PSAs, so I can't tell you what the probability of a fire in the engineering building versus any other event. I mean, I could tell you in our -- you know, in the history I don't think we have an event where, you know, an engineering building burnt down and threatened the reactor. You know, the engineering buildings tend to be, you know, protected in that way. You know, university, Environmental Health and Safety programs, you know, look at what we find is that it's a university, that's normally part of a state that normally has a lot of requirements on things like fire loading, fire response, fire protection. When I was a licensee, you know, fire in the facility was, you know, one of the events that we practiced. All the facilities have, you know, as part of the emergency planning process, have working relationships with the first responders, the ambulances, the fire brigades. The fire brigades that responded to the reactor I worked at, you know, at least once a year went through the reactor, were trained. You know, here's what to look for, here's the hazards of fire and radioactive material, and then they were involved in the active emergency drills which these licensees conduct every two years which is a full external response, you know, drill. So it is looked at.

MEMBER SKILLMAN: Al, let me ask this.

I've never been around a large quantity of graphite. Is carbon monoxide and carbon dioxide a concern around this type of machine?

MR. ADAMS: If there's -- no, I mean, not -- you know, a normal operational point of view are you talking?

MEMBER SKILLMAN: No. Just curious.

MR. ADAMS: Well, it turns out there's not a lot -- you know, we talk about graphite. There's really not a lot of graphite in these machines. You know, thermal columns are -- you know, a lot of facilities have graphite thermal columns. You know, that's normally four feet by four feet by maybe four feet square block of graphite blocks. The reflector elements are about the same size as a fuel element. You know, in the case of a TRIGA reflector it's, you know, a diameter of about that and the length of about that. So there really isn't a lot of graphite in these machines.

CHAIRMAN POWERS: Well, it takes very little graphite to be an awful lot of moles.

(Laughter)

CHAIRMAN POWERS: But in truth the graphite is usually configured so that its conduction is very high, so even if you get the front face very hot producing carbon monoxide on it, it conducts the heat wave so well that it puts itself out. It's not like a gas cooled reactor core where all the graphite is very hot, and so there's no conduction pathway, where here there's always a conduction path.

MEMBER SKILLMAN: Okay, thank you.

MR. ADAMS: I mean, a lot of the graphite is in the form -- you know, it's in the cladding of some sort. You know, the thermal columns that normally when -- you know, if you're not doing something, changing out an experiment, you know, they're basically a large shielding door that closes that basically protects the graphite pile. So, again, you know, in our history we have not -- we have not seen these issues arise. And we'll talk a little bit later on how we get information about what's going on in the world back to us where we can look for trends, and spot trends. Indeed in some areas we've seen trends in the past, and we focused on those trends. So Argonaut, and again it was a very common reactor, but right now in the U.S. there's only one that's still in operation.

Pulstar, there's one Pulstar left in the U.S., well, there's only two Pulstars. That's my native reactor technology. I grew up in the world of Pulstar. It was originally an MTR reactor designed by American Machine and Foundry, AMF, and the Pulstar was a conversion of the AMF MTR core. It went from a high enriched MTR core to a -- actually, it was the first HULU conversion I would think to a low enriched Pulstar core. It's a pool reactor, you know, core sits at the bottom of the pool. Its fuel is unique for research reactors. The fuel is uranium dioxide pellets in Zircaloy clad. It looks like miniature PWR fuel. And it's ver low enrichment. The one I worked at was 6 percent enriched, the remaining at NC State is 4 percent enriched, so a lot of uranium-238 in the core, a lot of Doppler, and that gave it the capability to pulse, so it was a pulsing reactor. NC State no longer has the authority to pulse in their license, and at Buffalo when I was there when we renewed in the early 1980s we removed the authority to pulse that reactor from the license, too.

The reactor pulsed, it was a lot of complexity you had to go through compared to a TRIGA reactor to pulse. The biggest one was that you had to have pulse core, so the day that you decide that you needed these fuel elements for normal steady state operation that was sort of the end of pulsing. So they pulsed, it was a lot of things that you had to do, a lot more you had to do. When I came to the NRC and saw my first TRIGA they go, you know, you want to see it pulse, and I said well, wait a minute, just how many days am I going to have to wait here? And they go okay, you know, want to see it pulse again? So, you know, it's an interesting reactor. Like I say, it looks like -- the fuel looks like miniature PWR fuel. Because of the uranium dioxide, because of the Zircaloid, you know that those are materials that have very high melting points. You know, this reactor is very safe at 1 megawatt. My Pulstar was a 2 megawatt. When we renewed we actually made a case to the NRC to eliminate our emergency core cooling system, again because of the peak temperatures that were reached during a loss of cooling accident that challenged the fuel or the cladding, and the NRC did that. When we renewed in the '80s the requirement to have an ECCS was removed from our license.

There's a picture of it. Again, it's at

1 megawatt that your starting to see -- you know, you're starting to have some capability. Again, training students is the primary responsibility but, you know, you have enough neutron flux there to start doing some good work in the area of neutron activation analysis. And that's sort of one of the bread and butter activities that research reactors do. The joke is, you know, NAA won't get you from A to Z, archaeology to zoology. You know, there's a lot of applications.

You start seeing experiments on beams. For example, you see prompt neutron gaps or neutron radiography. You know, this reactor can do, you know, good work, but it's also, it's where you start training the students that, you know, you can't walk into a place like NIST and use their beam lines, you know, to train because those beam lines are so valuable for research. So, it's where students that become the future researchers, and that is where they start learning the business. You can see the intense low positron beam, Ultrical neutron source, you know, so you see the technologies that you have at NIST, that you have at HIFAR, that you have at these very -- at these high powered, high flux cold neutron facilities, so this is where they learn to do these things.

From a safety point of view, you know, the accident we look at is the failure of a fuel pin in the release of the radioactive material in the gap. But, you know, at these facilities, you know, you start having significant radiation beams, you start active -- you know, you start having the capability to activate materials. And this is where you start focusing on the safety of the radiation protection program that you handle materials properly, that you assume the worst before you -- until you survey it and know what you have, that you make sure that you don't violate procedures and interlocks and put yourself into a situation where there's a beam open. So, you know, you start -- at 1 megawatt you're starting to see those safety considerations.

Pool reactors. This one is kind of tough. It's a pool reactor, and we sort of break them up into TRIGAs and you're not a TRIGA. And if you're not a TRIGA, you normally have MTR fuel, the plate fuel, but you see a wide range of power levels and designs here. So, you know, commonalities, they're in a pool. And later on we'll -- when we talk about what we've learned from the inspection program, from the reports from licensees that, you know, we've learned that pools are an area where we do look at the aging of those structures and what can happen.

In like water you can see it ranges from 2,000 gallons to, you know, beyond Olympic, 71,000 gallons, and the pool water there is mainly for shielding purposes. There's normally a bridge that the control rod drives and excess external facilities, and detectors are mounted on. We see sort of two types where the core is fixed sitting on the bottom of the pool and the bridge is there with the apparatus that extends from the bridge. We also see a design where the core is mounted to the bridge, and the core can actually move around. That basically you have your pool, you have your bridge core assembly, you have some tracks and you can run that entire assembly up and down the tracks and put them in different places in the pool. That gives the licensee some flexibility that for example, you can run the core up against a thermal column or a dry chamber and you do certain experiments, you can put the core, you know, you can move the core away from those to -- you know, for radiation safety purposes.

Some of the larger pools actually have like a gate in the middle of the pool so you can actually put the reactor in one half of the pool or the other and theoretically close the gate and drop the water level in the other half of the pool to do repairs or maintenance.

CHAIRMAN POWERS: So this particular configuration also makes them somewhat more seismically bold?

MR. ADAMS: So the facilities were -- again, depending on the power level were designed to withstand seismic events. The lower power facilities what we find historically, they were built to building codes or some sort of multiple of the building codes. The higher power facilities, when you look at those, there was an acceleration that was picked and the facility was designed to withstand that acceleration. You know, like the discussion we had when we were looking at the NIST license renewal.

What we find is that robustness of seismic response is proportional to the consequences of a loss of cooling accident. For those facilities where loss of cooling results in ECCS systems, you know, those are the reactors that you see a -- I would say a more rigorous design as far as seismic goes. But the answer is that, you know, like all structures, you know, they're subject to seismic constraints.

The pools come in a couple of different designs. There's the pools that have liners either stainless steel or aluminum liners that basically lines the tank, so from the primary coolant there's the liner, then there's the cement biological shield that the pool -- that the tank sits in. And, you know, these -- the pool structure not only is it keeping the water in, but in a lot of these reactors it's also the biological shield, so again from a response point of view it tends to be a very robust structure.

The other type of pool is the ones where you've dug a hole in the ground and the pool lives, you know, in the ground. So there's -- the ground sort of is --

CHAIRMAN POWERS: Well, the interest comes because you're going through quite a lot of revision. You are thinking about seismicity in the Central and Eastern United States, three of your examples of pool type reactors are located in a high seismic region of the country, and may not --

I don't know for sure but may not have been designed for the higher level of seismicity that we now anticipate in those regions.

MR. ADAMS: That's a possibility, and when that -- when we get to that point, you know, we'll have to make a decision what we do. Do we require some upgrading, or given the safety significance of the failures, do we move forward? Now, you know, we've sort of had, you know, sort of introduction to this issue with post-Fukushima examination of the research reactors. And what we've done, you know, after we looked at the safety significance of the various failures in those reactors, where we focused is on the three highest powered reactors to understand, you know, where they are from a seismic response.

MEMBER CORRADINI: Just one clarification. You said it and I just want to make sure. The five you picked as examples, if my memory is, at low enough power their MC is such you think that the coolant could disappear and they're fine.

MR. ADAMS: Yes.

MEMBER CORRADINI: I mean disappear literally. That's essentially from a credible accident just one minute --

mR. ADAMS: Well, for a loss of cooling accident for most of these facilities we assume that water just disappears. It makes the calculations a lot easier. By the time you get up to Rhode Island, you know, then you start looking -- you know, asking yourself questions. And at that 2 megawatt threshold, that becomes important. You know, the reactor has to run 24/7/365 to get that decay power level up. What we saw for most of these reactors that -- you know, it could be a 2 megawatt reactor but if it's running one hour a day, you know, five days a week, either the decay heat is not there, or what we see is when you shut down the reactor, even sometimes with this assumption when you shut down the reactor that, you know, once you've been shut down for, you know, five hours, 20 minutes, you know, depending on what the facility operating history is, you reach a point where the ECCS system is no longer needed. So it's different windows here.

You mentioned loss of coolant flow. That's also something we look at for those reactors that have forced flow. You know, most of these reactors, you know, up to around 2 megawatts, what you see is natural convection cooling. What you're used to seeing at the University of Wisconsin.

MEMBER CORRADINI: Right.

MR. ADAMS: You know, by the time you get above it, you know, by the time you get to the MIT, you know, their natural convection isn't going to work any more. So you can see they're pool reactors, but you can see there's a wide range in power levels here from, you know, Perdue had a kilowatt and indeed we're looking at -- Perdue has asked for a power increase I think up to 10 kilowatts for their license renewal, so that's -- you know, we're looking at upping that power level, but you can it's -- you know, there's a range of powers here, and you can see some pictures. But it's mainly the fact that they live in pools.

I mentioned stainless steel, aluminum lined pools. The other one we see are just concrete pools that are -- some have some epoxy coating on them. What we've seen is, as these type of facilities age we see, you know, pool failures where there's, you know, a loss of primary coolant. And so what we've done in response to that is, you know, you look, you know, back in the '70s or '80s when we evaluate a facility, yes, we did a loss of cooling accident. You know, the water just goes poof, and you analyze decay heat and direct SHINE for the core sitting there until you get the fire truck or the hose or something. But we didn't look at what if the pool starts leaking. Now that's an accident that NUREG-1537 says, you know, licensee, you need to tell us about that. And the Staff, we analyze that, so what's the safety significance of these small leaks determining? So we ask licensees well, you know, what's the smallest leak you can actually detect? You know, when you've got 70,000 gallons of water and it's evaporating, and all these processes are going on, that the loss has to reach a certain point before you even can recognize it. So that's one question we asked, what can you see, and what's the consequence from a public health and safety point of view if this happens?

It turns out the majority of these reactors at the low powered level, you know, the water that's in the pool meets Part 20 limits for either, you know, release to the environment, release to the sewer. Years ago some facility director took a drink of primary coolant to show a tour how safe his reactor was. We didn't like that but --

(Laughter)

MEMBER SKILLMAN: On that note, what oversight or what attention is given to the water itself? The water is great, it's a great shield, it's a great heat absorber, but if it's the wrong pH or the wrong chemistry it can doing more harm.

MR. ADAMS: Well, water quality is important, so there's technical specifications on conductivity and/or pH. Now in some cases if you limit -- if you maintain conductivity in these very low conductivity systems that you end up having a pH range that you can't go outside of just because of, you know, the chemistry. So depending on that ---

MEMBER SKILLMAN: Then my real question is what oversight or what attention is given to that through the inspection program?

MR. ADAMS: That's -- when the inspectors do operations inspections they look at the records of pH and conductivity.

MR. HARDESTY: There's also a tech spec limit on conductivity.

MR. ADAMS: Yes, so it's a direct license requirement. And as an operator you do it for safety reasons, too. All my in pool lighting was just bare wires because the water was such high purity that it wouldn't conduct electricity, so it's -- you do it to protect structures from corrosion, you know, some low level corrosion is going to occur, but the pH and conductivity levels we look at are sort of adjusted for protecting stainless steel and aluminum systems. You need to control water purity to keep activation down because, you know, the water is going through the core. Any impurities that are in that water are going to start activating which is going to give you a radiation protection problem. So there's another reason you maintain water quality at a high level, so it is something we look at.

MEMBER SKILLMAN: Thank you.

MR. ADAMS: You know, when we -- so we ask licensees, you know, we look at the radioactive content of the water, and it turns out, again, as I said, the water meets Part 20. What we've seen historically is the isotope that normally in these high purity systems, that the isotope that normally is a concern is sodium-24, you know, comes from the aluminum structures that put aluminum in the water. I think a 12-hour half-life, so even that isotope, you know, once the reactor is shut down for a short period of time, that drops off.

Facilities have replaced pools. When I worked at Buffalo, we had to replace the pool because of corrosion, and then the University replaced the pool a second time. USGS reactor, for example, replaced the pool. You know, other licensees, the cement pools that are epoxy lined that we've had licensees that have basically, you know, done maintenance to remove the coating and re-coat the pool. I think, for example, Penn State did that maintenance. So we look for that type of aging and when the licensees discover it, they take steps to address it; address if through actively fixing things. TRIGA reactors, a certain type of TRIGA we find that if they develop a small leak it's normally sort of in the same place, and that can be prevented by maintaining water temperature within a certain range. It turns out that it's -- that sort of run up and run down of temperature which really is, you know, stresses out these structures. So it is an anticipated operational occurrence that the licensees have to tell us about and we analyze, pool failure and heat exchanger failure.

CHAIRMAN POWERS: At this point, I think we will interrupt for about a 15-minute break, and return because I know that once you're through these backgrounds we're going to get into the subject of some interest which is the findings that have occurred over time. So let us return at 11:00.

(Whereupon, the proceedings went off the record at 10:42 a.m., and went back on the record at 10:59 a.m.)

CHAIRMAN POWERS: Are we ready to come back into session? Mr. Brown, you had a question?

MEMBER BROWN: Yes, if I can find my chair before I leave since I was attacked on my way out.

CHAIRMAN POWERS: This is a very hazardous subcommittee. People get attacked.

MEMBER BROWN: Yes.

CHAIRMAN POWERS: Actually, only Charlie gets attacked.

MEMBER BROWN: I'm used to it. It's on the pool reactors. You talked about conductivity and that the conductivity was kind of the metric you use for ensuring that the water stayed okay and didn't --

MR. ADAMS: Right. Conductivity and/or pH.

MEMBER BROWN: Okay. Fine. Is that a

sampled thing, or is that a continuously monitored --

MR. ADAMS: Most facilities have -- makeup demineralizers and cleanup demineralizers. There's normally a conductivity meter on the intake to the cleanup demineralizer. So, they, you know, they have an instrument that's continuously looking at it. They, you know, they --

MEMBER BROWN: Based on the input, right?

MR. ADAMS: Yes. Yes.

(Simultaneous speaking.)

MR. ADAMS: It's before the water -- it's before the water is cleaned up, you know. For purposes the tech specs say, you know, tech specs will say, you know, once a week, once a -- there will be a period that they actually have to take the measurement and write it down.

MEMBER BROWN: So, and that's -- is there any -- on the pool reactors, is there a flow such that you don't have stratification in these pools, I mean, if it's a static pool, or is it a -- and I don't mean a forced cooling type, but is there some minimal flow to prevent stratification so that you don't get pH or conductivity stratification within the pool itself?

MR. ADAMS: I don't -- we haven't seen anything like that.

MEMBER BROWN: Would you know?

CHAIRMAN POWERS: As soon as you turn the reactor on, you're going to get --

(Simultaneous speaking.)

(Laughter.)

MR. ADAMS: Normally the reactor -- the reactor stirs up the water pretty good.

MEMBER BROWN: Just through natural circulation --

MR. ADAMS: And even forced circulation, you know. Normally the, you know, the return lines into the pool are nowhere near the, you know, near the suction from the core to get that -- to get that circulation.

You know, can you get stratification? To some extent, but what we've seen is, you know, again the environment is an environment that pH and/or conductivity would not change rapidly, you know.

There's just -- it's, you know, temperatures from bath water to, you know, 110, 120 degrees Fahrenheit, atmospheric pressure. There's just, you know, there's not a driver there to send conductivity or pH, you know, out of, you know, that would be an acceptable band quickly. I mean, we've never seen, you know, we've never seen that.

MEMBER BROWN: But you say you only monitor it maybe once a week or something to write it down. I mean, is there an alarm on the conductivity or anything to measure it?

MR. ADAMS: Normally not.

MEMBER BROWN: So, there's no concern that you would have some difficulty with the conductivity or pH increasing to the point where it would be degrading within a week's period.

MR. ADAMS: Right. I mean, I'm not aware of anybody having to stop operation because of conductivity or pH.

MEMBER BROWN: Okay. Thank you.

MR. ADAMS: Again, it's just, you know, it's just a -- it's just a -- just because of the, you know, the operational conditions of the system.

MEMBER SKILLMAN: Alex, I think it's safe to say that most of the people who operates these pool reactors don't anticipate water chemistry excursion. And the data probably show that for many, many years these pools remain clean, quiescent, managed. And I think I heard you just say to Charlie you've never known of a significant excursion.

I would ask you to think hard about that. It doesn't take much for an excursion to accelerate on its own. A slight amount of organic material with the pool at about eight parts per million oxygen, which is where they run at atmospheric temperature and pressure, can become quite a problem very quickly.

MR. ADAMS: And so, you said that -- you've triggered my memory. There is an event that happened a while back where there as an issue with pool water quality. And the licensee picked up on that really quick and looked, you know, looked for the cause of it.

I think that's in the --

(Off mic comment.)

MR. ADAMS: Yeah. Strangely enough they -- it's a facility that did research with --

(Off mic comment.)

MR. ADAMS: AFRRI, yeah. That they -- that it was either the animals that, you know, that they used in their research, or even the floor wax they were looking at that was, you know, that was used on the floor.

So, yeah, there has been one event where the, you know, the licensee, you know, realized there was an issue quickly and tracked it down.

You know, even though there's a requirement that, you know, that this information gets, you know, written down for compliance issues, you know, showing the NRC, you know, at a certain periodicity to meet the tech specs, what we see is, for example, you know, each oncoming shift does a walk-down of the plant.

And, you know, even though for regulatory purposes I wrote down a number once a week every, you know, at least once a shift if the reactor is running, you know, these systems are looked at that there is startup check sheets, shutdown check sheets.

So, you know, things like conductivity meters are looked at with, you know, with a greater regularity than required by the technical specifications.

MEMBER SKILLMAN: Thank you.

MR. ADAMS: Let's see. Where were we? Tank reactors. So, tank reactors, the design feature they have there is the reactor lives in a tank. The reactor at Missouri is slightly pressurized, about 70-75 pounds.

I say normally used for the highest power reactors. If you go to the next slide, you'll see the first tank reactor we talk about is General Electric at a hundred kilowatts. So, again it's -- you see a lot of different design features.

The GE reactor is sort of unique in that its fuel form is unique. The fuel looks like silver dollar size which are on a, you know, which you're going to skewer and, you know, and put on your grill. the fuel silver dollars are on a structure that holds them and then those are the fuel elements that go into the tank.

The other two research reactors, you know, MIT, the reactor is located in the tank. Missouri, the reactor is located in the tank. The difference between Missouri and MIT, the reactor at Missouri, the tank that the reactor is in, is in a pool. In the case of MIT, the tank is -- the tank is self-contained.

So, you know, at this point you're, you know, you're at higher power levels, five megawatts, ten megawatts, you know, different uses, you know, different safety concerns come into play for these reactors.

MEMBER CORRADINI: So, I guess in the previous stuff, I thought MIT would be with MURR as a 104c.

Is it a 104a because of their former boron neutron capture here?

MR. ADAMS: So, MIT is the only reactor that's licensed under 104a. So, if you read their license, the license will say in, you know, in accordance with sections 104c and 104a of the Act, blah-blah, blah-blah, blah-blah.

MEMBER CORRADINI: And the reason is the BNCT?

MR. ADAMS: Yeah. And if you look historically, it appears back in 1957 when they put in their application. They said we want one of these and one of these, and the AEC said, here you go.

MEMBER CORRADINI: Okay. Thank you.

MEMBER REMPE: So, they did a re-licensing not long ago.

MR. ADAMS: Yes.

MEMBER REMPE: And why did they keep the 104a? Because it's not really being used.

MR. ADAMS: There are -- so, there was a lot of work done in BNCT in the late '50s, early '60s. And then in the late '90s there was another interest in BNCT and MIT did, you know, did come to us and there was a lot of discussions we had and put a -- developed a tech spec specifically for BNCT. And they did do a number of radiations on humans using the 104a license.

And BNCT is still a technology that is being actively researched at a number of facilities. There are facilities that are doing animal studies.

The focus of the research in this area now is improving the boron-containing drugs to deliver more boron to the tumor. So, it's still an area of research and development. They didn't want to close the door. And indeed if you're familiar at MIT, the original medical room under -- there's a medical room underneath the reactor. They built a -- they built a neutron multiplier that fed into a beam line, which went to a new irradiation room.

So, they put a lot of effort into updating the facility. And that was done through license renewal.

Next. By the time you get to, you

know, by the time you get to these reactors you see a large number of, you know, of teaching, but you also see a lot of research.

Missouri is -- their primary focus is on life sciences. They make a number of isotopes that end up being radiopharmaceuticals. You start seeing neutron radiography, neutron tomography, a lot of imagery with neutrons.

Explosives, all I'll say is that there's a lot of facilities who tech specs allow radiation of explosives. We rarely see these experiments being done.

There was a lot of work done in this area like back in the '50s and '60s. For example, the Army built a research reactor just to do radiography on explosives, but it's one of these things that, you know, that they keep it in their technical specifications and we evaluate it.

NAA, again a lot, you know, a lot of capability with NAA teaching. BNCT research, there's only a number of facilities that are actively pursuing it. Research and training.

General Electric, that reactor supported, you know, General Electric control and research in the fuel.

With Aerotest being shut down at the moment they -- GE does a lot of radiography on things like explosive bowls, explosive cords, turbine blades for high-performance engines.

Again, you see -- you see a large number of experimental facilities, beam ports, systems radiography. We see in-core facilities, pneumatic transfers, you know. We see a lot of facilities and, again, you know, the safety focus is internal to the users making sure that they handle the sources of radiation properly.

Next. Critical assembly facilities. Well, actually the S there is a little too much. There's one reactor license as a critical assembly. It's a research reactor that's owned by RPI.

It was licensed as a critical assembly originally. The original licensee of that facility was ALCO, the American Locomotive Corporation. They were one of the companies that was doing the Army -- that developed the Army package power reactors. And this was ALCO's critical assembly for doing the core research on the Army reactors.

It's still licensed as a critical assembly although RPI uses it as a research reactor. Historically there's been about 25-30 critical assemblies licensed. So, its RPI, it runs at a hundred watts.

It was -- a HEU reactor. It was converted to LEU and DOE took a very interesting approach to converting the reactor. So, you can see it's UO2 pellets and stainless steel tubes. What it's fueled with now is surplus fuel elements from the SPERT program that DOE had. So, it's basically SPERT fuel.

It has a design feature similar to the argonaut where you can drain the water out of the tank as an additional way of shutting the reactor down. Like I say, it's -- the university's use of it is like a research reactor, not really a critical --

MEMBER BALLINGER: As a point of local interest at the current -- currently they're building a casino --

MR. ADAMS: Yes, we're aware of that.

MEMBER BALLINGER: -- that's wrapping around this reactor. They refuse to sell the reactor. And so, they want to build a casino on the bank of the Mohawk River, which is where this is, and are building the casino around the reactor.

MR. ADAMS: And apparently they're

going to make the reactor look like --

MEMBER BALLINGER: Going to make it look like a casino, I guess. I don't know.

MR. ADAMS: Yes, we're aware of it. And, you know, they're not on site. So --

(Laughter.)

MR. ADAMS: Next. TRIGA stands for Training, Research, Isotope-production, General Atomics. General Atomics was the developer of the TRIGA. It's probably the most common reactor design in existence.

Their pool reactor is light water moderated. Solid homogeneous core. They have pulsing capability. You can see the power levels in the U.S. range from 250 kilowatts to 2.3 megawatts.

The unique part about it is the zirconium hydride fuel has a very strong negative temperature coefficient which allows the reactor to pulse.

My understanding is during development GA pulsed these reactors to, you know, very high power levels, you know, four or 5,000 megawatts during fuel development. So, 16 of them.

Their fuel pins, aluminum clad,

stainless clad. The original fuel was the aluminum clad. There's not a lot of aluminum clad left out there being used. The second type of fuel was the stainless steel clad.

Fuel comes in low enriched, high enriched -- used to. High enriched is gone. There's multiple fuel densities that you'll see out there.

From an accident analysis we assume a -- the hot pin fails in air and releases its fission products in the gap to the atmosphere. The failure mechanisms for aluminum fuel and stainless steel clad fuel differ.

The stainless steel clad fuel has a lot higher temperature safety limit than the aluminum clad fuel. And they're all natural convection cooled.

A lot of tank configurations. In-ground, several biological shields, several unique applications, fixed cores, movable cores. The design feature that links them together is the fuel.

General Atomics developed and marketed what we call TRIGA convert -- what was called TRIGA conversion, and still is. And that was not a conversion from HEU to LEU. It was a conversion where they developed a grid, a box that held four fuel elements that would go on an MTR grid plate.

So, there was a number of original MTR reactors. that converted to TRIGA so that they, you know, they have the square grid plate that you would expect to see with the MTR. Only when you look down, you see TRIGA fuel elements and they have pulsing capability. They were given a pulse rod.

Pulse rod, it's a pneumatic rod. You use air to eject a rod from the reactor and the reactor pulses.

There was technical specification limits on how much reactivity can be introduced in these pulses. And it's one of the when we license these, the TRIGA is one of the things that we do take a careful look at.

Again, used for a variety of purposes. Teaching neutron activation analysis. The facility at University of California-Davis that was built by the reactor -- built by the Air Force was originally built to do neutron radiography on the F-111 wings and parts. So, it's sort of a unique setup that fills with radiography bays around --

surrounding the reactor.

So, there's a lot of different configurations. Dry thimbles, dry tubes, beam ports, rotary specimen rack called a "lazy Susan" sort of because it -- you put your samples in it and the rack spins around for you to get even radiation. So, a lot of different ways of doing it.

The testing facility, I think we talked about that one earlier to a large extent. So, that is the reactor at NIST, the 20 megawatts. You can see it's U3O8 aluminum clad plates. 93 percent enriched cladding aluminum. There's some cadmium there to control peaking.

It's our only heavy-water cold reactor that exists. Heavy-water coolant, moderator, reflector. That's another reason why you want to have a tank reactor if you're using heavy water that you want to keep your very expensive heavy water from picking up moisture from the atmosphere.

CHAIRMAN POWERS: This is one of the few reactors that uses the thermodynamically unstable fuel.

MR. ADAMS: I'm sorry.

CHAIRMAN POWERS: Thermodynamically

unstable fuel.

MR. ADAMS: What do you mean by that?

CHAIRMAN POWERS: Well, were I to take that fuel and warm it up a little bit, it would turn into aluminum oxide and probably uranium dioxide, I would guess, but don't know that for a fact. And that would be a very exothermic reaction when it turned into aluminum oxide.

(Off mic comments.)

CHAIRMAN POWERS: Well, it is a permitted compound that they have created here.

MR. ADAMS: And sitting here I can't respond to that in any detail, you know. My guess, that was an issue that was looked at, you know, during re-licensing and probably looked at by the --

CHAIRMAN POWERS: I doubt it was looked at. It's universally ignored. But nevertheless it exists as an issue and I wonder why it is universally ignored.

MR. ADAMS: I can't answer that question sitting here.

The high-performance reactors, NIST, MIT, Missouri, are in the queue to undergo conversion to LEU. And, you know, at that point the fuel form is, you know, will end up changing significantly in these reactors.

Nothing new there. It's, you know, things we touched upon as we went through it. NIST is unique in that they're the only facility that does have a significant cold neutron source that if you get out there, there's an entire neutron guide.

Medical radioisotope facilities, you know, that's what we're looking at, at the moment. That's the future. And I'm not going to say much about that because, you know, the Committee, you know, spent a lot of time looking at the SHINE design for the construction permit and will, you know, will be back in front of the Committee when we get to the point where -- on the Northwest review where we, you know, we need to come to you and SHINE and Northwest will be back for operating licenses.

MR. HARDESTY: The one thing I do want to bring out here is that they are Class 103. So, they are not eligible for a non-expiring license. They will have to do license renewal under Class 103 licensing.

MR. ADAMS: So, talk about the inspection program and then talk about some of the findings we've seen.

So, the inspection program, it's a graded program given the safety significance of the facility, safety inspections Class I, Class II, and it's based on power level.

Through two megawatts and up you're a Class I facility. If you're less than two megawatts, you're a Class II facility. There's also a Class III facility, which our facilities are permanently shut down and waiting for decommissioning.

Those inspections are over at NMSS that once a reactor shuts down and we get the tech specs, at a certain point the facility is transferred over to NMSS.

So, the difference between these, there's different inspection procedures. They basically cover the same material. You'll see the Class I procedures are -- have more detail in them in the various areas.

The amount of time the inspectors spend on site at the Class I is greater than the Class II. So, normally on Class I the -- for safety inspection the inspector will be on site two weeks a year. For a Class II the inspector will be on site one week a year.

The difference is the Class I inspection program is -- the inspection program cycles annually. The Class II inspection programs cycle every two years.

There are security inspections that are based on SNM possession limits. Basically, you know, what Cat you are. And, again, the inspection program is based on your categories. You can see your -- the Cat, the three testing facilities get a one-week security inspection over two years. The Cat III is a one-week inspection over three years.

So, that's sort of the nuts and bolts of the program. There are also --

MEMBER SKILLMAN: And, Al, before you go on --

MR. ADAMS: Yes.

MEMBER SKILLMAN: -- let's go back to 50 for a second.

MR. ADAMS: Yes.

MEMBER SKILLMAN: Should the licensees of the Class I and Class II reactors anticipate that there will be drop-in visits by the inspectors, or are the two one weeks for the Class I and the two one-weeks over two years for Class II the only inspections that are applied to these licensees?

MR. ADAMS: So, those are the normal scheduled inspections. And indeed a lot of the time the inspector will call up and, you know, arrange when the inspection will occur with the facility to, you know, to make sure that they can, you know, that their impact on facility operations, teaching them that will be minimized, you know. Normally, you know, don't try to show up during final exams week or something like that.

However, we do have the, you know, the authority, you know, just like at any NRC facility we can show up, you know, whenever we want. And the regulations require unfeathered access.

And indeed, you know, at the 20, you know, like University of Missouri, that's a seven-day-a-week 24-hour day operation, you know. Our inspectors have dropped in unannounced at 2:00 in the morning and knocked on the door.

So, you know, so we do -- we do, you know, we do exercise, you know, the right to come in and inspect whenever we want.

If there's an event or we see something that would justify more inspection time or special inspections, they do occur.

So, you know, a lot of these, you know, if a licensee calls in with an event, we'll look at that event, you know, run it through the processes. And if, you know, if a special inspection needs to occur, you know, we go through that process.

So, it basically follows the same processes, inspection, enforcement processes as any other facility.

MEMBER SKILLMAN: Okay. Thank you.

MEMBER REMPE: So, how does your -- or how do your inspections interface with like OSHA inspections for a reactor facility? Because I've been in some of them and I'm just wondering especially with the next slide, do you -- is there overlap or do you say, ah, that's their issue and --

MR. ADAMS: Well, OSHA does not -- this is my understanding, because I'm not an expert in this. My understanding is OSHA does not actively inspect NRC facilities.

Is there someone from the inspection branch out there?

Mike, could you come to the microphone and --

MR. MORLANG: Sure.

(Pause.)

MR. MORLANG: My name is Mike Morlang with the NRR/PROB Oversight Branch, inspector for research and test reactors.

We routinely share information with OSHA. We'll look at their reports if they've done an inspection at the facility. And ours are obviously public information, the safety report. So, if there's something identified, we do share that information.

We have a fairly good working relationship, I guess would be the way to put it.

MEMBER REMPE: How often -- so, they do actually inspect facilities, is what I'm hearing from you.

MR. MORLANG: Some.

MEMBER REMPE: And how often do they come in?

MR. MORLANG: They -- OSHA just started doing that a few years ago. So, it's fairly new that they started doing that.

The universities weren't under OSHA at some time, and now they are.

MEMBER REMPE: Okay. Thank you.

MR. ADAMS: I think as an inspector if you -- if there's an event that is obviously, you know, it's not nuclear safety, but it is industrial safety and, you know, we're aware of it, we will pass that information on.

MR. MORLANG: Exactly. We'll identify it on the spot to the facility individuals.

MR. ADAMS: Yeah, and they'll look at it to see if there's any nexus to nuclear safety, you know. If something occurs and it's, you know, poor safety culture or, you know, some other issue that can find its way back to, you know, to nuclear safety, then we will look at that.

MS. GAVRILAS: This is Mirela Gavrilas. Just a small anecdote. I remember many years ago when I was at the University of Maryland somebody slipped on the stairs in the reactor and OSHA became involved after there was an incident in the reactor.

So, their involvement with research reactors is not new, but it used to be, as far as I know, incidental in the past.

MEMBER BALLINGER: Do I recall that when the SHINE people came in, I thought there was a much clearer distinction between the NRC inspection regime and the non-NRC safety chemical -- do you recall, Dana?

CHAIRMAN POWERS: Well, we have, I mean, there's a memo of understanding on this that they don't look at the nuclear --

MEMBER BALLINGER: Yes.

CHAIRMAN POWERS: -- aspects of facilities.

MEMBER BALLINGER: Yes.

MR. ADAMS: There it's, you know, because the other part of SHINE was the production facility. And there, you know, we're looking at licensed material commingled with chemicals and can that create a problem.

So, we looked -- so --

MEMBER STETKAR: And my recollection was NRC inspected anything that contained nuclear material. OSHA was everything else in the process --

CHAIRMAN POWERS: Yes.

MEMBER STETKAR: -- on a production facility.

CHAIRMAN POWERS: Right.

MR. ADAMS: So, we looked at violations from 2010 to 2016 and binned them and here's what we came up with: We identified 28 violations. And as you can see, 20 are what we consider operational. Operator error, tech spec, procedure violations.

Eight of them were what we call administrative, you know, you didn't fill out the form, posting and signage. We saw none related to, as you see, material deficiencies, inoperative equipment.

MR. HARDESTY: Yeah, I just wanted to add in the binning of these there were material failures, but the material failures in and of themselves did not cause a violation. It was the operator failing to recognize what the material deficiency was and then doing something afterwards that ended up being a violation.

So, there was some material failures, but they actually got analyzed and binned in as operational, because ultimately the violation was related to the operator not doing the right thing after material failure happened. And there was a couple of those.

MEMBER SKILLMAN: How did you come to be aware of these 28 violations?

MR. HARDESTY: A good number of them

are self-identified and -- but there are also a good number of them that are found during our routine inspection program. And Mike could speak at great length about that.

MEMBER SKILLMAN: Let me ask a deeper question. What formal process makes sure that the licensees are reporting when there is a deficiency?

MR. ADAMS: Well, yes. So, it -- so, reporting requirements come from several places. Some of them are in the regulations. For example, in the back of Part 20 if you have an incident that, you know, creates an overexposure or, you know, or large amount of contamination, there's requirements in the regulations to report events.

Every set of tech specs has a definition, a standard definition of reportable events that the licensee within a certain period of time, and mostly that case is the next working day, has to pick up the phone and tell us about it. So, it's a requirement of the regulations and the license technical specifications.

You know, the regulations require that, you know, that the licensees be truthful with us, that everything they tell us is truthful and accurate. So, you know, that's part of it, too.

Am I answering your question?

MEMBER SKILLMAN: Well, actually you're providing very good bait for more questions.

MR. ADAMS: Well, that's fine.

MEMBER SKILLMAN: Let me ask a question. It seems to me that part of what started this activity was the recognition that licensees were either tardy in reporting or having difficulty in assembling their licensing basis.

That caused a backlog after approximately 2001. That led to activities for streamlining that brings us to today's meeting.

And so, from my somewhat jaded point of view, this whole thing begins with some difficulties by the licensees to assemble the resources that are necessary to keep their licenses updated.

And hiding in that culture, hiding in that culture can be either a reluctance or an inability to report issues that are safety significant. And that's why I'm really asking the question.

How do we know that the information you provided here is all there is, or could there be a pot of information that is very significant and you are also not aware of it?

MEMBER CORRADINI: Can I ask a side question? So, that's a potential motivator, but my memory is since I've been involved in this with all the re-licensing, a lot of this just -- there was a big backlog because everything came -- all the initial -- a lot of the research reactors all got licensed in the late '50s and '60s and you guys got inundated by a large group of them simultaneously.

MR. ADAMS: Right. I mean, the backlog came from a couple of things. One was timing that in the early 2000s the 20-year license renewals that were done on these -- so, mostly, as you can see from the earlier slide, most of these facilities were licensed in the '60s.

And we licensed them for -- you pick a number. We handed that out as a term. Three years, seven years, ten years, 20 years, 30 years, 40 years. We handed them all out.

And what happened is the 20-year licenses came up for renewal in the '80s. TMI basically stopped regulation of research reactors for several years. I was a licensee. I didn't see an inspector for like three or four years. There was a backlog there.

The staff, you know, streamlined and renewed a number of licenses in a short period of time that -- licenses from the '80s came due in the early 2000s, and the 40-year licenses that were granted in the 1960s came due in the early 2000s.

So, all these renewals came in, 9/11 occurred. And for two, three years after 9/11, I did, and all the other senior project managers, was security assessment, security work. All this was set on the side.

So, those two things, and these were the first license renewals that the staff was reviewing with the benefit of NUREG-1537. There was, yeah, these renewals have generated a lot of RAIs. And that's basically to bring that yardstick we're using to be the same yardstick across the plate. So, all those things occurred, you know.

Reporting events, you know, could a licensee decide that they're going to be purposely, you know, hide things from us. I mean, you know, a licensee can do that. I mean, sooner or later we're going to find that out.

The worst thing you can do is be deliberate and willful. And, you know, you've seen that through how the NRC has handled enforcement cases in the past.

So, you know, there's an assumption there that, you know, it's trust, but verify. So, we expect licensees to report their problems to us, and they do and there's some advantage, you know.

If you discover it yourself, report it to us and take aggressive action. The enforcement program gives you credit for doing that versus, you know, we found it and, you know, that there wasn't corrective action. And the NRC will do what it takes.

Early in my career when I came here, we got -- I got involved with Georgia Tech who had issues that those issues could not be, you know, the licensee was not addressing those issues. We ordered that licensee to stop doing experiments. The problems continued. We ordered that licensee shut down until they fixed their, you know, cleaned their house.

So, you know, the NRC has all the normal enforcement and regulatory tools to maintain safety, you know, as anybody else. And it's back to that question, you know, looking at a license renewal every 20 years, will that, you know, would that have prevented what we've seen in the area of enforcement? And we don't think so.

And the next slide we'll talk about, you know, some of the, you know, some of the categories these have fallen into.

MEMBER SKILLMAN: And let me just follow up. What I hear you saying, Al, is, hey, we think this 28 is a pretty good number from 2010 to 2016. And we also think that prior to 2010 there were not at least purposeful violations, and we really don't think anything significant happened back in those earlier years.

Is that an accurate interpretation? It gets to the idea of not having to renew these licenses, because not renewing licenses can be a golden pathway to take no action in a lot of activities.

And if take no action in a lot of activities means I don't have to report at least as strenuously as I did before, then granting a no-cessation license is almost a license to do nothing unless the behavior has been demonstrating that the licensees really are reporting.

MR. ADAMS: And the license renewal process doesn't look at that beyond, you know, do they have the standard tech specs that define what a reportable event is and when they have to report it.

When those actions are carried out as mainly the inspection program, we do the license renewal, we go back and look at inspection reports as part of the license renewal, but the project managers, you know, if I'm a project manager for a facility every time the section report is issued, you know, not only do we have close communications with the inspectors because, you know, we're two different branches joined at the hip, but, you know, we read the inspection reports, we talk to the inspectors before they go out, we talk to the inspectors when they come back. So, you know, the inspection program watches what's going on.

We believe that the licensees report the problems that occur and, you know, the problems have different safety significance, you know.

Although it's not very common, there is the occasional severity Level 3 problem. We have written over the history of the research reactor program, we have issued several civil penalties.

Normally they end up being in the area of discrimination, but we have issued civil penalties for safety issues before.

MS. GAVRILAS: So, this is Mirela Gavrilas. I want to piggyback on what Al just said. We actually issued a civil penalty very recently and it was for a situation where we had some questions about the safety culture.

And that facility went through what we all thought collectively were extraordinary compensatory measures, yet we still issued the civil penalty because the buck stops there, you know. We have to set a line. And that's a very recent experience.

MR. ADAMS: Some measures they took, you know, new facility director. They brought in an external committee from the TRTR community to look at, you know, to look at the facility with outside eyes and basically do an out of the facility and, you know, and tell, you know, the licensee, the university what they saw, you know.

In addition to the inspection program, the required, you know, the requirement for reportable events, there's also requirements for safety committees that not only the safety committees have a set number of items they, you know, review as part of their actions, but there's also an audit requirement that the safety committee is periodically auditing the operations, looking for problems that maybe the operations folks have missed or looking for trends that maybe they're not seeing.

So, there's a lot of processes that are in place that license renewal or lack of license -- that process of going through a license renewal are not -- we believe are not going to affect.

MEMBER SKILLMAN: Okay Thank you.

MR. HARDESTY: I wanted to add to that, too, because you mentioned safety culture specifically. We as an organization have went through several phases where we've, you know, tried to impart on the licensees the importance of the safety culture. And that's no different in our organization.

We have met -- we traditionally go to the annual test research and training reactor annual meeting and we give presentations. They call it NRC Day. And we bring representatives from the safety culture branches with us to talk specifically about it.

We have interchanges with our licensees about safety culture. So, we're very much trying to instill that in them.

And at the same time in my own personal experience, these reactors aren't driven by a commercial or profit focus. They're doing research.

And so, they are more -- they tend to be more sensitive to having a problem, an outsider, you know, observing something wrong so that I think that there is a very strong self-reporting culture that we experience in our, you know, organization in terms of the research and test reactors.

MEMBER SKILLMAN: Thank you.

MR. ADAMS: Well, next slide. So, here's, you know, what I would say the more significant events that we've seen and characterized them. And you'll see they tend to end up in a couple of bins.

Exposure events, this is a person getting a higher exposure than was expected for what they were doing. And when you pull the string on these, they end up being a person that, you know, has, you know, there's a radiation protection program, you know. Regulations in Part 20 require a radiation protection program. That, you know, we look at that program, you know, both as part of the license renewal and there's a module in radiation protection that the inspectors do.

So, at least once that inspection cycle the inspectors have an inspection finding that the radiation protection program and the ALARA program meets the requirements of the regulations.

Despite that, despite, you know, requirements if you're a radiation worker yet you have to have training, you have to show the ability to do the job, despite all that it's basically a person that has not -- has either not followed the procedures, not followed their training, you know, that they basically removed the sample from the reactor without doing the proper surveys before they removed it, you know.

Then all of a sudden, you know, radiation monitors are going off and things like that and, you know, they have to do something in a big hurry or, you know, proper surveys wasn't -- were not done and a sample created contamination, or someone despite training, despite interlocks, you know, by, you know, goes though, you know, goes through a gate and despite signs blinking and bells dinging, you know, keeps walking on.

That's the kind of violations we've seen under exposure events versus the radiation protection program has systematically broken down.

And it shows that what we've said that we, you know, that the risk from these facilities are internal to the facility, you know, given the uniqueness and, you know, the difference in power reactors is the purpose of these reactors is to get the radiation out of the core, is to make samples radioactive, is to have beam tubes.

So, you know, this is an area we see. And when we see these type of events, they, you know, normally end up, I'd say, more than half the time resulting in a special inspection that occurs to focus on it, because one of the things we're concerned about is what we call significant potential for overexposure that these events did not result in overexposure, but we want to make sure that there is not a systematic breakdown and to understand why these events occurred and what the licensee has, you know, has done to prevent these events in the future.

The other one, operator absence, and this is, you know, an operator walks past the control room door, you know. Could be for five minutes, it could be for five seconds. Once you walk past the door, you've walked past the door and it's a -- it's a violation.

And the licensees that have done this have, you know, done all sorts of things to, you know, to address it with, you know, closed doors, sign on the doors, formal, you know, formal pointing at a person that they are in charge of the console and they're the console operator until they turn over to the next person, you know.

What we've seen, it's just, you know, a five-second lapse of concentration or, you know, one guy goes in this direction, the other guy goes in that direction. Both of them assume that the other guys was going to stay in the control room while, you know, he took -- or the other person took care of something.

The good news is, is that the places that experience this, we normally don't see repeat versions. And this is an area where we, you know, where we talk to the licensees because it's, you know, that, you know, despite all of the electronics and the system, you know, the operator is there for a reason.

System failure, Aerotest is down there. So, the technical specifications have requirements for doing surveillances on fuel and they define what is what we call damaged fuel.

Obviously if a fuel element is releasing fission products, that's the highest level of damage. We see TRIGA pin failures made, you know. It's been a while since we've seen one. Maybe every four or five years we'll see something.

Plate Fuel, I -- in the last 30 years we have not seen any plate fuel fail at all. And probably even goes back even further. In the '60s there were some issues, but apparently those issues were solved by increased quality control and a -- sort of a consolidation of the industry who was making these plates.

Aerotest had a number of fuel failures not indicated by the release of fission products. Although I -- although in hindsight they went and took some demineralizer resins and, you know, analyzed them to very low levels and did see some indication, but it was just the physical appearance of the fuel. And I think they took over 20 fuel elements out of service.

These were the old aluminum clad fuel elements. We still don't fully understand what we've seen there. However, these aluminum clad elements had an operating history unlike any other aluminum element we've seen. These were sort of the lead as far as how many hours they had, how many pulses they had.

These fuel elements went to India, came back from India, were at GA for a long period of time in the pulse development program and then ended up at Aerotest.

My theory is that they've reached the, you know, that they've reached the end of their life. That, you know, after 40, 50 years of a lot of operation that they've reached a point where, you know, they're at the end of their lives.

Again, Aerotest is, as we mentioned, shut down because of foreign control and domination, you know. If that issue is solved and they head back into operation, the status of their fuel is, you know, one of the things that the staff will focus on as we move forward.

Then there were stainless steel fuels. We haven't, you know, we haven't seen any patterns of, you know, issues with that fuel.

So, you know, aging -- the aging things we look at are fuel, that fuel either comes in two situations. It's facilities that consume fuel regularly, you know, that fuel isn't -- goes into the fuel cycle and, you know, is not in there very long.

And then the other end of the spectrum are these lifetime cores. And indeed some of these cores have been in operation 40, 50 years. And that's something, you know, that's something that we do look at. Fuel failure is one of those things that is reportable to us, you know, in a short time period.

MEMBER SKILLMAN: What is a short time period?

MR. ADAMS: Next working day to the headquarters operations officer. That's in the tech specs.

Now, if something happens that is a reportable requirement via the regulations, then the regulations tell you how quickly you have to pick up the phone. A one-hour notification, two-hour notification, but the reportable event notifications are normally reported in 24 hours.

If events occur, you know, the reactor has to be shut down, put into a safe configuration. And there has to be an analysis done and approval to restart by normally the facility director, in some cases the safety committee, before the reactor goes back into operation.

MEMBER SKILLMAN: Thank you.

MR. ADAMS: So, I'm at the end of what I wanted to talk about.

MEMBER STETKAR: What was the pool leak, Al, in North Carolina? Was it just a leak that --

MR. HARDESTY: Pool leak?

MEMBER STETKAR: Pool leak.

MR. HARDESTY: So, they --

MEMBER STETKAR: Corrosion or --

MR. HARDESTY: Say again?

MEMBER STETKAR: Corrosion, or somebody left a valve open, or somebody --

MR. HARDESTY: No, they actually installed a higher flow rate secondary cooling system that they were -- when they come back in for license renewal in 2017, they want to go to two megawatts. And so, they have been doing a lot of 5059 changes and other associated changes to the facility to get ready for that.

And one of the things they did is they put in this secondary cooling system and upped the flow rate. And when they did that, they are normally supposed to turn it off even before they upgraded it. But when they upgraded it, it had a significant more cooling capacity and they actually left it on overnight. Did not secure it like they were supposed to by procedure and it aggravated a known crack, I believe it was already known, in the lining.

And so, they experienced a much higher loss of water than they normally would trend. And so, then that --

The ultimate root cause was this higher flow rate cooling system that took the temperature of the pool way below what the tech spec value was supposed to be.

MR. ADAMS: We found that, you know, thermally cycling these pools that have the stainless steel or aluminum liners is not good for the pool.

The majority of the failures we've seen have been corrosion, but not corrosion from the inside of the pool. Corrosion from the outside of the pool.

What we've discovered is one of the worst things you can do is overflow your pool and get water down between the pool liner and the concrete structure that the pool lives in. That water in the concrete turns into a corrosive soup which basically corrodes the pool liner from the outside in, you know.

When we gained that knowledge, a couple of things that, for example, the new reactor at the University of Texas that there is a seal that if the pool does overflow, it doesn't go down in that space. And also actually before it gets to the top of the pool there is a -- basically a pathway that the pool will overflow onto the floor of the facility versus down in that spot between the pool liner and the concrete biological shield.

The facility that, for example, USGS replaced their liner in their entirety because of this issue. The new liner had a larger setoff from the concrete biological shield and they had a way to make -- to check to make sure that there was not moisture down in between that space.

So, lessons learned, we feed into how we license these things and move those lessons forward.

CHAIRMAN POWERS: I note that in your list of operator absence errors that you do not include an error committed at MIT.

MR. ADAMS: And I know that you're

talking about and that's because it was outside the time period that we're talking about. Yes, sir.

Probably the more significance -- and it wasn't operator absence. It was, you know, at the end of the day we believe the operator basically fell asleep at the console.

And the second operator was -- left the facility and couldn't, you know, couldn't get back in, because permission to get back in is given by the operator. So, that was -- we took a number of actions and that was a violation that rose to a higher level.

And MIT did, you know, a lot of training, a lot of staffing requirements and there is a system there that the operator has to prove to the electronics periodically, you know, alertness. So, yeah.

So, licensing oversight is with NRR. It's, you know, our motto is different that the regions are not inspecting our research reactors. That it's NRR and it's basically our sister branch that -- and that allows us close interactions.

We have stability in staff, you know. The folks tend to stay in the research reactor area for a while. I think our senior inspector has been inspecting research reactors from probably the late 1980s.

We now have NPUFs. They're neutron sources that thermal power -- it isn't thermal power that makes you a NPUF. It's that your utilization or production facility is not a power reactor.

CHAIRMAN POWERS: Seems to me that more so than -- or as much so as any branch you have a problem of knowledge preservation and passing on. We're not going to be here forever.

MR. ADAMS: Yeah, and, you know, part of that is there's, you know, that we do have knowledge transfer programs where, you know, I pass on my knowledge to the inspectors, you know. The inspectors pass on their knowledge as part of the qualification program, you know.

I think it's an issue that, you know, that NRC as an agency is concerned about. And we, you know, the folks that work in these areas, you know, we have the newer folks, but we also, you know, we also have some gray beards. So, that is an area that we are aware of and concerned about and, you know, actively work to pass the knowledge on.

To me, a great improvement in knowledge was, you know, writing 1537. That basically, you know, the project managers and, you know, contractors who were the real gray beards, you know, wrote down everything that was in their heads.

And we did have a -- we did have a chance -- there's some interim staff guidance to NUREG 1537. One of those was for liquid homogeneous reactors, because at one point we thought a licensee was going to come in with -- BMW was going to come in with liquid homogeneous reactors for medical isotope production and Research did that work for us.

And what they did is they assembled an international team of not only, you know, research reactor knowledge, but liquid homogeneous reactor knowledgeable people. And not only did they write an ISG for liquid homogeneous reactors that sits on top of NUREG-1537, but that group looked at 1537 from front to back and really didn't, you know, really didn't have very, you know, much to say about 1537.

So, it's, you know, it stood the test of time, you know. It was developed through the process where it went out for public comment. And, you know, we do have, you know, we do get, you know, indications that it is a, you know, it is a pretty good document through these things that have happened over the years of having it looked at.

So, that, I think that's important to knowledge transfer, too, that we have, you know, we do have things written down versus, you know, when I got to NRC, it was truly, you know, knowledge transfer. The old-timers, you know, talked to you.

MS. GAVRILAS: This is Mirela Gavrilas. Again, I'd like to add something on with regard to knowledge management, you know. That's a problem throughout the agency and definitely throughout the industry, but the Research and Test Reactor Group is fortunate in some regard and perhaps better at doing it than other parts of the organization, because they've operated for a long time as a center of excellence.

So, effectively they have the licensing people together with the oversight people, together with the security people and they cross-pollinate a lot and have dialog.

So, for those of us who are in the room with Al, we've heard most of the things that he's saying over and over. So, while we recognize that he is going to be -- when he leaves, he takes 30 years of RTR knowledge with him.

He's been very effective at transferring that knowledge in the past, I would say, three years as long as I've known him, for sure, to the staff that he is working with.

CHAIRMAN POWERS: Well, as an external observer, it's not clear to me that this is the vast organization that I'm seeing acknowledge transfer. Okay. I just pass that off.

MR. ADAMS: You mean the Research Reactor Group, or just NRC as an agency?

CHAIRMAN POWERS: No, this Research Reactor Group. That I have seen other organizations appear in front of my subcommittees and the committee itself that seem to have a more aggressive program.

My job is not to manage the Agency. I just pass on my observation.

MR. ADAMS: I appreciate that. And that's, you know, I think that's something we can look into, because I think that's important. That is important to us.

So, you know, what we said is that, you

know, five watts, 20 megawatts, we can bin them, but there's a lot of uniqueness, you know.

There's a lot of different applications and that, you know, the future at the moment is the medical isotope facilities. But, however, the medical isotope facilities will still be subject to license renewal. Am I correct there?

So, medical facilities are still going to be subject to license renewal, and so are the test reactors. So, right now it's only the research reactor that we are, you know, that we are applying this methodology to.

Although as you'll find out, for example, the requirement to keep your SAR up to date will also be applied to these facilities that will, you know, still go through formal license renewal.

CHAIRMAN POWERS: We're concluding this -- this is a background session for this that I had specifically asked that it be included, because many of us are not familiar with all the diversity of the research reactor.

So, I'll ask if there are any questions, because our next intent, I believe, is to go in and look at the specific proposal that's coming up. So, we'll get more into -- less into history and one item more into what's coming up after lunch.

So, are there any questions on this particular aspect?

MEMBER SKILLMAN: I do. Alex, let me come to you on this question, please. You identified 28 findings in the timespan between 2010 and 2016. And Dr. Powers said, hey, how about that issue at MIT? And you said, oh, that was before the cutoff time.

What I had asked about a half an hour ago was, are there any substantive issues prior to 2010? I believe your answer was no.

I'd like to ask you to think about that if there are some other issues that bear on how we will consider the importance of license renewal and activities for changes, I, for one, would like to know about those.

Did we have other significant exposures? Did we have other failures in operations? Did we have any facility breakdowns where the actual design of the facility failed indicating material conditions that hadn't been attended to either because of negligence, or because of error and oversight?

Is there other information that we should know about as we ponder change to the regulation?

MR. ADAMS: Sure. I mean, we, you know, based on your request for, you know, several years of information we decided, you know, 2010 to the present.

As you go back in history there is, you know, there is occasional severity Level 3 events that have happened. And, you know, we -- if you want, we can go back as far as you want and sort of pull those out.

We do have places where we gather, you know, we gather the more significant events and we have them documented that we use that as a teaching tool and also to look at things, you know.

These, you know, I can't remember an overexposure occurring, you know. That doesn't mean that it hasn't happened.

When I answered your question, I guess maybe I didn't understand what you were asking, you know. If you're asking, you know, have there been events prior to 2010 that, say, if I took my list back to 2000 or 1990, would this, you know, would this list of things we would point out to you be larger? The answer is yes that, you know, that there's always -- over the years there's always been issues with licenses.

MR. HARDESTY: And I will add that Mike and I did the data mining for this. And that even though we did go back further, what we had in 2010 to '16 is very representative of that larger time frame.

So, it's more of the same kind of things is what we observed. And the one list that we were using, that went back to 2000.

MR. MORLANG: I believe 2000.

MR. HARDESTY: So, I do have a tabular list that goes back that far if you'd like to see that, Mr. Skillman.

MR. MORLANG: I think it's important to note that the 28 --

(Off mic comments.)

MR. MORLAND: Of the 28 instances that we have listed, only one of those was a willful misconduct type of item. All the others were either identified during inspections or identified by the licensees and reported to us and looked at on the subsequent inspection.

MEMBER SKILLMAN: No. Thank you. I don't need to exhume the bodies or the skeletons. I'm just curious about what the data show. And if you're saying it's basically more of the same and that the pulse, the current cadence is self-reporting based on fidelity to the -- if what we're seeing is faithfulness to the tech specs, if the licensees are really doing that, then that's probably as good as it's going to get. So, I really don't need more.

MR. ADAMS: You know, most of the issues are reported, but the inspectors -- the inspectors still find things. It's always amazing that, you know, our inspectors can go out and they can, you know, go through the materials and, you know, find things that, you know, maybe the licensee wasn't fully aware of. So, you know, we do that.

You know, I think of, you know, all the events that happened over the years I've been at NRC. Like I said, the most significant ones were, you know, we shut, you know, for example, we shut Georgia Tech down because we lost confidence in their ability to run the reactor because of some events that occurred.

I can tell you an instance where most of the scram circuitry was disabled in one reactor and, you know, after we pulled that string, it was because an electronics tech switched out a module and assumed the new module was the same internally as the old module. And for some reason it had been modified and didn't do post-maintenance testing, which I think created a generic communications to the licensee, you know.

The significant events have resulted in generic communications and discussions at, you know, at the various meetings. And that licensee reported, too, when they went to shut down the reactor, you know, normally you run the control rods into 20 percent, you know, put a scram signal in.

Well, they put the scram signal in and the reactor didn't scram. That was a --- at least a severity Level 3 with a civil penalty.

And, you know, here's an example that this happened because they didn't recognize switching out a module as maintenance. And the tech specs required, you know, you do maintenance, you test.

MR. HARDESTY: And we talked about

special and reactive inspections when something goes wrong and of course the routine inspection program.

One thing that didn't get mentioned that I think is perhaps somewhat unique to us, because we are such a close-knit group and have a lot of synergy between the two branches, as well as a management that's right there with us, is that there have been cases where the licensee will call us up and they'll say, this isn't reportable, but we want you to know about it.

And so, that's a good side of the culture, but what happens on our side is we also look at it. And there have been a number of cases both where they didn't say it was a violation, but we thought it was maybe something that had to do with their op tempo and their culture where the director or the deputy director would go on site with the inspector and the PM for a visit to the facility just to kind of get a little feeling for what the --- what's going on at the facility to see if there's any, you know, possibility for a chilling effect.

I don't think we've ever really had anything like that, but we ---

So, we have, but in general it's --- we have --- our management is very supportive of us in going out to the facilities and talking directly to the directors.

In the case of TAMU when they had their one incident, which generated a lot of activities on our side, we actually asked to meet all the way up to the Level 1 and talk about them, what their corrective actions would be.

And our deputy -- or rather our director went with us to that visit and we had a very productive meeting in which they outlined their corrective actions and we followed up with them.

And of course they took independent action, as Al said, to have the TRTR have a separate audit group.

And so, they are very responsive and to trying to correct any deficiencies that might be either perceived or actual.

CHAIRMAN POWERS: One of the issues with these facilities, of course, is that they're older facilities. And so, you get kind of a churning of an operational and control systems that are operating and then we move more and more to digital systems.

Many of them are located on universities where you have lots of people unassociated with the reactor anxious to explore digital systems.

Do we have a potential issue here?

MR. HARDESTY: That's actually something we've been very proactive about. The -- our Research and Reactor Test -- the Licensing Branch has partnered with the power reactors on the digital I&C working groups on the embedded digital devices RIS, the counterfeit part RIS. All of those activities that are going on, they actually involve me. I'm actually the representative that typically goes with that.

And we also independently took a contract out with Oakridge National Lab through Research to, for lack of a better way to express it, distill the plethora of power reactor requirements down into a subset that would be more applicable for the research and test reactors community or the NPUF community.

And that ISG has actually just ended a 75-day public comment period yesterday. And so, we're getting -- we got a number of comments from the organization, but it's not new to them. They have seen this over the years as we went through and we said, here's a bit of requirements that we think are applicable to your community, and gave them the opportunity to feed that back.

And then along with that using this new interim staff guidance, we have started using a lot of the same processes that power reactors are using. It's called a Phase Zero review in which they will come into us with a design and talk about what their application should contain and the kinds of things that the ISG is telling them, because it's -- a lot of it is it's not new because the old -- I say "old," because the existing standard review plan has sections on digital -- or rather instrumentation control and some information on digital systems, but it's references to these power reactor standards.

So, what we did is we went to those same standards that were referenced and we extracted those clauses and put them into the ISG. So, they're learning a little bit with us in terms of what we expect for an application.

And we've been doing that with we started with the University of Florida. They had some other issues unrelated to licensing where they ended up withdrawing their application.

MIT is currently in with an amendment which we're reviewing. And Purdue University is going through the Phase Zero process right now to upgrade their digital I&C. So, there is a lot of interest because they're having problems getting replacement parts and we are proactively trying to address any issues they may have.

MR. ADAMS: And I'll change what I said before that. That is one area in NUREG-1537 where we are active. ISG is basically an update of Chapter 7, the ISC chapter in the NUREG, but, yeah, I mean, we do face a challenge that, you know, it's universities with electrical engineering departments and Ph.D.s and, you know, we see a lot of I've got the answer here on this breadboard and I use lab view to program it and let's, you know, let's bolt it onto the reactor.

So, you know, the inspectors are looking for that and there's been, you know, there's been several places where we told the licensee, you know, sorry, you know, you can't do that until you go through a full review.

MEMBER BROWN: Has that included as you

-- as they get into this area of applications of the new systems, have you incorporated not just like the controls and monitors and protection devices and that stuff, but the control of access in terms of where the information -- we've covered that extensively during the new design, new reactor design stuff with some agreements/disagreements relative to the cybersecurity and we're not allowed to talk about it, and, no, we can't look at the design, because that's somebody else's, and we don't have one-way devices, we're going to have two-way devices so that all of our data can be spread throughout the electrical engineering community, that's what I'm envisioning now, or the computer labs where they can process and see and send information back, or download software from some other part of the university, et cetera, et cetera, via network so that somebody can't take control of those control systems?

MR. HARDESTY: Absolutely we are considering that. Unlike the larger power reactor community where they decided to take the cybersecurity out and put it in NSIR and they kept the instrumentation control in NRR --

MEMBER BROWN: Don't get me started on

that.

MR. HARDESTY: I know. So, we maintained our center of excellence and we brought our security specialists not only for the facilities themselves, but also in relationship to cybersecurity, into our organization. So, we have a staff of three, right, security specialists that are helping us deal with that.

Now, that doesn't mean we don't leverage NSIR, because we do, but we've independently developed our own cybersecurity best practices document.

There are so many different things that the universities, bright minds say, hey, what if we could do that, what if we could do that. So, we were very concerned that they understood that there were limitations exactly like you have said.

You can't have your reactor system on the university network. Not allowed. Not going to happen. We're not going to permit it.

You have to have these firewalls. You have to have these access controls. Things have to be only accessible by authorized personnel and that has to be very well controlled.

And so, that's all in the best

practices document, and it's also included in the NUREG-1537 ISG at Chapter 7 what those requirements would be. It's guidance, so I use the term "requirements" nicely, but what our expectations are in terms of what their system should have.

So, yes, we have been proactively addressing that as well.

MEMBER BROWN: Well, the single point you ought to take away is the physical access of somebody coming in and do something to the equipment. That's largely administrative. That's paperwork. That's people have to sign in. You have only certain people have access and there's a way to get into equipment or not get into it and somebody's got to know they're doing it and what they're doing it with. So, but that's inside the plan.

The really key information is that there should be no external communications into the facility for the reactor -- or research reactor test equipment. And any information that goes out should go out through nothing but a hardware-type -- where there is no physical way to get any -- you can really fire your cyber guys, because the physical access can be controlled. I'm saying that with a little bit of tongue in cheek.

MR. HARDESTY: I completely understand.

MEMBER BROWN: So, I mean, it's real easy. I mean, you just don't allow anybody to connect in. A firewall that has bidirectional software -- has software that controls its directional capability, is fundamentally easily compromised by a 12-year-old today.

I mean, I'm saying that maybe with a little tongue in cheek, but not totally. These kids are learning to do stuff these days that every time you read the papers you'll find some group of teenagers at some high school has now broken into something locally and they're very skilled. They understand the stuff.

MR. HARDESTY: Well, when I alluded to firewalls, it was only internal. There is no external access to any of our networks.

We did do a -- I don't want to call it an audit. We went out and visited a number of the facilities as part of this project to develop this best practices and we did a cybersecurity audit to identify any critical digital assets. And the findings were -- the research and test reactors currently as they exist do not have any critical digital assets.

MEMBER BROWN: I'm not saying within the facility itself. You're going to want to have information going out so people can process it and do with it --

(Simultaneous speaking.)

MEMBER BROWN: And for that there ought to be literally an unbreakable wall to go outside. If you've got to carry it out, you put it on something, new hardware to take it out and --

MR. ADAMS: I mean, we've had to deal with, you know, remote education and the desire to, you know, have someone in another country see what the reactor is doing for, you know, a number of years now.

This is a bridge that we've crossed, you know, in the past, you know, to make sure that, you know, no one can get to the reactor from the outside.

MEMBER BROWN: Okay. Thank you.

CHAIRMAN POWERS: At this point, I think we will break for lunch and come back at -- what is that? 1:20.

(Whereupon, the above-entitled matter went off the record at 12:20 p.m. and resumed at

1:20 p.m.)

CHAIRMAN POWERS: Robert Beall is going to deal into the actual nitty-gritty on what's being proposed here.

MR. BEALL: Yes.

CHAIRMAN POWERS: So, I'll turn the floor over to you.

MR. BEALL: Okay, thank you, Dr. Powers.

Good afternoon. I'm going to be continuing on with the presentation this afternoon. Now that everybody on the Subcommittee is experts on NPUF courtesy of Duane and Al, this will go pretty quickly I guess, right? I can always hope.

I'd like to start out with what the purpose of the rule is going to be.

As lot of this will be familiar from the presentation we had this morning, but we talked a little bit this morning about the license renewal backlog, so streamlining the process should help reduce that backlog and eliminate it, and especially going forward with new license renewal applications that may come in.

Also, hoping to streamline the actual license renewal process.

And, also, we have some direction from the Commission via a number of SECY papers and SRMs that we've sent up over the years. They've asked to address, both in the short-term, the backlog in which Al and Duane have generated an ISG that they're currently using for the current license renewal applications they have in house.

And then, for the long-term, to enhance the process, and that's what we're doing here with the rulemaking that we'll be talking about in a minute.

The objective of the rulemaking was to try to establish a more effective and focused regulatory framework.

So, to do that, there are three regulations that we're looking at to modify. The first one is 10 CFR 2.109 which has to do with effective and timely renewal on application.

The second one is 10 CFR 50.71 which is maintenance of records and making of reports.

And, the third one is 10 CFR 50.51, continuation of a license.

But, before we got into the start of the formal proposed rulemaking, we did do a regulatory basis. This was completed, the final regulatory basis was issued in August of 2012.

From that regulatory basis, the staff concluded that the rulemaking should continue or was justified.

We did identify some constraints and limitations on what the rulemaking should contain. We also evaluated the feasibility of segregating the NPUF regulation, which means like setting up the regulations in its own sections in the 10 CFRs.

We also studied some benchmarking of looking at different methodologies. This benchmarking, Quynh, you can correct me if I'm wrong, I think we talked like DOE and people like that and to see how they did license renewal for their facilities.

So, we looked outside out little window to see what other people are doing. And, we also conducted a number of public meetings to get the stakeholders' feedback on the regulatory basis to see what they thought about what our proposed activities would be. And so, we actually had three public meetings on that.

Let me see, oops, I'm a little bit ahead of myself in my slides here.

Okay, so, thank you.

As we talked about this morning, the rulemaking affects all types of NPUFs. So, we talked about the earlier, the research reactors or the Class 104a's and c's, testing facilities are Class 104c's and the medical isotope facilities and processings are Class 103s. So, that's what you all are familiar with, everybody from this morning's conversation.

Next slide?

So, as Mirela said this morning, we are changing -- the proposed rule had nine activities or things that we were going to be changing. So, I'm going to go through each one of them now and discuss what things are being changed and what we're trying to do.

So, the first one is, and this is kind of a holdover, again, from this morning, is creating a new definition for the NPUFs. Okay? It does address -- it affects all the NPUF Class 104's and 103's. Okay?

We're trying to do that because, as we said this morning, there's no single definition that covers all the non-power facilities. Okay? So, we're adding the definition to Section 10 CFR 50.2. And, we wanted to do this so that we can have a flexible term that can capture all these different types of licensed facilities under 50.22 and 51.21(a) and 8.

Also, because of the different terms that's out there right now, we feel that this would add clarification and consistency to the way we can apply the regulations going forward.

Okay, next slide?

Another activity we're going to do is limiting the license terms for the facilities other than for testing facilities.

And, we talked about this this morning that it affects Class 104a and c, other than testing facilities. We talked about why testing facilities are a little different from the other NPUFs this morning.

The proposed rule would exempt Class 104a's and c's, NPUFs and from the requirements of having a 40-year fixed license term.

Basically, you would have a non-expiring license for these facilities going forward. Okay?

As we talked about this morning, again, it's the AEA has no licensing term for Class 104. It's also consistent with the minimum requirements standard that says, from the AEA for these type of facilities and with a non-expiring license, that also reduces the burdens on the licensees and the NRC.

But, we also feel because, and we'll talk about this is a second, it does -- we can still maintain the public health and safety.

MEMBER BLEY: Is a non-expiring license something that's common in the materials area or is this something new for us?

MR. HARDESTY: You mean is there one that exists now?

MEMBER BLEY: Yes, not for machines, but for materials. I'm guessing some of those are non-expiring.

MR. HARDESTY: To my knowledge, we're the --

MEMBER BLEY: The first?

MR. HARDESTY: -- only ones to attempt this. There are upwards of 80-year terms that they've applied in some of the materials areas, but we are the only one that is decided to go to a non-expiring license.

MEMBER BLEY: There's nothing in legislation that prohibits it?

MR. HARDESTY: No, and that specifically, what brought this up is that when we reviewed 104 and the Atomic Energy Act, the a and c specifically talk about what they're for and to minimally regulate them. But, there's nothing about license terms.

Whereas, under 103, it specifically says maximum of 40 years.

MEMBER BLEY: Okay. Thanks.

MR. ADAMS: There's some foreign countries that employ non-expiring licenses, but they have something called a periodic safety review instead.

MEMBER BLEY: Okay.

MR. BEALL: Okay, next slide?

Some of the areas that we looked at to validate what we're trying to do here is aging management. When you have a non-expiring license, are there any issues on the -- say, aging management that we have to address that would have been addressed, per se, when you have a license renewal process?

So, but, NPUFs have a very simple design. We went through all the -- well, they have a very -- they have a much -- they have varied designs all over the place, but their designs are very simple.

They're also, we talked about this morning, again, the low power and temperature that they operate under. Okay?

And, they do have surveillance requirements in their tech specs. So, they have to go in and do annual, daily, whatever, you know, for operation surveillances or whatever they have to do and before they can operate.

It also we said, okay, when you have a license renewal, there is opportunity there for the public involvement. Where can we maintain that?

So, if you look at the ways the public can still be involved in the operation of the facility. And so, if there's a licensing action in that facility, they can always request a hearing.

There's also the process of the 10 CFR 2.206 Petitions. And, also, of course, through the allegation of process. Those are the three vehicles that the public can still have an input on the operation of the facility.

MEMBER CORRADINI: What's an example of a typical licensing action for a research reactor? I'm not --

MR. HARDESTY: An amendment request.

MEMBER CORRADINI: An amendment request? Okay.

MR. HARDESTY: And also, I would point out that the five-year updates for their FSARs, although the one they submit may not actually be released, we will do redacted versions of each one, so they will be publically available for review.

MEMBER CORRADINI: And, that would be another venue?

MR. HARDESTY: Correct.

MEMBER BROWN: If you have a non-expiring license, how can an opportunity for public involvement be involved with the licensing action if you're not going to have any licensing?

MR. HARDESTY: So, the licensing action would be like a license amendment request. They still have to come in with an application and get it reviewed and approved by the NRC if they're going to amend their license.

MEMBER BROWN: Let me finish.

If they're not amending their license?

MR. HARDESTY: Oh, how would they if they're not amending their -- there's no licensing action?

MEMBER BROWN: Well, the other -- the 2.206 Petitions for the allegation process is regardless of licensing?

MR. HARDESTY: Right.

MEMBER BROWN: Before, we can do that any time?

MR. HARDESTY: Correct.

MEMBER BROWN: And, that's a requirement 40 years, at least, there was another for license renewal, that's the opportunity today. Isn't that correct? For public involvement?

MR. HARDESTY: Yes.

MEMBER BROWN: We're going banish that? You're taking that away and the only vehicle then, if they do something to their facility that requires them to do an LAR?

MR. HARDESTY: Or the ones that exist that always, the 2.206 type stuff and then they -- like, if they review --

MEMBER BROWN: Yes, and those were already there?

I was just questioning, you used the word licensing actions, they're out of it if they have a non-expiring license?

MR. HARDESTY: And they don't have any

licensing actions.

MEMBER BROWN: And, they have no other reason to submit an LAR?

MR. ADAMS: And, can tell you from a statistical point of view, over the last 30 years, there's been only one license renewal that went to hearing. So, it's relatively rare in our realm.

MEMBER BROWN: I don't know what that means, one license amendment request or --

MR. ADAMS: No, one license renewal in the '90s went to hearing. So, in the past 30 years, where we have given opportunity for hearing, we've only had one license renewal in the past 30 years that have gone to hearing.

So, it's not --

MEMBER BROWN: But, what if they don't go to hearing? I mean, do they get to -- they submit the license renewal and nobody does anything with it or what?

MR. ADAMS: No.

MEMBER BROWN: I don't understand the difference, what you're talking about.

MR. ADAMS: Well so, okay, their 40 years expired, right? So, there's a difference here in licensing path.

For example, in the case of SHINE for the construction permit, the hearing was mandatory. That, you know, there was a hearing to grant that licensing action.

For a research reactor, initial licensing and license renewal, a hearing is not mandatory. The only time you have a hearing is if you give opportunity for hearing and a person can come along and get standing and have a contention that gets admitted.

MEMBER BROWN: Okay. But, you all would grant the -- you granted the license initially without a hearing?

MR. ADAMS: May have, may not.

MEMBER BROWN: Well, yes.

MEMBER BLEY: Just take it at what he said, okay?

MEMBER BROWN: Well, he said there's no hearing unless somebody demands one.

MR. ADAMS: Unless they demand it.

MEMBER BROWN: So, you could have had 30 people come in to have a research reactor, they requested a license to do that. You granted it. And, if there was no hearing requested or demanded for some other reason, you didn't have -- you just granted the license.

MR. ADAMS: But, the only point I'm trying to --

MEMBER BROWN: But, that's what I'm talking about.

MR. ADAMS: Yes, the only point I'm trying to make is, historically, on license renewals, hearings have been very rare.

MEMBER BROWN: Yes, as opposed to --

MR. ADAMS: As opposed to other classes of licenses.

MEMBER BROWN: They come for a license renewal, there was no other reason to have a hearing, so 29 out of 30, I'm using my 30 as the number, got granted again or renewed by NRC without a hearing because there wasn't a petition or a demand or some other --

MR. ADAMS: But, there was still an opportunity.

MEMBER BROWN: I got that.

No, you've answered my question now.

MR. ADAMS: Okay.

MEMBER BROWN: I think.

MR. BEALL: Okay. Oversight and inspection activities, we talked about the -- right before lunch, we talked a lot about the inspection activities that Al and his staff or the other folks in our division do on the NPUF facilities, that will continue on.

We talked about also the very low number of design changes. They talked to something like five changes per year from all the facilities. So, that's also a very low number.

Also, one of the design changes or the regulatory changes we're putting in here is that Duane just talked about was the increased FSAR updates. So, that will help us and also help the licensees to keep the design basis up to date in a more frequent manner.

Because, one of the things that we talked about this morning is that the licensees were not always keeping their FSARs updated with design changes they may have done over the 20 or 40 year time period.

CHAIRMAN POWERS: How did you come up with the number five years?

MR. HARDESTY: Quite honestly, the number came from the original basis of what we were going to do for rulemaking that had a -- what we were calling an enhanced inspection at the time but that became later became referred to a licensing basis assessment. And, we decided on ten years for that.

But, very quickly, in the early stages of the proposed rule, we realized that all we were doing was going from a 20-year license renewal to a 10-year license renewal.

And so, we started thinking a little bit out of the box, decided that the ultimate streamlining was to do away with license renewal all together. So, why would we want this extra process that we're going to add in if we're not having issues anyway?

And so, the five years came before that decision was made which was half. We wanted one every -- to occur with every cycle and halfway in between. That's, quite honestly, where it came from.

But, when I went to substantiate that number later, I looked at the Statement of Considerations for why they do it at two years in the power reactor license and, originally, they had suggested five years. And, I thought that -- I felt, after looking at all the Statement of Considerations that two years was way too frequent for us to require these small facilities to do it, but five years seems like a reasonable number in which we could maintain continuity and basis without -- yes, overly burdening them. It was kind of a good balance.

CHAIRMAN POWERS: Did you ask the licensees about it?

MR. HARDESTY: We did. We presented it to them several -- we've had four -- three public meetings and --

MEMBER CORRADINI: I'm sure they're all listening as we speak.

MR. HARDESTY: Well, Mark's right behind you. He was at all three.

CHAIRMAN POWERS: Well, I mean, what motivates is the question, may have read into Mark's wheelhouse here, is that five years is greater than the average lifetime of the graduate student working in the facility, his tenure in office.

And so, you could easily have someone come in, the expert and the existing FSAR disappear. A new guy may appear and there's been a complete knowledge lost.

MR. HARDESTY: Right.

CHAIRMAN POWERS: And, by having it five years, whereas, four might not. At major publics, we don't' let them graduate unless they succeed.

MEMBER REMPE: At MIT, the students who went to the reactor had to stay there longer. There's a long history of names we could list that stay there longer because they're working at the reactor. But, I had never questioned.

What is the review going to be on the FSAR? Are you just going to look at the changes? Are you going to do a thorough review? Have you thought through what you're review process will be for this?

MR. HARDESTY: We've generated a draft regulatory guide that deals with the guidance for the licensees and what they're supposed to do for the FSAR updates. And, it also includes staff guidance of what should be done.

But, we also have, of course, bonding nonpublic project managers handbook which has guidance on what the staff is supposed to do.

And so, we've used this term called a delta review and it's exactly what you're talking about.

If there is no changes at all, they're still required to submit something to us. But, there wouldn't be -- if you look at 50.71, they're required to submit a change page. So, if there's no changes, then they can simply say that there's no changes and that would greatly simplify the process.

But, whatever changes they provide, we've kind of encouraged them or have been trying to encourage them to submit an entire update that, you know, a complete FSAR and include the change pages.

But, they do have the option of submitting just the change pages, in which case, the staff would have to go in and collate it into where the existing document is and we put it into ADAMS so that we maintain our documentation.

But, yes, as part of that, we're going to do a full review. I mean, because it's always good for the staff as well to review the entire FSAR. But, we'd be focused on the changes to make sure there's not something that we need to follow up on.

MEMBER REMPE: I saw the guide, but it's good to know there's an internal one.

I also was wondering, will there be an inspection as part of that? Before you say, we're going to stamp it? You won't change your inspection schedule? You're just going to do -- look at the paper basically?

MR. HARDESTY: Right. And, you brought up a very important point. That review is not an approval. Because, if it was an approval, it would become a licensing action and we can't -- there would have to be other changes reflected in the rule to make it a licensing action.

So, the NRC is not going to approve their FSAR updates. We'll just review them and follow up on them if there's something we have to follow up on. But, we will not go back to the licensees and say we've approved this.

And, Howard can speak to that better.

MEMBER CORRADINI: So, just from a continuity standpoint, what most of the research reactors just did in terms of their renewals is they're -- and they redid the FSAR, is the redoing of the FSAR five years similar to what they would have done in their most recent licensing actions or is there going to be totally different again than for 1537?

MR. HARDESTY: I think that there is an important nuance --

MEMBER CORRADINI: Do you know what I'm asking?

MR. HARDESTY: I do, I think so.

I think there's an important nuance that you have to caveat all that with is that 50.59, the regulations under 10 CFR 50.59 require that the licensee already make updates to their FSAR if they make changes to the facility that impact that. So, they're already supposed to be doing this documentation.

The only additional requirement we're putting on them is to submit it to us so that we also have all those changes into the FSAR.

Because, currently, the only way we get them is at the 20-year point.

MR. BEALL: Right, so we try to increase the timely review internally when we get those documents in.

MEMBER CORRADINI: But, the only reason I ask is, since, as you had noted, that 1537 was new to them in the sense that they now built up a nominal approach to how things are relicensed and now information is kept.

I was hoping that what they did there is similar to what they have to do here so that it's not like another step.

MR. ADAMS: No, yes, you're absolutely correct. So, in the round of license renewals we're doing now is where we're bringing them up to the standard yardstick, so to speak.

So, we have a licensing basis that matches up with the format and the content in 1537 in the standard review plan.

As we move forward, we expect license amendments that would come in that would use the applicable part of the format and content in the standard review plan.

So, if I get an FSAR update in, what I should expect to see is license amendments that I issued that I know what they talk about. 50.59 is that the licensee has done which reported as part of the annual report and are looked at by the inspection program.

So, theoretically, as I read this updated FSAR every five years, I should be getting surprised. And, you know, if I do --

MEMBER CORRADINI: You are in the preparation?

MR. ADAMS: Yes. Or if I -- yes, if I do end up getting surprised, you know, then I need to, you know, I need to pull that string. But, the important part was, it's not a licensing action.

I don't -- on the power reactor side, are those FSAR reviews licensing actions? People are nodding their head no. So, it's similar.

But, you know, again, we're interested in safety. If we read something and we go, where did that come from? You know, and it's safety significant, you know, we're going to follow it.

MR. HARDESTY: And, in fact, we do that already when we get their annual reports, if they summarize their 50.59 changes and we don't understand them or the inspector goes out and has a question they do inspector qualified and then come back and talk to the PM, we do that.

So, we have an existing framework to accomplish that.

MEMBER CORRADINI: Thank you.

MR. BEALL: Next slide?

So, as we talked about this morning, the Atomic Energy Act doesn't really establish a licensing term for these class of facilities.

So, right now, the regulations talks

about limiting to about less than 40 years. And, what we currently do now is give them a license for about 20 years for the term. Okay?

So, not having a non-expiring license, we feel -- the staff feels that is it consistent with Section 104 to impose only the minimum amount of regulations under the act.

And, also with the aging management systems and the oversight and the checks we do and the surveillance requirements, we feel that we can still maintain the public health and safety by making this change.

So, I'll also note that the Class 103 facilities like SHINE will still have to have the, you know, will not be part of this. So, they'll come back and have a normal licensing term and the same thing with test reactors. Okay?

Well, speaking of which, that's what this slide is all about.

A good segue, right.

So, it affects all Class 103's and existing facilities will still have a licensing term of some sort.

They have to come in and when they want to have a license renewal, they have a possible hearing and all that good stuff. So, the proposed rule will consolidate the license renewal requirements under a very new section in the 10 CFRs, 50.135, that's a brand new one that we're creating for this.

And so, we're hoping to use this to clarify license renewal reprocess and also to help with the efficiency of how we do the license renewal process for these types of facilities.

MR. ADAMS: Can I add something here?

So, I was surprised that someone didn't say 20 years when the regulations say you can go up to 40 years?

Twenty years was an administrative decision that we made because we felt that was, you know, a long enough period of time to go between not seeing any FSAR updates.

You know, given this five-year rule with these licensees, that would be a reason to, you know, to consider renewing licenses for more than 20 years because now we would have that FSAR update on both sides of the fence.

MR. BEALL: Okay. So, this -- the before requirement is what we just finished talking about a little bit is about the five-year update for the FSARs. This does affect all new NPUFs Class 104's and 103's.

So, the proposed rule would extend it to all the new NPUFs. During the license renewal some licensees are unable to provide the documentation that we talked about this morning is that, you know, one of the reasons we're doing this is to try to have more frequent FSAR updates instead of having it just when the license renewal process starts.

So, this also benefits, we talked about -- a little bit about knowledge transfer. Also, for the inspections programs so that the inspectors don't have to go through a ton of paperwork when they go through there. They have something to look at here at the facility, at the NRC Headquarters, before they go out to the facility.

MEMBER BLEY: Has there been any push back on this idea when you've talked to the facilities?

MR. HARDESTY: Push back from the licensees?

MEMBER BLEY: Yes.

MR. HARDESTY: No, we did not get any push back from the licensees. The -- I guess the one comment that would even come closest to this is that I did have a couple offline, not during the public meeting, that said that this was a very major paradigm shift and they did not think that we would be successful.

But, no, they all embrace this idea. In fact, and we've had other licensees that have come in and even to the Commission and said so much as, you know, why do we even regulate? There's no consequence to us, why regulate us?

So, I think that they embrace the idea that we're trying to move to this more of a minimum regulations standpoint.

MEMBER STETKAR: Explore -- and I don't know if you've thought about this, and I'm personally not even completely clear in terms of power reactor requirements.

I've been told, on good faith, that when power reactors update their FSARs and submit them, they do not update things like their environmental information, weather related information, nearby hazardous facilities, any site related stuff. That's the -- I've been told they don't do that.

So, for example, if somebody builds a

weapons manufacturing facility next door to your nuclear plant, you don't update that information in your FSAR because you weren't licensed to that.

MR. HARDESTY: So, the regulations only talk about changes that affect the FSAR. So, if it affects what's in the FSAR, then it should be updated.

Our guidance documents are more specific in which they adhere to the 1537 guidance that we provide. So, essentially, if it affects one of the 18 chapters or so, I guess it was actually only 16 because of this other information, but anyway, if it affects one of the chapters that are part of the NUREG-1537 guidance, our guidance basically says that we expect to see that updated in the FSAR.

MR. ADAMS: Yes, but we can't comment on what the power reactors do.

MEMBER STETKAR: No, and I don't particularly care. I was using that as a lead in.

So, for example, if you had an updated seismic hazard assessment in your local area or around your facility within the last five years that indicated that you're seismic hazard had increased, would that need to be information that's included in the updated FSAR for one of these facilities?

Or, if somebody changed the amount of air traffic at a local airport that's across the street from your facility, for example?

MR. HARDESTY: It would certainly be the expectation that --

MEMBER STETKAR: That's just an example.

MR. HARDESTY: It would certainly be the expectation that that would be evaluated. However, if it didn't constitute in a change of the analyzed condition in the FSAR, then it probably wouldn't be updated.

Because they don't speak the -- not a lot of them, you know, have, quote, the data specifically saying this particular data about this many airplanes or, you know, air traffic, in your example.

That kind of level of detail isn't in their current FSARs, so you wouldn't expect that -- there wouldn't be a needed update just because that traffic was changed numerically.

However, if the overall analysis of the consequences and probability changed then, yes, we would expect that to be updated.

And, the interesting side of that is that, if we know about it and they didn't make the change, then obviously, we'll question it and force an update. If they know about it, then we would expect them to change it.

MEMBER STETKAR: Well, that's -- I'm not going to comment on the power reactors. The power reactors people have known about things and yet, have not been updated in the FSAR because there's no legal requirement to update them in the FSAR.

MR. HARDESTY: Right. You have to remember, there are --

MEMBER STETKAR: So, I'm trying to pulse you in terms of looking now forward over many possible years of incremental updates to an FSAR whether the surroundings of the facility could change substantially where the licensee wouldn't need to inform you about it.

Where's the --

MR. HARDESTY: You wouldn't need to.

MEMBER STETKAR: Would be required to?

MR. HARDESTY: So, that kind of information would be in Chapter 2 of NUREG-1537 and we would expect that a corresponding update would occur if it affected their FSAR in that section when they went to -- when these new things were identified so that they would be reflected in their FSAR. That's basically what the guidance says.

MEMBER CORRADINI: So, can I say it back to you so I understand?

You're saying the spirit of this is, with whatever chapter it is, the spirit of this is if something changes around their site, they ought to inform you as part of an update of the FSAR? That's what I -- the spirit of this? Am I understanding you?

MR. HARDESTY: With the caveat that it changes the analysis.

MEMBER CORRADINI: Right.

MR. ADAMS: Yes, the example of if someone builds an explosive, you know, factory across the street, you probably want to know about that.

Or, the example with MIT of the --

MEMBER CORRADINI: Well, I was going to say that would be --

MR. ADAMS: Yes, yes, there was a change that had a safety implication, you know, that changes and have safety implications then there's, you know, changes that don't.

MR. FOLK: I would add with respect to power reactors, you're correct, that environmental information would not, you know, demographic information that was part of the original FSAR would not be updated.

But, where information relevant to a tech spec change and environmental information that relates to that, that would be updated. For example, something --

MEMBER STETKAR: Tech specs, like an environmental discharged one -- I'm talking about it's not clear that somebody would need to report the fact that somebody built a munitions plant immediately adjacent to my fence provided that there weren't a bizillion people housed there during the day that could be possibly exposed to a release that would change my licensing basis.

Because it's more, you know, it's not --

MR. ADAMS: And, that's, you know, part of the interesting fact that, you know, 50.59 is changes to the facility, procedures and that. And, you know, across the street is not the facility, but it still is the FSAR.

MEMBER STETKAR: But, again, I don't want to argue. I wanted to use it because we've run into this in the past with the power reactors and people have argued that, at least at the license renewal stage, there's some attention paid to that because of the environmental review.

MR. HARDESTY: Certainly, that's part of our standard review plan. And, they do report that, at least the environmental impact in their annual report as far as that's what it relates to and things.

But, you know, you mentioned moving something hazardous adjacent to the reactor, we would also consider the converse of that is that if they decided to build a casino or if they decided to build a new dorm room or a new student center that was within, you know, a proximity that was of concern, then we would expect them to update for that as well.

MEMBER STETKAR: That's what I said. Well, if, you know, if this munitions factory were going to employ 500,000 people that obviously would change the demographics in terms of your licensing basis for releases. But -- okay.

MR. BEALL: Another proposed change is to the timely renewal provisions of the regulations.

This does affect all NPUFs, but not the 104a's and c's because they don't have a -- they don't have to worry about timely renewal for them because they have a non-expiring license.

Also, it also exempts the -- and so, it really affects just the Class 103 facilities.

So, the issue we're having here right now is that the current regulations in 10 CFR 2.109 talks about that if you submit your license application within 30 days of your license expiring, you can continue on with your operations on your timely renewal provisions, similar to what's going on with Indian Point.

And so, but the 30-day time period doesn't allow Al and his staff to perform a sufficient review of the applications. Because, all of a sudden, you're into timely renewal operation very quickly.

And so, what we're going to here is change the regulations to allow licensees to submit within two years of their current license to expire. And, that would give Al and his folks more breathing room to do the review of the applications for the current license expires.

MR. ADAMS: With the 30 days, there's no way you can do an acceptance review of a license renewal application. So, basically, whatever, you know, whatever was in the envelop is what we, you know, went with from there.

And so, you know, the, you know the REI process became a substitute for an acceptance review. So, we, you know, we'd like to have some more time for that, you know, if there are serious shortcomings in the application, we can basically return the application to be, you know, to be worked on and the license is still in place.

Because after the -- if you're in 31 days before you expire and that 31 days is up, then you continue on the fact that you're on timely renewal, which doesn't allow us to reject the application.

MEMBER REMPE: So, even though you never accept the application, you can't reject it?

MR. ADAMS: We accept the application through lack of rejection.

MR. BEALL: Okay.

Number six is going to be talked about

by Rich Clement.

MR. CLEMENT: Thank you, Bob.

The staff is proposing a new regulation to provide an accident dose criteria of 1 rem total effective dose equivalent for NPUFs other than testing facilities.

TEDE is defined in Part 20, it means the sum of the internal and external radiation exposures.

Testing facilities and power reactors are subject to the reactor site criteria in Part 100.

Currently, results from the accident analyses for NPUFs, other than testing facilities, are compared with the standards in Part 20 for protection against ionizing radiation.

The standards in Part 20 provide a limit on the maximum yearly dose a member of the public can receive from operation of any NRC licensed facility.

The annual public dose limit of .1 rem applies to normal operating conditions.

In addition to the dose limits in Part 20, accident dose criteria are also applied to determine the acceptability of a licensed facility.

The accident dose criteria are not dose limits, but provide defense-in-depth so that in the unlikely event of an accident, no acute radiation related harm will result to any member of the public.

And, the NRC Atomic Safety and Licensing Appeals Board suggested that the standards in Part 20 are unduly restrictive as accident dose criteria for research reactors. This was a ruling in 1972.

Previously, the NRC had generally found accident doses of .5 rem whole body and 3 rem thyroid from iodine exposures for members of the public to be acceptable.

However, in January of 1994, the NRC implemented a change in Part 20 that reduced the public dose limit from .5 rem to .1 rem.

Because of NPUFs low potential radiological risks to the environment and the public, the .1 rem public dose limit is restrictive as applied to accident consequences such as the maximum hypothetical accidents considered in NPUF license renewal applications.

Also, the staff considers the accident dose criterion Part 100, which is 25 rem whole body and 300 rem thyroid to be too high for NPUFs other than testing facilities.

In 1992, the Environmental Protection Agency published Protective Action Guides, or PAGs, and the Manual Protective Action Guides and Protective Actions for Nuclear Incidents.

In 2013, the EPA made revisions to the PAG Manual which is currently in draft interim.

The PAGs are dose guidelines to support decisions that trigger protective actions such as staying indoors or evacuation to protect the public during a radiological incident.

In the early phase, that's the beginning of the incident that may last a few hours or two days.

The PAG that recommends the protective action of sheltering in place or evacuation of the public to avoid inhalation of gases or particulates in an atmospheric plume and to minimize external radiation exposure ranges from 1 rem to 5 rem.

The proposed accident dose criterion of 1 rem total effective dose equivalent for NPUFs other than testing facilities is consistent with the early phase PAG and provides adequate protection for public from unnecessary exposure to radiation.

MEMBER CORRADINI: So, given your explanation, I want to make sure, so you said, I can't remember the date, somewhere in your explanation, '94 you said EPA went from X to Y?

MR. CLEMENT: It was the NRC, it changed Part 20.

MEMBER CORRADINI: Okay.

MR. CLEMENT: In 1991, there was a rule change. There was a two or three years implementation period. So --

MEMBER CORRADINI: Where EPA started setting the -- go ahead, I'm sorry.

MR. CLEMENT: The NRC public dose limit prior to 1991 was .5 rem to a member of the public. And, in 1991 when there was a rule change, the public dose limit was reduced by a factor of 5 from .5 rem to .1 rem.

MEMBER CORRADINI: For normal operations?

MR. CLEMENT: For normal operations, that's correct.

There is no accident dose criteria in Part 20. It's in Part 100 applies to testing facilities and power reactors.

So, we are proposing new regulations for accident dose criteria for NPUFs other than testing facilities.

MEMBER CORRADINI: Okay.

MR. CLEMENT: Based on the EPA PAG which has some precedence.

MEMBER CORRADINI: Okay. So, that's the short answer I was looking for. I got you.

MR. ADAMS: So, up until now, we've had no accident limits for research reactors. We, by default, use the regulations in Part 20 for normal operations.

MEMBER CORRADINI: Okay, I got you.

CHAIRMAN POWERS: And, there the problem.

I mean, you said, okay, .1 is too low and .5 seems too high. I don't quite understand that, but I really don't understand why, you know, one's too hot and one's too cold, but one is just right.

MEMBER STETKAR: What are you, Goldilocks or something?

CHAIRMAN POWERS: Yes, this is the Goldilocks approach to picking a number. I mean, it's between point -- I will agree it's been .1 and

25.

And, I agree .1 seems too low and 25 seems too high, but I don't know what one -- why one?

MR. CLEMENT: Well, that's a really good question.

We have asked in the Federal Register Notice that will be published whether or not the proposed accident dose criteria of 1 rem total effective dose equivalent is a reasonable number.

And, we've asked for feedback to say that, if there is another number that you would like to propose, please provide the rational basis.

But, there is precedence for using PAGs for radiological terrorist events, for example, EPA PAG is used. So, there is a precedence and there is a basis and we figured 1 rem TEDE, if there is -- in the unlikely event of an accident, there would be shelter in place.

CHAIRMAN POWERS: So it belonged to somebody else?

MR. CLEMENT: We haven't picked that PAG.

MEMBER CORRADINI: So, I know we're not supposed to go there, but since you brought it up, how is the original PAG justified because I'm not even clear why that's a good number.

I know it's a number that you can anchor yourself to, but why is 1 rem appropriate? Why not 2? Why not 3?

Because the Health Physics Society says they don't know anything below 1 or I was going to say 10 rem.

MR. CLEMENT: Maybe you're right.

MEMBER CORRADINI: They don't know anything below 10 rem for a health effect, so why 1?

MR. CLEMENT: There is some technical basis. So, it has been adopted. There is some precedence established with that. And, you know, 1 rem is --

MEMBER CORRADINI: Have you had history?

MR. CLEMENT: -- 1 rem is as good as any number -- any other number right now.

MEMBER REMPE: So, I worked at another organization years ago where they applied the PAG to the exclusionary boundary around a plant because it was a gas reactor.

And, this 1 rem you're going to apply

is at the unrestricted area which, I assume, is --

CHAIRMAN POWERS: The door.

MEMBER REMPE: The door.

But, anyhow, this is -- they weren't doing the door. It reminded about what is actually in the PAG document. Is it supposed to be the door or is it supposed to be at the exclusion area boundary?

MR. CLEMENT: The PAG is defined at the exclusion area and it's following the onset of a fission product release.

So, it's at the exclusion area, at the low population zone or it's at the population center.

So, the criteria that we're proposing will be a member of the public and the nearest unrestricted area.

Now, from the accident analyses that I have seen and I'm sure Al's group has reviewed, the 100 millirem is restrictive because, from my calculations, a member of the public could exceed 100 millirem.

There is a provision in Part 20, 1301(d) that a licensee or applicant may apply for a prior authorization to operate up to that annual dose limit of .5 rem to a member of the public.

But, I think this might --

MR. ADAMS: Yes, and there's a couple instances where we had to use that to move, you know, to find the accident scenarios to be acceptable.

But, it's the unrestricted area and, for a lot of these facilities, it's what Dr. Corradini said, it's the door or it's, you know, it's the fence. It's the fence, you know, five feet away from the facility.

And, that's the same with the, you know, the EPZs for these facilities of most are the, you know, inner boundary of the confinement or containment.

MEMBER REMPE: So, the person walking down the street is further out and so, in a way, you're applying the PAG in a very conservative manner if I'm interpreting this correctly.

MR. ADAMS: Well, what we do when we do this analysis is we, you know, we have the source term from the MHA and we look for the maximally exposed individual where ever that person might be.

Sometimes they're at the fence, sometimes we found that it's not the guy at the fence because the plume goes over his head and it's the guy that's, you know, 200 feet in that direction.

Or, sometimes we find the plume goes over the guy's head but the shine from this -- from the radiological cloud in the building creates the build.

So, if, you know, we look for that maximally exposed individual where ever they are and figure out, you know, figure out what the dose is in that person.

We also, because we, you know, how we've done this, we also look at the nearest permanent residents and then we also look for any special situations. For example, on one campus, there is a dorm which, you know, the ninth floor of the dorm lines up with the top fo the stack.

MR. CLEMENT: Which could be exposed to shine or anything like that.

MR. ADAMS: Yes, so --

CHAIRMAN POWERS: Actually, it's the air intake because of the stack, it's the air intake in the dorm and where it feeds into the ninth floor on the building that will be your maximally exposed individual and it'll be the krypton that gets them.

MR. ADAMS: Yes, so you know, so we look for that person in the unrestricted area.

MEMBER REMPE: Okay. So anywhere beyond is where you're -- when I'm reading the text here, it's not just at that boundary of the unrestricted area, it's anywhere?

MR. CLEMENT: It's the nearest unrestricted area.

MEMBER REMPE: Okay, thank you.

MR. CLEMENT: So, it is conservative.

MEMBER CORRADINI: So, I'll just register my -- I understand your logic. You logic is you're connecting to the EPA number, which I get.

But, I'm still not clear as to what that -- why that number is the right number from a health standpoint. But that's in some sense immaterial, but that's your logic, is it connects to the EPA number.

MR. CLEMENT: Correct.

MEMBER CORRADINI: Okay.

MEMBER BROWN: Well, on that line, can I ask, I want to try to increase my understanding of your all's argument that you all have been going through.

Isn't this a reduction? I mean, I went back and looked at your -- it says in there that they considered the -- if I can find it -- the staff considers the accident dose criteria in Part 100 25 rem and 300 rem to the thyroid to be too high.

Therefore, they're proposing to amend it to reduce it.

MR. CLEMENT: For research reactors --

MEMBER BROWN: Yes, for NPUFs?

MR. CLEMENT: Right.

MEMBER BROWN: Okay. And so, I'm trying -- that --

MR. ADAMS: So, you're reading the -- what the Board suggested to the staff. Part 100 has that 25 rem number in it but Part 100 only applies to test reactors, power plants, not research reactors.

So, what the Board was telling the staff was --

MEMBER BROWN: What applies to research reactors now? What's the existing requirements?

MR. CLEMENT: There isn't any.

MR. ADAMS: So, by default, we sure the

normal operational radiation dose limits.

MR. CLEMENT: Which is not necessarily the --

MR. ADAMS: Which are the 1 rem -- 100 millirem and, in some cases, we can go up to 500.

CHAIRMAN POWERS: What you're saying is that the individual that walks by Seabrook during an accident is going to be less protected than the individual who walks by MIT during an accident even if it's the same individual?

MR. ADAMS: I don't want to put it that way.

CHAIRMAN POWERS: Well, you didn't, I did.

MR. ADAMS: Okay. But so, you know, but what the difference is, is that along with Part 100 comes all the siting criteria with Part 100 what Rich was saying, you know, low population, distance to population centers.

You don't get the 25 but you also, you know, you also don't have to, you know, you don't have that constraint. The lower number recognizes the fact that these reactors are on the base of an engineering --

CHAIRMAN POWERS: Perfect, perfect.

Now I understand. Yes, good. That is the right answer for me anyway. Yes, I mean it makes sense.

He's saying my data about outrageous circumstances, there's a lower population zone, whereas, MIT has lots of inhabitants loosely classified as people.

MEMBER BALLINGER: The dorm is right across the tracks. The new one's going to have 500 students in it.

CHAIRMAN POWERS: Yes, and so he's saying, therefore, we lower the number down because nearly all of these fit, not all of them but nearly all of them have a large population in the area affected.

MR. ADAMS: Right.

MR. BEALL: Okay.

CHAIRMAN POWERS: I understand and it's a good clarification.

MR. BEALL: Okay. Another proposed change we're looking at is to 10 CFR 50.59. This is for when the NPUFs start to move into decommissioning.

Currently, if a NPUF is decommissioning and the fuel has been moved offsite, they cannot make any other changes to the facilities using a

50.59 process. They have to come in to us and ask for a license condition to allow them to make changes.

So, what we do here is we're going to make a slight change to 50.59 to allow that process to be applicable to NPUFs when the fuel is moved offsite and they want to continue with the decommissioning process at their facility. Okay?

MEMBER SKILLMAN: Was there support for this proposed change from license holders?

MR. ADAMS: There wasn't -- there was no sort of objection to it. This was an area that was introduced in the 50.59 when some changes were made in the past related to how you transition from operating status to decommissioning status, you know, 50.82 stuff.

And, what had happened was the way it was written that if you were a research -- if you are research reactor and you shutdown and you moved your fuel offsite, then for some reason, 50.59 didn't apply anymore.

And, what we had to do as the staff working on decommissioning plans is we basically had to put a license condition in the license which was 50.59 verbatim put in the license or else, for example, if you wanted to make a change to a -- if you had a procedure that says, I'm going to use disposable PCs and you said, you know what, I want to use a nuclear laundry instead. That would have to come in as a license amendment because you couldn't make that change in the procedure under 50.59.

So this corrects an inadvertent error that was introduced in the past.

MEMBER SKILLMAN: Alex, as you've explained this, you've triggered a concern that I have and that is, one of the real problems in industry is that some licensees were using 50.59 as a change process when, in reality, 50.59 is a screening process to determine whether or not you need to seek a license amendment.

Those are two very different things.

MR. ADAMS: Yes, I agree. It's the, you know, it's the screening process.

MEMBER SKILLMAN: It's the screening process.

MR. ADAMS: Yes.

MEMBER SKILLMAN: So, in the explanation that you just provided, it sounded as though you would have a licensee using 50.59 as method to change from a laundry to a --

MR. ADAMS: Well, it was -- it would be -- you would have to go through the screening process to see if you can make that change.

MEMBER SKILLMAN: Well, that would suggest then that, having a laundry or not a laundry was part of the original license.

MR. ADAMS: It would be a procedure that was in the license, yes.

MEMBER SKILLMAN: Okay.

MR. ADAMS: It was -- and, what the staff was doing is, we were basically reproducing 50.59 verbatim as a license condition for that -- we were getting license amendments requests, you know, to change things that had no safety significance and would have sailed through the 50.59 screening.

MEMBER SKILLMAN: Okay, so by adding this to this proposed change, what you're simply doing is applying the 50.59 to a defueled NPUF and making it necessary for the licensee to determine whether or not a license amendment is required.

MR. ADAMS: Right. And, it's where we were before a change was made to 50.59 a number of years back related to facilities and it was that,

that all those questions that came up about power reactors transitioning that, you know, is it still an operating license once you, you know, you submit your certification of, you know, defueling and your certification of permanent shutdown, was it still an operating license?

That the words in the regulation that said, you know, operating license apply to those reactors.

Part of the, you know, part of the rulemaking to fix that inadvertently fixed it for power reactors but didn't recognize the fact that research -- most research reactors, the fuel is owned by DOE and leaves site rapidly.

MEMBER SKILLMAN: Okay, thank you. Now I understand.

MR. BEALL: Okay. The proposed change number eight is going to be discussed by Kevin Folk.

MR. FOLK: Thanks, Bob, Members of the Subcommittee.

I'm going to break from our Part 50 discussion here for a minute and talk about the Part 51, our environmental protection regulation.

Just by a little way of background,

NRC's environmental protection regulations under Part 51 implement the National Environmental Policy Act.

These regulations require the staff to do an environmental review for the Agency's licensing and related regulatory actions.

So, specifically, NPUFs, you know, to enable the staff to conduct its independent analysis of the environmental impacts of a licensing action that we may take and to prepare environmental documentation that's required under the National Environmental Policy Act and our regulations, we require environmental information from the applicant normally in the form of an Environmental Report, which I think we mentioned in some of our earlier discussions.

So, the requirement for this environmental information in the form of a formal Environmental Report specific to NPUFs is not currently contained in Part 51.45 or Section 51.45 of our regulations as it is for power reactors.

So, that brings us to the purpose of this change and sort of delving into Part 51 that to provide consistency in the form and quality of environmental documentation that we receive from our applicants, we are proposing adding the provision that they come in with a, at license renewal, with an Environmental Report for the staff's independent review.

MEMBER CORRADINI: So, maybe I don't appreciate that, but since we're not -- since we're now -- we don't have license renewal or we have ongoing, I don't understand.

MR. FOLK: Well, we would continue to have license renewal for the Class 103 facilities.

MEMBER CORRADINI: Oh, I'm sorry.

MR. FOLK: SHINE, Northwest, those types of facilities.

MEMBER CORRADINI: Okay.

MR. FOLK: And for testing facilities.

MEMBER CORRADINI: I misunderstood. So, it's for those?

MR. FOLK: That's correct.

MEMBER CORRADINI: Okay.

MR. FOLK: It's part of the broader license renewal framework that we're proposing, correct.

MEMBER BROWN: So, it's not going to change? That's going to be the -- that's going to remain the same? I'm trying to have a takeaway.

You haven't added this, this is what exists today?

MR. FOLK: At the moment, there is not a specific requirement for an Environmental Report under 51.45.

MEMBER BROWN: For the test reactors?

MR. FOLK: That is correct. We are proposing to add that requirement similar as to what exists for power reactors.

MEMBER CORRADINI: And, just to repeat for --

MEMBER BROWN: Why? I'm sorry.

MEMBER CORRADINI: Go ahead.

MEMBER BROWN: I was just asking why are you upping the ante on the test reactors now after 70 years, 60 years of experience with test reactors?

MR. FOLK: Sure, sure. They provide environmental documentation but as regulatory requirements have evolved and the scrutiny of environmental issues has evolved and increased, we find ourselves needing to compare more and more apples to apples, if you will.

On the power side, our licensees have become very custom to understand what information we need to be able to meet our NEPA requirements.

You know they work together very proactively to see what information we need and what types of questions we have in the terms of RAIs.

We continue to do environment reviews for, you know, license amendments and so forth. But, there are sometimes differences in the quality of that information that we get from particular licensees.

So, the overarching purpose here is to provide a clear technical direction to licensees to facilitate them providing us information such that we're not in the situation, perhaps, of unnecessarily issuing RAIs.

MR. ADAMS: I think there was a way to get there, but it was kind of convoluted.

MR. FOLK: Well, I'll give a specific answer or a specific example.

When SHINE came in for their construction permit application, they looked at our regulations as certainly they should and said, well, there's no requirement for us to provide an Environmental Report. And, there is no specific requirement.

We've relied on 51.41 of our regulations which says that the Commission may request environmental information. And so, well, what's the form of that environmental information that we would provide?

Well, the staff undertook an initiative to develop an ISG for the medical radioisotope production facilities, and ISG to 1537 which prescribes the type of information for that Environmental Report. It also includes guidance to staff on how to -- as part of the review process of that environmental report.

MR. ADAMS: I mean, that's what I was looking for.

MR. FOLK: Yes.

MR. ADAMS: 51.41.

MR. FOLK: 51.41.

MR. ADAMS: You know, we would get the question, you know, the license renewal, when we -- about a year before a license expires, you would send out a standard letter that says, here's what we expect to see in your application. And we would get, well, why do I need an Environmental Report?

And, we basically would have to go back to 51.41 saying, you know, that we need it for we can meet our requirements under NEPA because the Commission may require an applicant blah, blah, blah, blah.

So, what we're doing is we're clarifying and making a more direct tie to what, you know, we've been doing sort of the long way over the years.

MEMBER BROWN: Okay, I lost the bubble a little bit on the other stuff.

SHINE is a test reactor then?

MR. ADAMS: SHINE is a special case.

MEMBER BROWN: It's a --

MR. ADAMS: 103.

MEMBER BROWN: 103.

MR. ADAMS: Right.

MEMBER BROWN: So, I'm still talking about test reactors. SHINE, you people keep beckering into SHINE and I'm -- you keep changing which tree I'm working on here. Okay?

I've got research reactors, test reactors and SHINE and W-whoever they are for --

MEMBER CORRADINI: He needs a VIN diagram.

MEMBER BROWN: So, why impose this on -- I understand SHINE a little bit more, I think, I guess, even though there's no requirement, right? But the test reactors, I still can't connect the dots as to why you're upping the ante on the test reactors.

MR. HARDESTY: No, they've always had the requirement.

MEMBER BROWN: That's --

MR. HARDESTY: They've always had the requirement, the testing facilities, because they're actually required to do an Environmental Impact Statement. Well, we're required to do it.

MEMBER BROWN: Were?

MR. HARDESTY: The federal agencies.

MEMBER BROWN: I thought you said they weren't before, that's why I'm confused. Neither the research reactors nor the test reactors and you were now -- you just said you were adding this as a requirement.

MR. HARDESTY: I think adding is a misnomer, it's more of a clarification because we have always solicited the information. We have to do an environmental analysis anytime we do a licensing action.

So, whether it be an amendment or a license renewal or anything else, a license transfer, et cetera, we have to do an environmental -- determine whether an Environmental Impact Statement is necessary or an Environmental Analysis or -- and there's other things, finding a no significant impact for that.

But, in order to facilitate that, we've always requested from the licensee environmental information typically by RAI because of the 50.41 clause allowing us to do that.

This is just meant to clarify that to the licensees that, as part of license renewal in that new -- we're coming to that or, actually, I guess we talked about it, the new section that talks about license renewal for 103s and testing facilities, they are required to provide that Environmental Report.

The reason why the NPUFs, the other NPUFs fall off is because they're not doing license renewal, but it would still apply to them for licensing actions like amendments.

MS. GAVRILAS: This is Mirela Gavrilas.

If I can add something for clarity because test facilities come up over and over and we think NIST. When the staff thinks test facility, we think of potential 500 megawatt test facility that is now being proposed, for example, in certain circles at DOE.

So, while the threshold between research reactors and test reactors is the 10 megawatts. There's no upper limit on test reactors, so people are talking about large in terms of power rating test reactors and we want to make sure that what ever we do covers those facilities as well.

MR. FOLK: If I might -- may add, Mirela, under 51.20 by regulations, a license renewal of testing facilities of which there is one, as we mentioned, NIST, requires the staff to prepare and Environmental Impact Statement. So, they are already required to come in with a formal Environmental Report.

Clear as mud?

MEMBER BROWN: It just sounded to me like we were embarking on a full-blown NEPA exploding requirement for these and, depending on what the size of the, quote, test reactor is and how many people work there, that's -- power plants is one thing. I mean, they've got hundreds of hundreds of folks that work on this between the corporate offices and the other stuff.

Whereas, you have two or three people or four or five, whatever here it is. And so, I'm trying to sort out a lot rocks to get the information you wanted to do the full-blown NEPA approach.

Issuing an RAI saying we want this, this, this and this, that's kind of a different thing.

MR. FOLK: NEPA only applies where there's a licensing action to take. So, for the facilities that would be converted or may be converted to non-expiring licenses and, therefore, would not be required to come in for license renewal, there's no regulatory action to take.

MEMBER BROWN: I understand that part, it's the research reactors you're talking about. I got that. I know which tree I'm working on now.

MR. ADAMS: And, I think the test reactor, because we're required to do an EIS, they have to come in with an Environmental Report.

MR. FOLK: That's correct.

MR. ADAMS: Okay? So, it would be the, you know, the only folks left are these medical facilities that are under 103, they're not test reactors, they're not a type of facility that we're required to an EIS for, however, the way we get an Environmental Report from them is not the 51.45 but it's the --

MEMBER BROWN: It's under there, though, right?

MR. ADAMS: Yes, we get there but it's a long road and now we're just -- we're clarifying to make the explanation to regulation more direct and clearer.

MR. FOLK: And, this rule for those 103 facilities, this rule would not reinvent the wheel for them. They would be required to come in with an Environmental Report, but it could be a supplement to their original Environmental Report. And that's -- but that's specified in the proposed language as well.

MR. BEALL: Okay. And our final proposed change has to do with financial qualifications and Kos Lois will be taking -- will discuss this slide.

MR. LOIS: Thank you.

My name is Kos Lois and I'm a Financial Analyst in NRR. I appreciate the opportunity to speak about eliminating the requirements for the NPUFs to submit financial qualification information with their license renewal application.

As it first of all states, this proposed rule impact Class 103 NPUFs and testing facilities. There are 31 NPUF facilities, as we discussed earlier this morning, 25 of which are academia, 3 are private industry and 3 are federal government.

The second bullet, 10 CFR 50.33(f)(2) requires financial qualification information at license renewal.

The current financial qualification regulations at 10 CFR 50.33 require the licensees to provide evidence that they have a reasonable assurance of obtaining the funds necessary to cover the estimated operation costs for the first five years of their operations.

Currently, this requires licensees at the time of initial licensing and on license renewal to provide financial statements and forecasts the future operational costs.

MEMBER REMPE: So -- go ahead, finish your slide.

MR. LOIS: Third bullet, this proposed rule would eliminate the financial qualification requirements at license renewal stage only. So, the licensees would still need to provide the financial statements and forecasts of their operational costs at the initial licensing stage.

There is -- and, I'd like to just add to this point, there is another rulemaking ongoing that is reassessing the financial qualification requirements for all the 10 CFR Part 50 licensees, including the NPUFs, and the Commission provided staff direction to pursue that rulemaking. And, if anyone's interested, that's SRM SECY-14-0089.

CHAIRMAN POWERS: Since there is this other activity going on, why shouldn't you remain mute on this subject until that is completed?

You don't know where it's going and don't know what they're going to come up with, why is this -- why add this into your activity?

MR. HARDESTY: So, we included them in our working group and we had several discussions with the people that are working on that rule and the people that were working on our rule. And this was the division of labor, as it were, that we decided on in order to keep it the most clean.

They really hadn't addressed the non-power facilities in what they were working on, but they knew they needed to and we were already working on addressing it because we wanted to get --

CHAIRMAN POWERS: So, you really -- you're part of it, you're just ahead of it?

MR. HARDESTY: That's correct.

CHAIRMAN POWERS: And they're not going to do anything that's going to undo what you're doing?

MR. HARDESTY: They were counting on us getting this through. If we don't, then obviously, they'd have to address it.

CHAIRMAN POWERS: Okay.

I mean, clearly, what I'm concerned about is they come up with something that's working on to this.

MR. ADAMS: We're coordinating with them closely and what this does is --

CHAIRMAN POWERS: What you're telling me is that you're actually doing the NPUF part of their job?

MR. ADAMS: Their rule, that's correct.

CHAIRMAN POWERS: And so, we don't -- there is no possibilities that they will come up --

MR. BEALL: They are aware of what we're doing. So, we've sent them copies of our proposed rule language and all this good stuff.

CHAIRMAN POWERS: And, they're not going to do anything to undo you on their on volition, I'd say?

MEMBER BROWN: Say no, say no out loud.

MR. HARDESTY: Kos is actually on both rulemaking groups. So, he's our middleman.

CHAIRMAN POWERS: You can't preclude somebody external to the group might impose something on them, but on their own volition, they're not addressing your topic, they're counting on you doing that?

MR. HARDESTY: That is correct.

MEMBER SKILLMAN: Why is this a good idea?

MR. HARDESTY: Why is this a good idea?

MEMBER SKILLMAN: Yes.

MR. HARDESTY: Because this is one of the most burdensome things that the licensees have complained to the Commission about.

MEMBER SKILLMAN: So?

MR. HARDESTY: And so, the Commission directed the staff to look into this. And, when the staff looked into it, there was basically no connection found between financial surety and safety.

MR. ADAMS: For licensing. My understanding is this is consistent with what's required of the power reactors. So, basically, we're making alignment with the power reactors that do not have to submit this information.

And, the question is --

MEMBER SKILLMAN: At license renewal?

MR. ADAMS: At license renewal, right.

So, why do I, the little research reactor, have to prove that, you know, questions like, you know, prove you're the State of Wisconsin? I believe those are questions we have to ask.

So, I mean --

CHAIRMAN POWERS: That's a legitimate question in the case of the State of Wisconsin.

MR. ADAMS: So, you know, driving force was that we had a requirement that, for research reactors, that was much more onerous than the mirror requirement for power reactors.

MEMBER SKILLMAN: It almost seems counterintuitive. It strikes me that if you're a very small operation, there may be value in demonstrating that you do have financial capability even thought it's burdensome.

MR. ADAMS: And so, we're only looking at license renewal for initial licensing that, you know, you still would have to show it. But, you have to step back, they're small operations but, the majority of them are the State of, you know, State of Fill-in-the-Blank.

MEMBER SKILLMAN: But, here I am, I'm out 22 years. I expect to run for another 22. I'm somewhere between almost dead broke and certainly dead broke but I'm just about there, but I'm hanging on. And, I know I have equipment that I need to repair. But, now I'm not going to have to disclose that.

MEMBER STETKAR: And, you only need to have one of them have an accident.

MR. ADAMS: Well, so and it's financial information as, where am I going to get my money from? And, the answer is, the State of Fill-in-the-Blank through appropriations will give me, you know, and we let, you know, give us the information.

MEMBER SKILLMAN: Except that you have something like 50.9 which says that you've got to be accurate and truthful. And so, you can't go in smoking the books saying, you know, I can get this money when I need it when, in fact, you can't.

MR. ADAMS: Well, just like anything else, if the licensee is lying to us, and especially a State licensee, you know, if we see the material condition of a facility start to deteriorate through the inspection program rapidly, we're going to start to ask questions.

And, I'll be honest with you, the licensee will come and say, hey --

MEMBER SKILLMAN: But, the financial conditions can be vastly different than what is apparent in the physical condition. You can have an entity that's on the verge of bankruptcy or that's in some legal activities that really do prevent it from being solvent six months from now and it needs that money to run the operation.

MR. ADAMS: But those inspections are still ongoing even though our financial --

MEMBER REMPE: Let's --

MEMBER CORRADINI: So, I ask a different question?

So, I interpreted -- the Members are going to ask you a bunch of stuff, but what I guess I'm curious about is, one of the answers you said is you're making it consistent with what power reactors required to do for their license renewal.

MR. ADAMS: Yes.

MEMBER CORRADINI: Isn't that it in a nutshell? Why should this be more onerous for the research reactor than for the power reactor?

MEMBER REMPE: Okay. Let's take -- this is for Class 103 NPUFs and testing facilities. Mirela said on the prior slide, I'm thinking about the new 500 megawatt thermal reactor that's going to be put at a DOE site from Joe Blow and his financial venture capitalists.

And, five years after it's operated, Joe Blow and his venture capitalists are saying, well, we didn't really market these to other facilities.

And then I'm wondering maybe we should look at their finances.

MR. ADAMS: Well, we still look at financial for initial licensing.

MEMBER REMPE: Yes, but after five years when you can't market it to across the world --

MEMBER STETKAR: A 1000 megawatt electric merchant plant in the Northeast of the

United States.

MEMBER REMPE: But he has a decommissioning fund.

MR. ADAMS: Well, not necessarily.

MEMBER STETKAR: Yes, but that's decommissioning doesn't help you in terms of day to day operations.

MEMBER REMPE: I'm wondering what's going to happen with the facility on the DOE side.

MR. ADAMS: Well, that facility, you know, the next time we would look at the financial condition is license renewal which might be 20, 30, 40 years down the road.

So, we look at, you know, we look at it for initial licensing and it's back to, you know, our licensees are mostly governments, state governments or federal governments and there are the three facilities that are private companies.

And, sort of the parallel to this is, you know, in decommissioning funding, state governments can give us the basically the assurance that, you know, that they're a government entity and that's it. They don't have to put, you know, any of the financial tools that, you know, that the private companies have to put up.

MEMBER REMPE: But, this is the 104s. The slide is for the 103s and the testing facilities, right?

MR. ADAMS: Because they're the only ones that will have license renewals.

MEMBER REMPE: Right. And so, you're going to eliminate the financial qualifications for them?

MR. ADAMS: At license renewal.

MEMBER REMPE: At license renewal?

MR. ADAMS: Right.

MEMBER REMPE: They're not going to be state governments like you were saying --

MR. ADAMS: Well, that's --

MEMBER REMPE: -- in your last sentence.

MR. ADAMS: Well, that's true. I mean that would be, you know, NIST would be --

MEMBER REMPE: NIST and --

MR. ADAMS: -- and the private --

MEMBER REMPE: -- SHINE which is depending on NSA money and something we don't know about that may or may not happen.

MEMBER CORRADINI: I'm not sure what you're worried about. They're not even built yet and they haven't been qualified yet.

Once they get an operating license, they have to go through this qualification, this financial qualification and then, I don't know what the SHINE's license would be to pick SHINE.

Well, let's say it's 20 years, then they would have to go through a similar to a power reactor in 20 years. That's what I --

MEMBER REMPE: They won't have to do financial qualification.

MEMBER CORRADINI: That's what I thought Al was telling us.

MR. ADAMS: Right, but in the lead up to that license renewal, we have an inspection program. We're, you know, obviously, if we walk into the place and half of the staff is not there anymore from last time and staffing is one of the things we look at.

And, you know, and we see the equipment falling apart --

MR. LOIS: Al, can I add one more thing, too? Aside from initial licensing and at license renewal, there is a provision in 10 CFR 50.33(f)(5) that does say the Commission may request an established entity to submit additional or more detailed information respecting its financial arrangements and status of funds if the Commission considered information appropriate.

So, that's always --

MEMBER REMPE: It may. Yes, I just -- it doesn't seem like such a bad thing to be asking for their financial assurances through the years.

CHAIRMAN POWERS: Well, I think the argument here is that it's redundant, that they get alerted to degradation in their finances by other ways. And so, they don't need that information. That's the sense I'm getting here.

MEMBER BROWN: Well, they can also, based on a comment over there, I mean, if you're doing your inspections or whatever it is, you geez, things are looking a little shoddy. You can come in and ask for the information to see if there's a driver for the thing.

I mean, there are a lot of ways to get there as opposed to requiring some formal 500 pages worth of stuff. I don't know.

MR. LOIS: And, actually, to my next bullet over there, I know some of this is repetitive from what Al and Duane mentioned this morning, but the NRC's primary means to ensure the safe operation is through the inspection and enforcement programs that are in place.

They were discussed this morning, but we do perform routine safety inspections, inspections of physical security and safeguard programs and reactor inspections when necessary.

We also -- NRC also has a training qualification program in place for the NPUF inspectors and the examiners.

And, the NRC also manages the review of the emergency and security plans and develops and implements policy and guidance concerning the NPUF licensing program.

So, we have the ability to look more to the financial, you know, integrity if we need. However, we do have all these other programs in place to ensure that these facilities are operating safely.

MR. ADAMS: And, could you say -- could you tell us briefly what kind of information that they submit to us?

MR. LOIS: Sure. They submit their operating costs. Yes, they submit their operating costs and sources of funds to cover those costs. All the things that come in in the report.

I mean, they have things -- salaries, benefits, I mean they have all sorts of the breakdown associated with the facility that we evaluate. And they do it --

MR. ADAMS: And, that's for the first five years?

MR. LOIS: That's for the first five years. And, the way it currently is, obviously, when we do have license renewal, they provide it for the next five years.

MEMBER SKILLMAN: I would like to respond to Mike Corradini's challenge. What are you afraid of?

The answer is nothing, in all candor. This is the business of the entity that has the license.

But, my experience is, the organizations that have to account financially have, in addition to the discipline of owning the plant, operating the plant, maintaining the plant, protecting the public, protecting the -- now coming through emergency planning, taking the appropriate actions with their radiological protection program.

They also have a fiscal discipline of being able to understand what are the revenues?

What are the costs? What are the projected costs for the next several calendar quarters and the next two or three years? What are the capital outlays that are necessary to maintain the facility?

And, at least my experience over all these years is the financial discipline runs parallel to the operational discipline. They are literally locked at the hip.

And so, this, in my mind, severs that very important connection. And it is immaterial to me whether the financial qualification is indicating an abundance of funds or a very slim amount of funds, but that, to me, is important.

MEMBER CORRADINI: But the -- so, I want to make sure I understand that.

So, your point is that you don't think nine makes sense. So, that means you would rather require nine for all 100 operating reactors because it's not required of the 100 operating reactors.

MEMBER SKILLMAN: Well, what you get with the commercials, no, what you get with the utilities is a financial report annually, but they are generally reporting quarterly.

There is a huge amount of attention to the finances of the big news.

MEMBER STETKAR: And, you have resident inspectors there. You have resident inspectors, not --

MEMBER CORRADINI: But the inspectors don't inspect the finances.

MEMBER SKILLMAN: Well, they inspect everything but finances.

MEMBER STETKAR: But they wander around the plant and you don't have an inspection once every couple of years or so kind of.

MEMBER SKILLMAN: So, I'm with Mike that, to a very large degree, the health of the finances at least are a leading indicator of the potential health of the facility.

MEMBER CORRADINI: So, let me --

MEMBER SKILLMAN: So, it seems to me there's a connection there that is worth retaining.

MEMBER CORRADINI: So, let me make sure I understand who this applies to because I thought, and maybe I'm off base, so it applies to the NIST reactor, it applies to the MIT reactor --

MEMBER REMPE: No.

MEMBER CORRADINI: It's a 103 --

MR. ADAMS: If we get, you know, if we go forward with everything in this rulemaking package, because license renewal will be eliminated for research reactors, it would only apply to test reactors and Class 103 facilities.

MEMBER CORRADINI: So --

MR. ADAMS: So, NIST, SHINE and Northwest, if they become licensees.

MEMBER REMPE: And, something new that might be built on venture capital.

MR. ADAMS: Yes.

MEMBER REMPE: Oh, and something new that's large built on venture capital money, perhaps.

MR. ADAMS: Well, again, the initial -- for the initial construction permit and license, there is a requirement for financial information. It's that, you know, it's the renewal for those facilities that occurs, you know, 20, 30, 40 years down the road.

So, we would have been watching that facility operate for 20 to 40 years before a license renewal comes up and we look at that and potentially, we'd want to look at financial again.

MEMBER CORRADINI: So, what you explained, I just want to make sure I'm -- so, now I've got who it applies to, but SHINE and Northwest have yet to even get their operating license. So, they have yet to even go through this process. Is that correct?

MR. ADAMS: Correct.

MEMBER CORRADINI: So, it's really NIST?

MEMBER REMPE: Right.

MEMBER CORRADINI: Okay. So, back to Dick's point then, in the case of that as an example, which is government owned, you still think they would need to show financial qualification upon renewal? That's the only reactor that fits in this category.

CHAIRMAN POWERS: You're asking me?

MEMBER CORRADINI: Yes.

CHAIRMAN POWERS: The answer's yes, sir. Yes. Yes, but the answer is fairly simple. I mean it's a one line statement. It's full faith and security of the American government. I mean but it's one line.

MEMBER STETKAR: This rulemaking doesn't say -- this isn't the NIST rulemaking, it's the rulemaking that will exist 79 years from now.

MR. BOWERS: If I could just add --

MEMBER STETKAR: Because there isn't

any more money left for anymore rulemaking.

MR. BOWERS: If I could add one statement?

My name's Tony Bowers. I'm the Branch Chief for the Financial Analysis International Projects Branch in NRR.

This is a great, great discussion, great debate about the importance of finance, or lack thereof.

And, Kos, one important thing as Kos mentioned, there is an ongoing rulemaking for all Part 50 licensees. That actually came from Commission direction in SRM 13-0124, not 14-0089.

But, one thing I'd like to clear up is the assertion that there's any nexus between safety and money. I'd like to, you know, just go back to either Duane or Al made the statement that the data doesn't support that statement.

And, that's currently what we're looking to validate. Currently, there is no data that we have come across to support the statement that there is a direct nexus between safety and a one-time look at a licensees financial condition.

That's all I'd like to say.

Thank you.

MR. BENOWITZ: I'll support -- just to continue on that point, partly because I used to work on that rulemaking.

There have been over the last few decades, NRC staff and Commission determinations about the lack of a nexus. So, it's not a recent look at that issue, there is actually historical lack of a nexus between the financial health of a licensee and its ability to safely operate its facility.

CHAIRMAN POWERS: I think what you said, I'm just taking notes here, is that, if I look at the database, I come to the conclusion that there is not a course connection between financial health and the ability to operate a facility safely.

MR. BENOWITZ: That's correct.

My name Howard Benowitz, again, from OGC.

CHAIRMAN POWERS: Thank you a lot.

MR. BEALL: Continuing on the topic of money, the -- as part of the proposed rule package, the staff also did a draft regulatory analysis and also considered whether or not the backfit rule, 51.09, would apply to this proposed rulemaking.

So, what we have in the top chart is the cost and cost savings to both the Agency and to the licensee. There will be a one-time implementation cost, $720,000.00 for the NRC. That cost is basically the cost it takes to finish up the rulemaking and internal changes that Al and his folks have to make to implement the final rule.

And, a one-time cost of $140,000.00 to the licensees.

And then, there's continuing operating costs. Now, this operating cost you see here --

MEMBER BROWN: I thought you said licensees, is that individual licensee or total?

MR. BEALL: Total.

MEMBER BROWN: So, 31 into $140,000.00 is -- it's what, $22,000.00 -- $5,000.00, whatever, I can't even do the math anymore it's so outrageous.

I mean, you're talking, what, 30 times --

MR. BEALL: Five thousand dollars --

MEMBER BROWN: Five thousand, yes, something --

CHAIRMAN POWERS: It didn't cost very much not to do something.

MEMBER BROWN: Well, no, that's implementation costs. I mean, but it sounds like they're going to have to do something.

CHAIRMAN POWERS: Yes, they've got to do --

MEMBER BROWN: But they've got to change the procedures. I was looking to the hours that you program for some of these things. And, the dollar cost value it seems like that those numbers are so low that I would have walked out of the room if I'd been a licensee. I mean that's the total for all the licensees you said?

MR. BEALL: Right.

MEMBER BROWN: Thirty-one licensees?

CHAIRMAN POWERS: Again, it doesn't cost much not to do something.

MEMBER BROWN: But they've got to do something to get to not do something. That's the implementation cost.

MR. BEALL: Right. As well as changing --

MEMBER BROWN: But this is not a cost for not doing anything later, this is a cost just to not be able to do anything later.

MR. HARDESTY: But, you have to

remember that one of the things we are requiring is the update of their FSARs. And, we went in with a base assumption that they were starting at ground zero. We don't really expect that, but we're saying, you know, this is what it's going to take them to get from what ever they have to what ever we will accept. Accept's probably not the right word. What ever we will allow them to submit as part of 50.71(e) update.

So, that is included in that cost. And, Liz Gormsen can give you a lot more details behind the numbers if you'd like to have that.

MEMBER BROWN: My brain would explode. The numbers are so small as to be -- I'd just --

MR. BEALL: Well, we're hoping to get bigger numbers from the industry once -- because this is a draft regulatory basis. And so, this will be released, this document with the rest of the rulemaking package.

And so, the RTR folks are able to see this and hopefully give us feedback on what they really think the implementation cost will be. And then, we'll update the numbers in the final rule package.

And, the operation costs you see here,

$1.8 million and $1.6 million, respectively, is over a 20-year time period. So, that's -- so it's not much of a per year basis.

So, the average savings we're seeing here, cost savings around $12 million and $5.5 million, respectively.

So, the total net benefit we calculated to be approximately $13 million. And, of course, you can see the three and seven percent discount rates there also as it breaks down.

The other thing we look at is backfit. Backfit 51.09 does not apply to the NPUFs. 51.09 is really written for power reactors. And so, there have been other documents that have gone up to the Commission, other rulemakings that apply to NPUFs, or RTRs at the time, that had not -- that stated that backfit was not applicable.

And, since this rulemaking is totally on RTR/NPUF activities, the backfit considerations of 51.09 do not apply. And so, it has not been considered as part of this rulemaking.

MEMBER BALLINGER: I've got a question. What is included in the cost savings?

MS. GORMSEN: Good afternoon. Liz Gormsen from ICF.

Cost savings are largely driven by the non-expiring license option under the rulemaking so that, over the 20-year period, there is a substantial savings from licensees not having to submit an application, respond to RAIs, for the NRC staff to not have to review the application and develop RAIs and interact with the licensees. So, you get a cost savings from those activities.

MEMBER BALLINGER: So, but that's effectively a one-time operation for a facility if it's 20 years.

MS. GORMSEN: Right.

MEMBER BALLINGER: So, it's effectively a one-time cost?

MS. GORMSEN: Right. And, it was a pretty substantial outlay, looked at NRC staff time keeping data to figure out how much time is spent on these activities.

MEMBER BALLINGER: Because, I do have numbers for the licensing renewal effort on the MIT reactor. And, I can tell you it doesn't match up with this.

If you divide 30 into this, it ain't the same number.

MS. GORMSEN: Well, right. And, we did

have to bend the licensees into different cost categories or cost saving categories, depending on -- and we did it by actually power level.

The higher level facilities were actually assigned a higher cost and the lower power facilities were assigned a lower cost.

MEMBER BALLINGER: And what was the higher cost? What was the higher power facility cost assigned?

MS. GORMSEN: I can look it up for you. I don't have it right here.

MEMBER BALLINGER: I'd like that because I'd like to compare it with the number, meaning that yours is less costly.

MR. BEALL: Are you kidding?

MS. GORMSEN: We also did have --

MEMBER BALLINGER: MIT can't do anything for $5,000.00.

MS. GORMSEN: Yes.

MEMBER BALLINGER: They can't build a commode for that.

MS. GORMSEN: But, for a facility like MIT, it was much higher than that.

We talked to licensees at TRTR to get more information on, you know, what their experiences were like. They were rough estimates and we didn't have hard data to back it up. So, we welcome --

MEMBER BALLINGER: Well, MIT, they now have hard data.

MS. GORMSEN: They do?

MEMBER BALLINGER: I think so, yes. Just contact Lynn Winn Yu (phonetic) at MIT.

MS. GORMSEN: Yes, that would be great. Yes, but we can get that data to you on the 12 categories.

MR. BEALL: Thank you, Liz.

Okay, next?

So, the proposed package that's going out for public comment will consist of a number of documents and all these documents will be released at the same time asking for public feedback on them.

It will be a SECY paper which will be going, of course, to the Commission that summarizes the proposed rule.

There's a Federal Register Notice. And also, in the Federal Register Notice, there will be a number of questions that we're asking the public to give us feedback on. Of course, all the documents, of course.

We also have the regulatory analysis and backfit discussion that will be going out, the Environmental Assessment, we have a draft Regulatory Guide, DG 2006.

So, the rulemaking package, will be going to OGC shortly. And, also, additional documents for the in public rulemaking will have congressional letters and, of course, an OMB statement has to go out for OMB review before anything happens.

Also, while all other stuff is out for public comment, Al and his folks, or as Duane had mentioned earlier, is that we're updating the Project Manager Handbooks, okay, to reflect that changes of this proposed rule. So, our internal documents will also be updated.

Okay, next one?

We plan to come back to the Full Committee on March 3rd of this year. We'll be presenting this again. And, right now, we're currently scheduled to submit the package to the Commission on April 1st of this year.

Right now, the proposed rule will be going out for a 75-day comment period. Like I said earlier, all those documents will be submitted to the public both in ADAMS and on regulations.gov to get feedback. And, we're also looking at doing a public -- some type of press release or something like that also to let everybody know that it's out there for public comment.

And, of course, we also hope -- we will be holding a public meeting during the public comment period.

And, also, if it doesn't line up, we'll also have a public meeting during the 2006 RTR -- or excuse me, TRTR conference in August. I think that's late August, correct? In Albuquerque. I think it's Albuquerque, yes.

MEMBER REMPE: Before you get into the summary stuff --

MR. BEALL: Yes, ma'am?

MEMBER REMPE: -- when I was reading the information that we were provided, it's my understanding that the 104s have to go through a renewal before they can ever go to this new process.

And, you're going to start with the most recent renewal, so like the MIT reactor, who ever just got through a license renewal are going to have to be in the first group. You've grouped them and the ones that haven't gone through it because they're still trying to find their licensing basis get a little more time.

And, one of the -- and, you had different options you were talking about for what you could have done when you were trying to meet the Commission guidance.

And, one of the things that was suggested was updating this NUREG-1537 with lessons learned from license renewals.

And, since you're going to make the whole group go through license renewal before they can live life without license renewal, it seemed like it would be a good idea to update that NUREG anyhow.

And, I didn't hear anything about that in the discussion today. And, is your plan to update 1537?

MR. HARDESTY: So, Al kind of alluded to that a little bit earlier.

MEMBER REMPE: I must have missed it, sorry.

MR. HARDESTY: When we did the ISG for the medical isotope facilities, we had a bunch of independent organizations outside of us that were also looking at that documentation and they looked at the original NUREG-1537 and contrasted that with the ISG.

And so, what we found since that original statement was that NUREG-1537 is high level enough that it withstood the test of time and continues to stand that test of time with regard to the level of information and our expectations from a guidance standpoint on the regulations.

So, the only things that we've actually updated have been the ISG, the Interim Staff Guidance for how we do a streamline license renewal which was our focused review, the medical isotope facilities and then the INC stuff.

Those were the only three areas where we've thought we needed augment NUREG-1537.

Eventually, we plan to republish NUREG-1537 to incorporate all the Interim Staff Guidance. But, that will be at a point where we think that we can put what really is working. Because we started going through the ISG process for license renewal and we're done with probably, what, 75 percent of them already.

So, there's a considerably less number

that still have to go. I forget, what's bucket 3-5? What's the third bucket that we're expecting to have to do right license renewal?

MEMBER REMPE: You have to come to the mic and say your name. Sorry.

MS. GORMSEN: I don't remember it off the top of my head. This Liz Gormsen for ICF. But, I think it's around five.

MR. HARDESTY: I think it was five.

MEMBER REMPE: It's in the information, I saw it when I reading through this, I just don't remember.

MR. HARDESTY: So, it's a relatively small number compared to those that have already been through the process.

So, the thought we had as the staff was that, if you're, for example, Texas A&M TRIGA who just completed license renewal that you have been through a review under NUREG-1537.

If you're North Carolina State who is coming in 2017, you have not been through NUREG-1537 level review.

And, that's kind of our new benchmark, our new yardstick as Al called it, is that if you've had a review to what the staff considers the ideal standard review plan, then you'll meet the entrance criteria for this.

MEMBER REMPE: Or you might just have a one page saying I just did this, can you accept -- but you didn't -- you passed it and so, I don't need to do much to get through this requirement for doing another license renewal?

MR. ADAMS: Well, if you have a license renewal under NUREG-1537, then you're done. By the end of this year, I'm expecting that about 26, 27 of the 31 will be in that condition.

MEMBER REMPE: I thought in here it said that even -- you grouped the plants into categories and the ones who had already gone through license renewal will need to do something before they can go into this new process where you don't have to have renewal, you'll just submit your updated FSARs.

MR. ADAMS: So, the one --

MEMBER REMPE: I'm pretty sure I read that, did I misunderstand it?

MR. HARDESTY: You did. No, I just want to caveat what those buckets mean.

So, the ones that have done recent license renewal, they have the most updated FSAR and corresponding safety evaluation from the staff.

They will be ordered into a non-expiring license immediately.

MEMBER REMPE: Without submitting anything new? Because it sounded like they had to submit something.

MR. HARDESTY: They will have to submit an FSAR update.

MEMBER REMPE: Okay.

MR. HARDESTY: And so, we're expecting that they can do it immediately because they're very current.

MEMBER REMPE: And so, they'll say nothing changed and they'll give you a one-pager?

MR. HARDESTY: Correct.

MEMBER REMPE: On top of their existing FSAR.

MR. HARDESTY: Correct.

MEMBER REMPE: Okay.

MR. HARDESTY: Then, there's another category that has gone through a NUREG-1537 update, but they were done back in the 2006 to 2010 time frame. So, it's been, you know, six or ten years by the time we get this rulemaking in place.

So, since there's no requirement for

them to submit an FSAR to us, we made the assumption that they'll need a little time to do some work on that FSAR to get it to where it matches the draft Reg Guide guidance to submit it to us. So, that's what the thought was there.

And then, that last category were the ones that will be going through or scheduled to go through license renewal and we don't want to order them into this process until they complete license renewal.

MEMBER REMPE: So, if they've had a license renewal, they just have to submit something with an updated FSAR, they do not have to go through license renewal again?

MR. HARDESTY: Correct.

MEMBER REMPE: Okay. And then, those who haven't have a lot more time?

MR. HARDESTY: Correct.

MEMBER REMPE: And, you will not issue an updated 1537 until you feel like you've had enough lessons learned?

MR. HARDESTY: Well, after we've gone through the ISG process completely over all the facilities then I think that's, I mean, obviously, that's -- my Branch Chief could probably speak better to that tasking.

But, that is the intent is that once we've completed all of that, then we'll consolidate all of the findings and lessons learned and determine what updates are necessary.

MEMBER REMPE: Okay, thank you. I was a bit unclear on some of the details, so thanks.

MR. HARDESTY: So, moving forward on the 103s and the testing facilities, we don't plan on necessarily doing away with the ISG process. It's a living document and so, that type of streamlining is still being considered as the practice that will go on for even the facilities that will continue to be in license renewal.

In other words, we'll do a focused review. It won't be exactly the same because the ISG originally was written to encompass four specific areas and then, one of the lessons learned that we did get and that we are already incorporating is that we realized very quickly that it was very myopic to look at those only four areas without saying, you know, hey, we have to look at the rest of this.

So, the staff was already doing it. We were looking at the entire FSAR and when we found areas that fell outside of those four categories, then we also considered them and made those part of the license renewal.

So, that was part of our growth process in using and adopting the ISG. And, that's what we intend to continue to do for the future license renewals.

MEMBER REMPE: Thank you.

MR. BEALL: So, we're hoping to wrap up the final NPUF rule sometime in early 2018.

So -- oh wait.

Okay, actually, we missed one. Thank you.

MR. HARDESTY: That works better.

MR. BEALL: That works better. Okay.

So, wrapping up the proposed rule, the proposed rule, like we said earlier, it's only going to be applied to Class 103s and 104a and c NPUF facilities.

There are nine proposed changes that we're going to make the regulations. The major ones are the non-expiring licenses, having the Class 103 NPUFs and testing facilities submit their license renewal applications within a two-year window now instead of a 30-day window. The FSAR updates every five years and the new accident dose criteria for the NPUFs.

The staff feels that eliminating the licensing terms will reduce the burden of both the licensees and staff. It's allowed by the IAEA. It's the minimum of regulations.

CHAIRMAN POWERS: It's not by the IAEA.

MR. BEALL: It's the AEA, thank you.

CHAIRMAN POWERS: The Atomic Energy Act.

MR. BEALL: Yes, I know, that too.

Minimum regulations on licensees.

We will be continuing the level of oversight and inspections by the staff and the improved FSAR documentation goes along with helping to justify eliminating the licensing terms.

As we saw in the slide earlier, the quantitative benefits of the proposed rule is around $13 million over a 20-year time period. And so, the staff feels that this proposed rule will maintain the safety of the public and health -- maintain the health -- public health and safety while continuing the safe operations of the facilities.

That wraps up our presentation for the

day. Any questions, please?

CHAIRMAN POWERS: What I would like to do is go ahead and have a break and come back in about 15 minutes and we can interrogate Mr. Beall to our heart's content, maybe not his content.

And then, get public comments.

Then, our intention is to have the staff present this material to the Full Committee in March. And then so, we need to give them some guidance on how to put what has been about seven hours of presentation or so into about an hour. But, I think you can.

By the way, I mean you've fulfilled my expectations admirably on this. Duane and I had a chance to talk about this and it did everything I aspired you to do here and very well.

But, we need to also discuss the topics that we would like to address in a draft letter that we prepare for the Full Committee's consideration.

And, I would invite the staff to help us with that because we're really communicating to the Commission on that letter and the kinds of things that we need to address in that as we explore both the upsides and downsides of this proposed activity.

So, that's my intention. And so, I suggest that we meet back here at 25 after the hour and pursue those issues.

(Whereupon, the above-entitled matter went off the record at 3:08 p.m.)

CHAIRMAN POWERS: What we need to make sure we understand is what is being proposed and what is controversial or contentious about what is being proposed. There are nine elements and I guess Ms. Beall is the object of our interrogation here.

So, I would ask, do members have any questions to pose specifically on what is being proposed?

MEMBER CORRADINI: As long as we hear from TRTR, no.

CHAIRMAN POWERS: What is TRTR?

MEMBER CORRADINI: The equivalent of the industry group that is going to be regulated.

CHAIRMAN POWERS: We have them not on my schedule.

MEMBER CORRADINI: I'm sure they would like to say something.

CHAIRMAN POWERS: Okay.

MR. HARDESTY: The executive chair of TRTR, Jerry Jenkins, is actually on the phone and we can open the lines if you want to hear from him.

CHAIRMAN POWERS: We will do that when the time comes to do that. I first want to make sure that we've exhausted our scheduled speakers here and there are no remaining questions to be asked.

MEMBER BLEY: I have one. I sort of asked it earlier.

The license that doesn't expire idea, have you had conversations with the Commission about this yet?

MR. HARDESTY: The Commission actually proposed the idea to us in an SRM. We put forth a SECY that had several options and at the time the Commissioner or the Chairman, rather, Chairman Klein, gave us feedback and it's in the voting record about us considering streamlining and, in particular, a license that would be -- what were the exact words? It wasn't non-expiring.

MR. ADAMS: Yeah, I forget. We went up to the Commission with a number of ideas and the Commission paper for the future of licensing for non- power reactors and the Commission came back and said, hey, you know, these are good ideas and here's one, you know, that, here's something you should continue to think about and this was one of the concepts that was, you know, that was on that list.

CHAIRMAN POWERS: It's a licensing under sufferance kind that has been used in Europe forever. And I think it's -- I mean, it's not a break from all precedent but it's certainly different--

MR. ADAMS: It's different and I believe that --

CHAIRMAN POWERS: In this particular case it has a traction just because of the peculiarities of the facilities.

Now, one thing that is unclear to me in this is how the operations of these facilities for protracted periods of time how that interfaces with Gall.

MR. ADAMS: So, well, the answer there -- let me step back.

The other thing that the Commission -- I believe we sent the 2012 reg basis to the Commission so the fact that this came out of our reg basis and the Commission also filed it so and we've talked to the Commission staff about this over time.

So, you're looking at, you know, aging and what we've done with aging. So, it was interesting because, you know, back when we finally got to the poinnt where Pall reactors were starting to enter license renewal, you know, a lot of consideration was given to how to go forward there. And, you know, the answer there was a focus on aging. At that point we had to decide what to do with the research reactors and there was two things. One, by that poinnt we had already done probably tens and tens of license renewals so we already had that process established. And I think it was -- and at that point in time that process was license renewal was equivalent to initial licensing. So, you basically look at everything again from top to bottom.

They decided they didn't want to do that for Pall reactors so, you know, they went in the way of aging. And then we looked and we looked at aging and said, wow, if we just focus on aging we're not sure what's going to be left.

Traditionally, if you look at our SERs that we write, we do talk about aging and aging is focused in two areas. Fuel cladding and instrumentation and control systems. And I mentioned we also have looked at pull failures, heat exchanger failures. And these areas are based on what we've observed from watching these facilities, you know, run from the '50s and not only the 31 that we have today but the other 110 that are no longer with us. So, you know, is there something equivalent to the Pall reactor pool program, the answer is no. but we have seen components that aging is a consideration for we have looked at those and there's information that we get from the licensees ongoing. So, you know, there's reportable events. And, you know, we can bring, you know, the standard tech specs and show you the kind of things they have to tell us about. But it's basically equipment failures that have safety significance, failures to fuel cladding, primary coolant boundary, containment boundaries that are safety significant, releases that are safety significant.

The other thing they have to tell us is in their annual reports are the kind of maintenance things they're doing both routine and non-routine maintenance. So, you know, we get to see, you know, this is broke, this is broke, this is broke, you know, I have a reportable event. Geez, I'm calling you up because, you know, we discovered that, you know, that the pool is leaking or a heat exchanger is doing this. So, we get information, you know. What we look for is, you know, are we starting to see a trend. An example that was the pooling that we had seen enough pools fail that we said, you know what, there's something here. Like I say, if you go back to the '80s, you know, we didn't look at that. Now, that's right in the NUREG 1537 that the licensee has to tell us about it for that it becomes a pre-analyzed operational event rather than a, oh, my God, you know, what are we going to do?

So, I don't know if I'm answering your question, but that's sort of the approach we took towards aging.

Now, these machines are so simple that failures, you know, manifest themselves. Failures in the instrumentation control system, the ones we've seen basically shut down the reactor, you know, except for, you know, very unusual occurrences like the one I talked about where, you know, someone switched out a component that was internally modified to do exactly what it did and didn't test the results. And, you know, as we see things, you know, we'll pursue them.

MR. HARDESTY: I would add to that that again the big difference between a power reactor and our impulse is that we don't have to wait for the next scheduled shutdown period or they don't have to wait or anything like that. And it's very common and, in fact, it's happened very recently where if a facility has something that's broken they can't fix it, they just remain shut down. You know, there's no immediate actions that they try to do to restore operations. That's a very controlled evolution that they fix whatever it is that's broken and return to operation. Don't have that same op tempo driving them for immediate recovery.

MS. GAVRILAS: This is Mirela Gavrilas. If I can add something to this and most of our rulemaking, have a steering committee that has management from various organizations that are interested in that particular rulemaking. And for this steering committee we had with us the Division for License Renewal, NRR, and they got very engaged because they see it as potentially precedent setting. So, they were very interested in how this rule is evolving and they wanted us to articulate very clearly why for RCRs we are thinking of non-expiring license. And there was three elements that went into our response.

The first one was Al just talked about the aging mechanism, few and far between and we handled them in tech specs. The second one is the low consequences of a failure in one of the systems. And the third one was the slowly evolving licensing basis in terms of rulemaking. Rules that are promulgated usually are safety significant. RTRs are typically excluded from rulemaking just on the basis of it doesn't apply to them most rulemaking.

So, the licensing basis for the community of licensees is very slow moving. Those are three substantial differences between Pall reactors and non-Pall reactors.

CHAIRMAN POWERS: Let's say the three points that you make there on your thinking is one of the items that shouldn't show up for the full committee and those are good ones to make. They should understand -- the full committee should really understand what was in your thinking and pulling its weight.

Okay. Any other questions proposed at this point?

MEMBER BALLINGER: I have one comment. Have an actual number for you.

The cost to renew the license of the MIT reactor was $2 million, for the record.

CHAIRMAN POWERS: It's a hell of a price, for the record.

CHAIRMAN POWERS: We should open up the line and then invite comment from those people that are electronically connected to it.

Okay. If there's anybody connected to us by the phone bridge that would care to make a comment then now is the time to do so. In order to do so, please identify yourself and proceed with your comment.

MR. JENKINS: This is Jerry Jenkins, Chairman, of the National Organization of Test Research and Training Reactors or TRTR that you've been discussing this morning.

I'd like to state the position of the community which is the community of non-power reactors that this is a very important rulemaking process for us based exactly on what the staff has told you.

The licensing process has evolved over time we now follow NUREG 1537 as most of the reactors will like Al explained earlier. We have gotten to the point where our safety analysis reports look very much like what the power reactor safety analysis reports look like. It's an easy document to maintain in its present form as long as there's no moving target on what the SAR should look like in 10 years.

So, the actual process of going to this non-expiring license that will be a significant burden relief for the research and test reactor community, especially the facilities that just have one or two people on staff because we were always working reviewing the safety analysis report every year anyway or the security plans, tech specs. They're all being reviewed every year. Now, this will just formalize that process and it will allow us to continue to operate in a safe and effective manner of these facilities that have very, very large safety envelopes as it is.

Most of the reactors as Al has explained to you are very small in the big scheme of things. You do have the higher power reactors but obviously those are under a higher level of scrutiny than the small reactors are. This is anticipated on -- I'm sorry?

CHAIRMAN POWERS: Please continue.

MR. JENKINS: Okay. We don't anticipate any change in how we are inspected or how we would handle any license amendment request until even our 5059 reviews going down the road. We try to maintain best practices.

We meet every year as a group but the National Organizations of Testors there's training after it's annual meeting. We are always sharing best practices. We're always trying to do the best thing. We support each other. So, this is something we are very interested in seeing happen and we will do everything we can to support the process.

CHAIRMAN POWERS: Thank you. Are there any other comments the people would like to make?

MR. LEWIS: Martin Lewis for the public.

CHAIRMAN POWERS: Marvin? Please make your comment.

MR. LEWIS: Yes. First of all, I'm so pleased to hear you talk about financials finally. After many times raising financials in public meetings the once I didn't hear people dancing around saying, oh, no, we can't discuss financials because that's not a safety, you know. Well, thank you for that.

But at the same time I also point out that there is a nexus to safety. If you can't buy gas for your fire engine, it is not going to get to the fire. And maybe in some states it happens that way that you get to a fire without any gas but I can honestly tell you in Philadelphia that doesn't happen. Sometimes the engine doesn't get to the fire even with gas. But that's Philadelphia traffic for you.

And I just wanted to point that out and I'm glad to hear that people are finally talking financials.

Thank you.

CHAIRMAN POWERS: Are there any other comments to be made? I hear none and, therefore, close the line again.

And we come to the point where we need to give the staff some guidance on how they might truncate this rather nice set of presentations down to a manageable portion to fit within the time they will be allowed to have. And I think -- I don't have guidance on the time right now but in total I doubt that it will extend beyond two hours. So, you can anticipate you might at best have an hour.

My first suggestion to you is the area of truncation that's open to you strikes me as it is just the background section, that is being proposed was rather succinct and fairly compact. And I don't think there's much that can be removed from that because it's nine bullets and nine slides essentially. There's a little bit of elaboration in there but there's not much. And so I think we need to think carefully about what points you need to make in the background section. And I think I would adopt the view that if members needed to have the detailed background you provided us they would have been here at this meeting -- the subcommittee meeting. And I would suggest to you that the points you want to make in that background section are perhaps three.

One is that you have a diverse set of Inpuffs. You'll have to define Inpuff for them. They're diverse. They're diverse in design and they're diverse in ownership. They're small. And you need to in that background draw the distinction that you do between the gurus that are going to get this -- that you're proposing have this continuing or non-expiring license in those that will not fall into that category. And those are the only points you really make in that background section to the full committee. To us you did a very nice job telling us what the designs look like and things like that. I think you have to dispense with that just to fit into the time period.

I presume you could add background slides available if somebody asks you a question about what the design was. But I would not make it a part. That's my suggestion. I'll walk around and ask the members if they have any suggestions.

MEMBER SKILLMAN: Yes, sir, I do. First of all, thank you very much. This is been a very beneficial exchange from early this morning. Thank you. You're thoroughly prepared and the material is clear. Here is where I would suggest you start.

In the Atomic Energy Act it's Sections 103 and 104. That's where you really draw the roots for what you're proposing. Of the nine points that you're suggesting for changing the regulation at least my view is four through nine are very clear. The machination comes in one, two and three. Number one, we need a definition. Got it. Easy to talk about. But two and three begin to weave this interesting relationship between what's a test reactor and what's not a test reactor. And once you introduce that set of permutation in combinations now you've got 31 targets with a couple of different bins. My view is, if you can find a way to present that very clearly then we with the rest of our members will have no consternation or ambiguity in what you're proposing. To me that is the area that was confusing to me actually until Joy began to pull the pieces one at a time.

So, again, I think your items four through nine are very clear. They may be controversial to some of the members but they're clear. But sorting out what you mean by the exceptions for test reactor for an Inpuff versus a non-test reactor would benefit from clarification so all nine of your points flow very smoothly.

Thank you.

CHAIRMAN POWERS: Ron, did you have a point to make?

MEMBER BALLINGER: Yes, I mean, I think I agree with what Dick was saying but in the interest of compassion for those members who unavoidably could not attend, might we consider the background as a package which is separate from anything that gets presented so that members that want to look at it it will have available to them.

CHAIRMAN POWERS: The slides from the subcommittee are available for the members at all times.

MEMBER BALLINGER: Okay. But I'm not talking about subcommittee members.

CHAIRMAN POWERS: Any member can get --

MEMBER BALLINGER: Okay.

CHAIRMAN POWERS: -- the slides from the subcommittee.

Sir?

MEMBER STETKAR: I have nothing to add other than this is a great education experience for me. I came to learn.

CHAIRMAN POWERS: Oh, okay. Did you?

MEMBER STETKAR: I did.

CHAIRMAN POWERS: Oh, my God.

MEMBER STETKAR: I now know everything.

CHAIRMAN POWERS: And we won't go into that. Professor Corradini?

MEMBER CORRADINI: No, I think -- I think all you folks have covered it.

CHAIRMAN POWERS: Mr. Chairman Bley?

MEMBER BLEY: I have just a couple things.

I agree with Dana, the three points Mirela made on the non-expiring license is crucial and I would almost start with that.

CHAIRMAN POWERS: Well, I'm not sure I would start with that but I would certainly introduce that section that deals with what's being proposed.

MEMBER BLEY: Fair enough.

CHAIRMAN POWERS: I would put it -- I would really highlight. Here's what our thinking was. Here's what led us to think that this was a good thing to propose.

MEMBER BLEY: This is an okay thing. I was thinking a little bit about our meeting and also about the thing you talked about for next year and about what Ted was talking through and I don't know if you can do it. I'm visioning a kind of graphic that puts all these different kind of definitions of reactors and non-reactors and makes a picture of it. I think it might get rid of four slides and be much clearer and maybe --

CHAIRMAN POWERS: I agree with you.

MEMBER BLEY: And most likely if

something in the future ought to be done you'll see it and oh, yes. Something like a Venn diagram but some kind of graphic I think could help.

And the only negative thing I have to say, this is one of the two or three absolutely worst acronyms I've ever run into.

MR. HARDESTY: We left that up to the staff to try to help us come up with a better name and this was the least of the worst. A minority view I actually kind of like it.

CHAIRMAN POWERS: We call it Inpuff but the community likes to call it Inpouf. Mr. Brown?

MEMBER BROWN: Came to the meeting because I wanted to learn something since I had no idea what these things generally look like from the regulatory standpoint. So, I thought the presentation and the material we got to prepare for it was very, very good. And so this has been very informative for me. I thought you all did a good job on this from that standpoint. That's not to say you didn't do it on some other standpoint. But, I guess, if I was going to simplify this thing I would take -- I would add on to Dick's thing. Within your first nine or ten vu-graphs there was some definitions of what is this, what is that, things like that that if you don't understand those you don't understand one through nine. And then you need Dana's comment about you need -- okay. This is what we intend to do to try to categorize this thing. These are all major things we're trying to accomplish and these are the nine steps we're going through and then try to walk, you know, try to categorize those. All those little pictures of triggers and this that and the other thing you ought to can and all that kind -- there's a lot of miscellaneous stuff that you don't need and a little bit of an attachment to the Atomic Energy Act where you talk about there are no requirements in a few of these places, get introduced at the right place and that you're introducing some clarifications or however you want to phrase them to do it. So, I think you could reduce this thing to 20 or 30 slides if you could probably present within the hour to hour and a half that you will probably end up with because I could probably do it for you but you don't want me to and I'm not going to.

So, you've got some condensations in there that are very good if you pick out the right ones and then try to adjust them to meet that general approach. So, that's all I have.

MEMBER REMPE: I would like to share my appreciation. I really enjoyed the background section. I went into some of these reactor types but it's a nice overview and some of the personal insights from your own experience were worthwhile hearing and I appreciated it.

I also appreciated what the rule is doing because I did read through it but it helped to discuss it today. And I think my colleagues have told you how to simply it and good luck with it. But it's worthwhile seeing the staff working to try and reduce the burden when you see things that you believe aren't necessary. So, thanks.

CHAIRMAN POWERS: I wouldn't again work very hard to get to the nine points in a logical fashion because I think those are well expressed and fairly succinct. There's not much cutting you can do there.

Okay. At this point we move now to the discussion of formulating a draft letter within the committee. You can sit here or not as you see fit.

I would welcome suggestions -- that's right. I do want to go off the record too.

(Whereupon, the above-entitled matter

went off the record at 3:51 p.m.)

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

ACRS Subcommittee Meeting:

Non-power Production or Utilization Facility (NPUF) License Renewal Rulemaking

February 3, 2016

NRC Staff Presenters

- Robert Beall, NRR: Rulemaking PM
- Duane Hardesty, NRR: Technical Lead
- Al Adams, NRR: Branch Chief - Research & Test Reactors Licensing
- Rich Clement, NRO: Radiation Protection & Consequence Branch
- Kevin Folk, NRR: Environmental Review & Guidance Update Branch
- Kosmas Lois, NRR: Financial Analysis & International Projects Branch

Agenda

- Background on NPUFs
- Background on the NPUF proposed rule
- Summary of the NPUF proposed rule
- Rulemaking documents and schedule

Introduction to Non-power Production or Utilization Facilities (NPUFs)

Duane Hardesty

Alexander Adams, Jr.

Research and Test Reactors Licensing Branch

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Regulatory Authority

- Pursuant to Section 101 of the Atomic Energy Act of 1954, as amended (AEA), the NRC licenses production and utilization facilities
- All current power reactors and non-power facilities are licensed as utilization facilities
- Two primary types of licenses:
  - Section 103 Commercial Licenses
  - Section 104 Medical Therapy and Research and Development Licenses

Power vs. Non-power

Nuclear power plant objective:

- Make electricity
- Maximum heat/energy output
- Large core volume at maximum power density

NPP results:

- High power >1000 MW
- High temperature / pressure
- Complex safety systems
- Low peaking factor, low leakage core
- High stored energy

Non-power production or utilization facility objective:

- Make radiation
  - High flux in beams / traps
  - High irradiation flux positions
- Lowest possible power, fuel consumption, and stored energy

NPUF results:

- Low power < 20 MW
- Low temperature / atmospheric pressure
- Passive, simple safety systems
- High leakage core (neutron leakage feeds beam tubes)
- High peaking factor in flux trap
- Compact core design

Regulatory Authority (cont.)

- Three subsets of production or utilization facility licenses provided for in Section 104 of AEA
  - 104(a) Medical therapy licenses
  - 104(b) Commercial demonstration licenses
  - 104(c) Research and development licenses
- All NRC-licensed non-power or production facilities are licensed pursuant to 104(c) of the AEA, one facility also holds a 104(a) license

Regulatory Policy

The policy for regulation of Class 104 NPUFs is described in the Atomic Energy Act of 1954, as amended, Section 104a. and c.

Sec. 104. Medical Therapy and Research and Development

a. …the Commission is directed to permit the widest amount of effective medical therapy possible with the amount of special nuclear material available for such purposes and to impose the minimum amount of regulation consistent with its obligations under this Act to promote the common defense and security and to protect the health and safety of the public.

c. The Commission is directed to impose only such minimum amount of regulation of the licensee as the Commission finds will permit the Commission to fulfill its obligations under this Act to promote the common defense and security and to protect the health and safety of the public and will permit the conduct of widespread and diverse research and development.

Regulatory Definitions

- Non-power reactor means a research or test reactor licensed under § § 50.21(c) or 50.22 of this part for research and development [*10 CFR 50.2 Definitions*].

- Research reactor means a nuclear reactor licensed by the Commission under the authority of subsection 104c of the Act and pursuant to the provisions of § 50.21(c) of this chapter for operation at a thermal power level of 10 megawatts or less, and which is not a testing facility as defined by paragraph (m) of this section [*§ 170.3 Definitions*].

Regulatory Definitions (cont.)

- Testing facility means a nuclear reactor which is of a type described in § 50.21(c) of this part and for which an application has been filed for a license authorizing operation at:

  (1) A thermal power level in excess of 10 megawatts; or

  (2) A thermal power level in excess of 1 megawatt, if the reactor is to contain:

    (i) A circulating loop through the core in which the applicant proposes to conduct fuel experiments; or

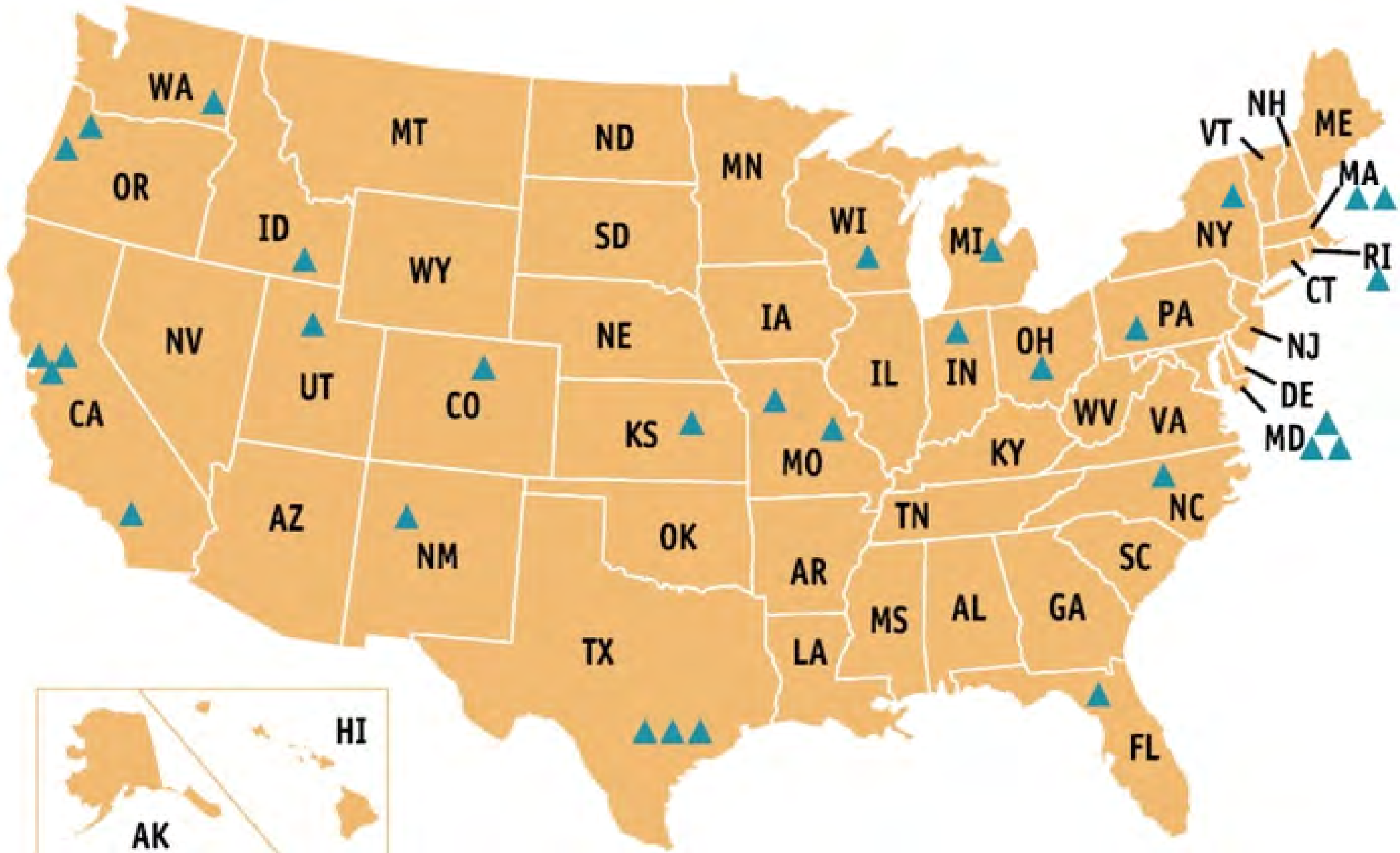
    (ii) A liquid fuel loading; or

    (iii) An experimental facility in the core in excess of 16 square inches in cross-section. [§ 170.3 Definitions]

Proposed Definition

- *Non-power production or utilization facility* means a non-power reactor, testing facility, or other production or utilization facility, licensed under § 50.21(a) or § 50.21(c) or § 50.22, that is not a nuclear power reactor.

U.S. Non-power Production or Utilization Facilities



- **36 licensed research and test reactors**
  - **31 reactors operating in 21 States**
  - **5 reactors permanently shut down and in decommissioning**

List of Currently Licensed NPUFs

LICENSEE	TYPE	LICENSED	POWER, kW	MISSION
Aerotest	TRIGA	1965	250	Private
AFRRI	TRIGA	1962	1,100	Federal
Dow Chemical	TRIGA	1967	300	Private
General Electric	Nuclear test	1957	100	Private
Idaho State University	AGN	1967	0.005	Academic
Kansas State University	TRIGA	1962	1,250	Academic
Massachusetts Institute of Tech	HWR reflector	1968	6,000	Academic
National Institute of Science & Technology	Nuclear test	1970	20,000	Federal
North Carolina State University	Pulstar	1972	1,000	Academic
Ohio State University	Pool	1961	500	Academic
Oregon State University	TRIGA	1967	1,100	Academic
Penn State University	TRIGA	1955	1,100	Academic
Purdue University	Lockheed	1962	1	Academic
Reed College	TRIGA	1968	250	Academic
Rensselaer Institute of Tech	Critical facility	1964	0.1	Academic

List of Currently Licensed NPUFs (cont.)

LICENSEE	TYPE	LICENSED	POWER, kW	MISSION
Rhode Island AEC	Pool	1964	2,000	Academic
Texas A&M University	AGN	1957	0.005	Academic
Texas A&M University	TRIGA	1961	1,000	Academic
US Geological Survey	TRIGA	1969	1,000	Federal
University of California - Davis	TRIGA	1998	2,300	Academic
University of California - Irvine	TRIGA	1969	250	Academic
University of Florida	Argonaut	1959	100	Academic
University of Maryland	TRIGA	1960	250	Academic
University of Mass - Lowell	Pool	1974	1,000	Academic
University of Missouri - Columbia	Tank	1966	10,000	Academic
Missouri University of Science & Tech.	Pool	1961	200	Academic
University of New Mexico	AGN	1966	0.005	Academic
University of Texas	TRIGA	1992	1,100	Academic
University of Utah	TRIGA	1975	100	Academic
University of Wisconsin	TRIGA	1960	1,000	Academic
Washington State University	TRIGA	1961	1,000	Academic

Characterization of Operating NPUFs by Decade Licensed

4	1950s
21	1960s
4	1970s
2	1990s
2	*2010s* *

* Shine and Northwest submitted construction permit applications for a Class 103 medical isotope production facility

Characterization of NPUFs by Power

4 $< 1\ kW_{th}$

12 $> 1\ kW_{th}$ but $< 1\ MW_{th}$

10 $> 1\ MW_{th}$ but $< 2\ MW_{th}$

5 $> 2\ MW_{th}$

Characterization of NPUFs by Fuel Type

3 AGNs

8 Plate-type fuel

16 TRIGA

4 One-of-a-kind

Characterization of NPUFs by Mission

25	Academia
3	Private Industry
3	Federal Government

Primary Mission of NPUFs

- Private Industry (3)
  - Service radiograph (Aerotest)
  - Product characterization and research (Dow)
  - Power reactor studies (GE)

- Federal Government (3)
  - Radiation effects studies (AFRRI)
  - Materials studies, basic science (NIST)
  - Geological characterizations (USGS)

Primary Mission of NPUFs (cont.)

Academia (25)

- Laboratory classes
- Basic nuclear research
- Academic research or outside services
  - Neutron activation analysis ⇨
  - Neutron radiography ⇨
  - Neutron scattering ⇨
  - Material irradiation ⇨
  - Isotope supply ⇨

NPUF Utilization

Very Low	Few hours/year	Laboratory classes	4
Low	Few hours/week	Classes and limited research/ service work	16
Moderate	20 to 40 hours/week	Classes and extensive research/ service work	7
High	24 hours/day 7 days/week	Substantial research and service	4

NPUF Staffing

Small Organization

Staff of 1 or 2

~~~~~~~~~~~~~~~~~~~~~~~

Director (SRO, Part time)

<u>Outside Support</u>

RSO (health and safety)

Clerical

Facility engineering

Physical plant crafts

Administrative services

– 25 facilities

Large Organization

Staff of ~10 to 50

~~~~~~~~~~~~~~~~~~~~~~~~~~

Director, Deputy Director

Administration

Operations

Engineering & maintenance

<u>Outside Support</u>

RSO/HP technician

Physical plant

Administrative services

– MURR, NIST, MIT, AFRRI, OSU, TAMU(T)

Description of NPUF Types

- AGN
- Argonaut
- Pulstar
- Pool and Tank
- Critical assemblies
- TRIGA
- Testing facilities
- Medical radioisotope irradiation and processing (Mo_{99})

AGN Reactor

- Aerojet General Nucleonics (AGN)
  - Compact, self-contained (portable) reactor
  - Fuel is a mixture of enriched uranium oxide in a polyethylene moderator
  - 10-inch diameter core has holes for insertion of control rods made of same composition as fuel
  - Center of core is a “fuse” which if melted, drops the lower half of the core
  - A graphite, lead, and water shield surrounds core
  - The core is a vertical water tank surrounded by a concrete shield

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AGN Research Reactors

- Currently 3 licensed AGN research reactors
  - Texas A&M University (5 watts)
  - Idaho State University (5 watts)
  - University of New Mexico (5 watts)

- Located in campus engineering building
- Class 104c research reactor

AGN major projects, experiments, and uses of the reactor

- Nuclear engineering laboratories
  – Reactor dynamics
  – Reactor operations
  – Reactivity feedback
  – Subcritical multiplication
- High school science workshops

- Training of power reactor personnel, emergency responders and general public
- Experimental stations:
  – Experimental access ports
  – Allows placement of samples in most intense neutron flux

Argonaut Reactor

- Heterogeneous core
- Fuel: Material Test Reactor (MTR-type) plate
- Characteristics
  - Coolant: Forced flow demineralized light water
  - Reflector: Graphite
  - Moderator: Demineralized light water and graphite blocks
  - Biological shield: cast-in-place concrete
- Graphite thermal column for irradiations

Argonaut Cutaway View

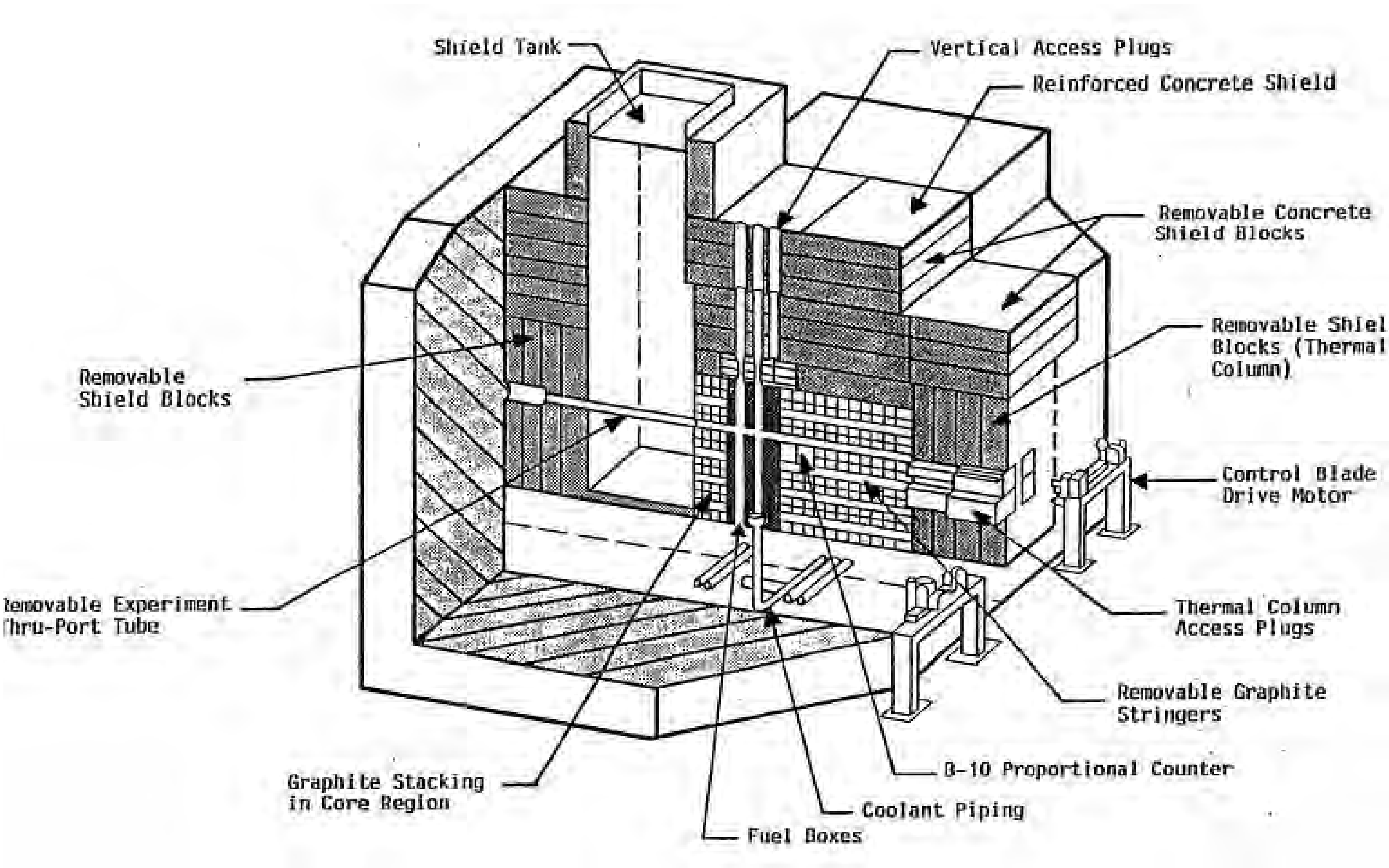
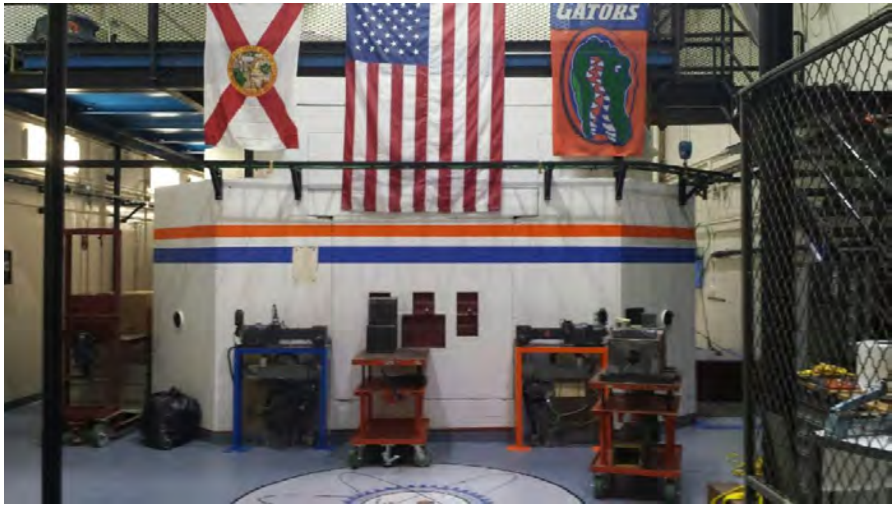


FIGURE 3 CUTAWAY VIEW OF THE UFTR

Argonaut Research Reactor

- Currently 1 licensed Argonaut reactor
  - University of Florida Training Reactor (100 kWth)



  - Located in campus engineering building
  - Class 104c research reactor

Argonaut major projects, experiments, and uses of the reactor

- Reactor tours and demonstrations including high school classes
- Research activities including: neutron activation analysis research, basic physics research and plasma physics studies
- Maintenance, surveillance, and testing, plus various extended inspection activities
- College courses, reactor operations laboratory, nuclear engineering laboratory and demonstrations
- UFTR operator training and requalification, and support staff and other training

PULSTAR Reactor

- Pool-type, light water moderated
- Solid homogeneous core
- Uses 4% enriched, pin-type fuel consisting of uranium dioxide pellets
- Coolant/Moderator: demineralized light water
- Reflector: demineralized light water and beryllium
- Cladding: Zircaloy
- Originally designed for pulse capabilities but no longer authorized

Pulstar Research Reactor

- Currently 1 licensed Pulstar reactor
  - North Carolina State University (1 MW_{th})
  - Located in campus engineering building
  - Class 104c research reactor

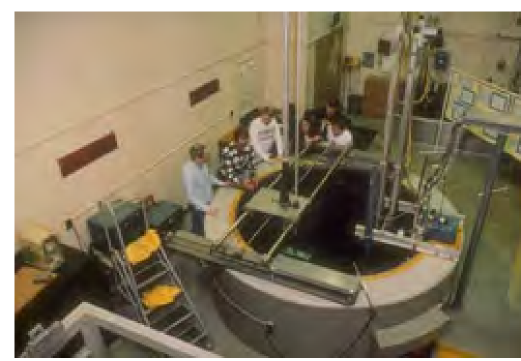
Pulstar major projects, experiments, and uses of the reactor

- Variety of irradiation facilities used for teaching and analytical services.
- Neutron activation analysis (NAA) provided to academic institutions, federal and state agencies, and commercial companies across the country.
- Fixed beam facilities for prompt neutron capture gamma analysis and neutron radiography.
- Experimental Stations:
  - Intense slow positron beam
  - Ultra cold neutron source
  - Powder neutron diffractometer
  - Neutron imaging facility

Pool Reactors

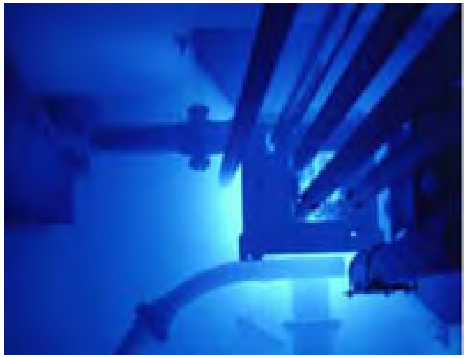
- Term to describe an NPUF facility where the reactor core is located in a pool of water
  - Sealed or metal-lined concrete structure
  - Purified light water
  - Range of sizes and depths (2,000 to 71,000 gallons)
  - Pool water provides significant radiation shielding

- Core can be mounted from a movable bridge
  - Move to specific experiment locations exposure rooms, etc.
  - Gate isolates the core for maintenance on drained half of the pool



Pool Research Reactors

- Currently 5 licensed pool reactors
  - Purdue University (1 kW_{th})
  - Missouri University of Science and Technology (200 kW_{th})
  - Ohio State University (500 kW_{th})
  - University of Massachusetts-Lowell (1 MW_{th})
  - Rhode Island AEC (2 MW_{th})



Pool Reactor major projects, experiments, and uses

- Neutron activation analyses
- Irradiation experiments
- Neutron radiography
- Teaching laboratories
- Experimental stations:
  - Thermalizing column with bulk shielding tank (RIAEC, MUS&T, OSU)
  - Dry irradiation room (RIAEC, UMass-Lowell)
  - Pneumatic transfer tubes
  - Central Thimble
  - Dry Tube

Tank Reactors

- A term used to differentiate an NPUF with a sealed enclosure
- Prevents exchange of air and water vapor between reactor and ambient atmosphere
- Allows for pressurization (slight), HVAC isolation, offgas collection, etc.
- Used normally for only the highest power NPUFs

Tank Research Reactors

- Currently 3 licensed tank research reactors
  - General Electric-Vallecitos (100 kW_{th})
    - Located in remote fenced compound
  - Massachusetts Institute of Technology (6 MW_{th})
    - Located on MIT campus
  - University of Missouri-Columbia (10 MW_{th})
    - Located in fenced compound on university
- All are Class 104c
- MIT also Class 104a

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Tank Reactor major projects, experiments, and uses

- Types of Experiments:
  - Radiopharmaceutical production (MURR)
  - Neutron radiography
  - Explosives experiments
  - Neutron activation analyses
  - Teaching laboratories
  - Boron neutron capture theory
  - Research and training
  - Failed fuel rod testing (GE)
- Experimental Stations:
  - Beam ports
  - Radiography film transfer system
  - In-core facilities
  - Pneumatic transfer

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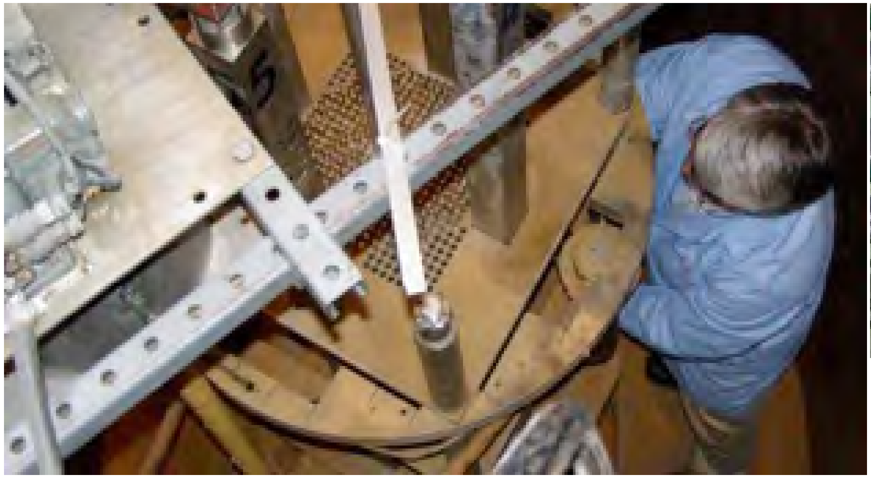
Critical Assembly Facilities

- Very low power level research reactor
- Built to determine and/or verify fuel parameters for new fuel designs
- Licensed for multiple grid plate designs
- When not is use, fuel is frequently placed in a vault



Critical Assemblies

- Currently 1 licensed Critical Assembly
  - Rensselaer Polytechnic Institute (0.1 kW_{th})
    - Rated power: 100 Watts
    - Light water moderator critical facility, core in tank of water
    - UO_2 sintered pellets in stainless steel tubes (4.8% enriched)
    - Coolant/Moderator: light water
    - Reflector: light water
    - Cladding: Stainless steel

Critical Assembly major projects, experiments, and uses

- Types of Experiments:
  - Neutron activation analyses
  - Neutron powder diffractometry
  - Neutron radiography
  - Teaching laboratories

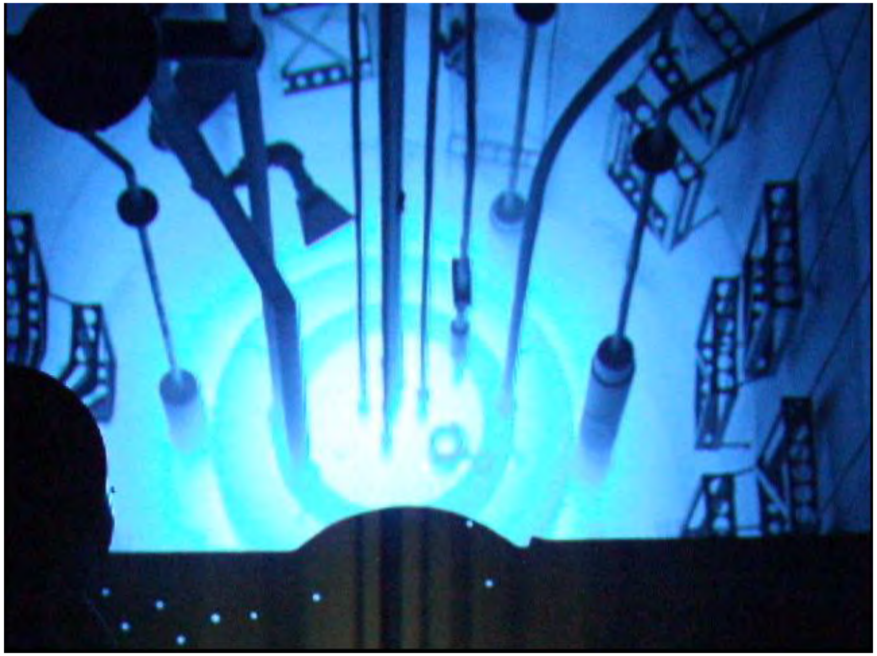
- Experimental Stations:
  - Central thimble
  - Pneumatic transfer
  - Dry tubes (2)
  - Thermalizing column with bulk shielding tank
  - Thermal column with removable door
  - Beam ports: radial (2), piercing (fast neutron), tangential

TRIGA Reactor

- **T**raining, **R**esearch, **I**sotope-production, **G**eneral **A**tomics
  - Pool-type, light water moderated
  - Solid homogeneous core
  - Pulsing reactor
  - Rated power: 250 kW_{th} to 2.3 MW_{th}
  - Coolant: Demineralized light water
  - Moderator: Zirconium hydride, demineralized light water, and graphite
  - Reflector: Graphite
  - Cladding: stainless steel or Aluminum

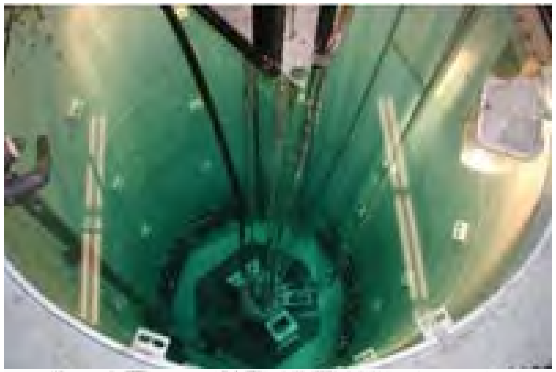
TRIGA Research Reactor

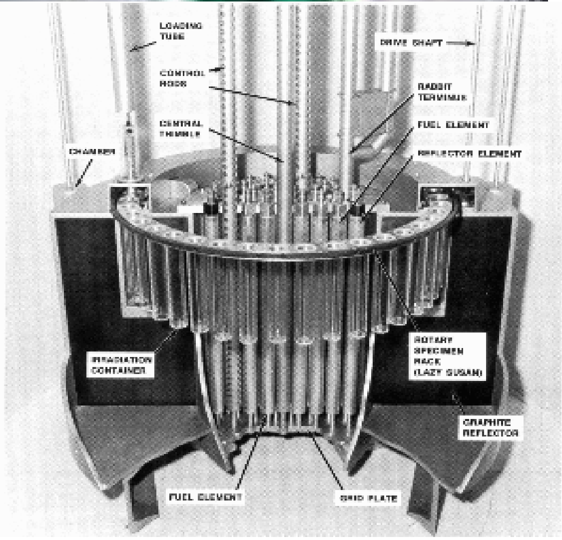
- Currently 16 licensed TRIGA reactor
  - Training-Research-Isotope-General Atomics
  - Located in engineering or research bldg.
  - All Class 104 c.
- TRIGA Reactors
  - Dow Chemical Company (100 kilowatts)
  - University of Utah (100 kilowatts)
  - Aerotest (250 kilowatts)
  - Kansas State University (1.25 megawatts)
  - Reed College (250 kilowatts)
  - University of California-Irvine (250 kilowatts)
  - University of Maryland (250 kilowatts)
  - Texas A&M University (1.0 megawatts)
  - U.S. Geological Survey (1.0 megawatts)
  - University of Wisconsin (1.0 megawatts)
  - Washington State University (1.0 megawatts)
  - Oregon State University (1.1 megawatts)
  - Pennsylvania State University (1.1 megawatts)
  - Armed Forces Radiobiology Research Institute (1.1 megawatts)
  - University of Texas (1.1 megawatts)
  - University of California-Davis (2.3 megawatts)



TRIGA major projects, experiments, and uses of the Reactors

- Types of Experiments:
  - Teaching laboratories
  - Neutron activation analyses
  - Radiation hardening of electronic equipment
  - Neutron radiography
  - Radiochemistry
  - Production of radiotracers
- Experimental Stations:
  - Central thimble
  - Pneumatic transfer
  - Dry tubes
  - Thermalizing column with bulk shielding tank
  - Thermal column with removable door
  - Rotating specimen rack (“lazy susan")
  - In-pool irradiation apparatus





Testing Facility

- Currently 1 licensed testing facility
  - National Institute of Standards and Technology (20 megawatts)
  - Located on large government complex
  - Class 104c
- Reactor
  - Fuel: U_3O_8-AL, plates (93% Enrichment)
  - Cladding: cadmium/aluminum
  - Coolant: heavy water (D_2O)
  - Reflector: heavy water (D_2O)
  - Moderator: heavy water
  - Maximum Excess Reactivity: 10.0% Δk/k
  - Reactor shield: concrete, lead, and iron

Testing facility major projects, experiments, and uses of the reactor

- Types of Experiments:
  - Thermal and cold neutron research
  - Neutron activation analyses
  - Neutron scattering
  - Neutron imaging
  - Neutron physics
  - Radiochemistry
- Experimental Stations:
  - Pneumatic transfer
  - Multi-axis crystal spectrometer
  - Ultra/small angle neutron scattering
  - Cold and thermal neutron imaging and depth profiling
  - Neutron reflectometers, diffractometers, spectrometers, and interferometer

Medical Radioisotope Irradiation and Processing

- Currently reviewing two construction permit applications
- SHINE Medical Technologies, Inc. (SHINE)
  - Irradiation facility houses eight accelerator-driven subcritical operating assemblies for the fission of 19.75% enriched aqueous target solution
  - Moderation and reflection provided by light water pool
  - Cooling provided by light water pool and forced convection
  - Radioisotope production facility consists of three hot cells for chemical separation and purification of fission products
- Northwest Medical Isotopes, LLC (NWMI)
  - Proposes to manufacture 19.75% enriched solid targets for irradiation at existing research reactors
  - Radioisotope production facility consists of two hot cells for chemical separation and purification of fission products

Medical Radioisotope Irradiation and Processing facility major projects and uses

- SHINE and NWMI to be licensed as class 103 commercial facilities
  - Target irradiation performed by *utilization facilities* (SHINE)
    - Each of SHINE's irradiation units will operate at about 100 kW
  - Fission product separation performed by *production facility* (SHINE and NWMI)
- Facilities will be primarily dedicated to the production of molybdenum-99

Inspection Program

- Safety Inspections
  - **Class I** (5 - Thermal power ≥ 2 MW)
    - MIT, MURR, NIST, RINSC, and UC Davis
    - 2 one-week visits annually. (Safety Inspections)
  - **Class II** (26 - Thermal power < 2 MW)
    - 2 one-week visits over 2 years.
- Security Inspections (Based on licensed possession limits)
  - **Cat II** (3)
    - MIT, MURR, NIST
    - 1 one-week visit over 2 years
  - **Cat III** (28)
    - 1 one-week visit over 3 years:

NPUF Violation Summary

- For the period of 2010-2016:
  - Operational: 20
    - Operator error, TS or procedure violations, etc.
  - Administrative: 8
    - Record keeping, posting and signage, etc.
  - Material: 0
    - Inoperative equipment
    - Material deficiencies

NPUF Violation Examples

- For the period of 2010-2016:
  - Exposure events:
    - Kansas State University - 2010
    - University of Maryland – 2011
    - North Carolina State University – 2011
    - Rhode Island Nuclear Science Center – 2012
  - Operator Absence:
    - U Wisconsin - 2011
    - UC Irvine – 2012
    - Reed College – 2013
    - Texas A&M University – 2014
  - System Failure:
    - Aerotest - fuel failures – 2011
    - North Carolina State University – reactor pool leak - 2011

Summary

- Primary responsibility for licensing and oversight is with NRR
- NPUFs are neutron sources; thermal power is incidental
- NPUFs incorporate numerous design techniques to bring neutrons to experiments or experiments to the neutrons
- The NPUFs operating in the US range from $5W_{th}$ to 20 MW_{th}
- Every NPUF is unique from the others
- NPUFs support multi-disciplinary research, commercial, industrial and educational applications for the benefit of mankind
- Medical radioisotope irradiation and processing facilities are not licensed, but construction permits being reviewed

QUESTIONS?

U.S.NRC

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Protecting People and the Environment

Proposed Rule for Non-power Production or Utilization Facilities (NPUFs)

Robert Beall

Sr. Project Manager

Rulemaking Branch

Purpose of the NPUF Proposed Rule

- Eliminate the NPUF license renewal backlog.
- Streamline the license renewal process.
- Implement Commission directed the staff:
  - Short-term plan: address the backlog with the Interim Staff Guidance (ISG)
  - Long-term plan: enhance license renewal process

Background on NPUF Proposed Rule

- Objective: “establish a more efficient, effective and focused regulatory framework”
- The proposed rulemaking will modify:
  - 10 CFR 2.109 “*Effect of timely renewal application*”
  - 10 CFR 50.71 “*Maintenance of records, making of reports*”
  - 10 CFR 50.51 “*Continuation of license*”

NPUF Regulatory Basis

- Regulatory Basis completed August 2012
  - Rulemaking justified
  - Identified constraints and limitations
  - Evaluated feasibility for segregation of NPUF regulations
  - Studied benchmarks for alternate methodology
  - Conducted public meetings to solicit stakeholder feedback

Applicability of the NPUF Proposed Rule

- Rulemaking affects all NPUFs:
  - Research reactors (Class 104a & c)
  - Testing facilities (Class 104c)
  - Medical radioisotope irradiation and processing facilities (Class 103)

Summary of the NPUF Proposed Rule

1. Create a definition for NPUF

- Affects all NPUFs
- No single definition exists to cover all non-power facilities
- Proposed rule would revise 10 CFR 50.2, Definitions
- Flexible term is needed to capture all non-power facilities licensed under § 50.22 and § 50.21(a) and (c)
- Ensures clarity and consistency for the applicability of NPUF regulations

Summary of the NPUF Proposed Rule

2. Eliminate license terms for facilities, other than testing facilities, licensed under 10 CFR 50.21(a) and (c)

- Affects Class 104a and 104c NPUFs, other than testing facilities
- Proposed rule would exempt Class 104a and 104c NPUFs, other than testing facilities, from 10 CFR 50.51, which requires 40-year fixed license terms
- No license term specified in AEA for Class 104 NPUFs
- Consistent with AEA's minimum regulation standard
- Reduces burden for licensees and NRC, but maintains public health and safety

Non-expiring License Questions

- Aging management
  - Simple designs
  - Low operating power and temperatures
  - Surveillance requirements
- Opportunity for hearings & public involvement
  - Licensing actions
  - 10 CFR 2.206 petitions
  - Allegation process
- Oversight and Inspection activity
  - Increased FSAR updates
  - Continuing staff onsite inspections
  - Very low number of design changes each year
- The above actions help ensure the public health and safety

Non-expiring License Rationale

- AEA does not establish a license term for Class 104a. or 104c.
  - Limited only by 10 CFR 50.51(a) to $\leq$ 40 years
  - Staff currently licensing NPUFs for 20 year terms
- Non-expiring license is consistent with AEA Sec. 104 to "…impose only such minimum amount of regulation…under this act to promote the common defense and security and to protect health and safety of the public…"

Summary of the NPUF Proposed Rule

3. Define the license renewal process for testing facilities and NPUFs licensed under 10 CFR 50.22

- Affects Class 103 NPUFs and testing facilities
- NPUF license renewal regulatory requirements default to initial licensing requirements
- Proposed rule would consolidate license renewal requirements under 10 CFR 50.135
- Clarifies license renewal process
- Enhances regulatory efficiency

Summary of the NPUF Proposed Rule

4. **Require all NPUF licensees to submit routine FSAR updates to the NRC every five years**
   - Affects all NPUFs
   - 10 CFR 50.71(e) only requires FSAR updates by power reactor licensees
   - Proposed rule would extend applicability to NPUFs
   - During license renewal, some licensees unable to provide documentation on licensing basis
   - Benefits knowledge management, NRC's inspection program, and licensee operator training and exams

Summary of the NPUF Proposed Rule

5. Amend current timely renewal provision

- Affects all NPUFs
- 10 CFR 2.109, Effect of timely renewal application, provides 30-day timely renewal
- Proposed rule would:
  - Create two-year timely renewal for Class 103 and testing facilities and
  - Exempt Class 104a and 104c NPUFs, other than testing facilities
- Thirty days is not a sufficient period of time for adequate assessment of license renewal application
- Two years would provide sufficient time and allow facility to operate under current license terms

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Summary of the NPUF Proposed Rule

6. **Provide an accident dose criterion of 1 rem (0.01 Sv) TEDE for NPUFs other than testing facilities**
    - Affects all NPUFs except testing facilities
    - Standards in Part 20 are applied to NPUFs, other than testing facilities, as accident dose criteria
    - Part 20 public dose limits are unnecessarily restrictive as accident criteria
    - Proposed rule would create new accident dose criterion for NPUFs, other than testing facilities, in 10 CFR 50.34
    - Proposed criterion is consistent with early phase PAG and provides adequate protection from unnecessary exposure to radiation

Summary of the NPUF Proposed Rule

7. **Extend applicability of 10 CFR 50.59 to NPUFs regardless of decommissioning status**
   - Affects all NPUFs
   - 10 CFR 50.59 currently is not applicable to NPUFs during decommissioning
   - Proposed rule would extend applicability during decommissioning
   - Avoids burden of issuing license amendments

Summary of the NPUF Proposed Rule

8. Clarify applicant's requirement for meeting the existing provisions of 10 CFR 51.45

- Affects all NPUFs
- 10 CFR 51.45 does not explicitly identify environmental documentation needed from NPUF applicants
- Proposed rule would define environmental reporting requirements for NPUFs
- Applicant must submit environmental report, or supplement, to assist the NRC staff's review
- Improves consistency and clarifies Part 51 requirements

Summary of the NPUF Proposed Rule

9. Eliminate requirement for NPUFs to submit financial qualification information with license renewal application

- Affects Class 103 NPUFs and testing facilities
- 10 CFR 50.33(f)(2) requires financial qualification information at license renewal
- Proposed rule would eliminate financial qualification requirements at license renewal
- Financial qualification information does not have a significant impact on the NRC’s determination on the license renewal application
- Reduces burden without affecting results of NRC’s review

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Summary of the NPUF Proposed Rule

- **Costs and Costs Savings (Undiscounted)**

	NRC	Licensee
Implementation Costs	$720,000	$140,000
Operations Costs	$1.8 million	$1.6 million
Cost Savings	$12 million	$5.5 million
Net Benefits (Cost Savings – Costs)	$9.4 million	$3.8 million

- **Total Net Benefit (Undiscounted): $13 million**
  – 3 Percent discounting: $8.9 million
  – 7 Percent discounting: $5.3 million
- **Backfit Considerations:**
  – Section 50.109 does not apply to NPUFs
  – Section 50.109 not applied to this proposed rule

NPUF Proposed Rule Package

- SECY Paper.
- *Federal Register Notice* (FRN).
- Regulatory analysis & backfit discussion.
- Environmental assessment.
- Draft Reg Guide DG-2006.
- Rulemaking package currently in review by OGC.
- Additional supporting NPUF rulemaking documents.
  - Congressional letters.
  - Omb statement
- NRR/DPR supporting NPUF documents.
  - Project Manager Handbook Sections 4 & 5 updates.

NPUF Rulemaking Schedule

- ACRS Full Committee: March 3, 2016.
- Commission review: April 1, 2016.
- Proposed NPUF rule will be issued for public comment in the early summer of 2016.
  - 75 day comment period.
  - All supporting documents will be issued together.
  - The staff will hold a public on the proposed rulemaking during the 2016 TRTR conference in August.
- The final NPUF rule should be issued early in 2018.

NPUF Proposed Rule Summary

- The proposed rule will amend the regulations related to license renewal for NPUFs licensed under sections 103 and 104a and c of the AEA.
- There are 9 proposed changes to the regulations which include:
  - Most NPUF would have non-expiring licenses.
  - Class 103 NPUFs and testing facilities can submit their license renewal application 2 years prior to the current license expiration date.
  - Require licensees to submit an updated FSAR every 5 years.
  - Establish an accident dose criteria for most NPUFs.

NPUF Proposed Rule Summary

- Eliminating licensing terms will reduce the burden on both the licensees and staff.
  - Allowed by the AEA
  - Minimum regulation on licensees
  - Continued oversight and inspections by staff
  - Improved FSAR documentation
- Total quantitative benefit of the proposed rule: $13 million
- Maintains the safe operation of the facility while protecting the public health and safety.

QUESTIONS?

BACK UP SLIDES

- NPUF experiments
- NPUF applications & utilization
- Regulatory basis information
- Typical fuel characteristics
- MHA types

Experiments

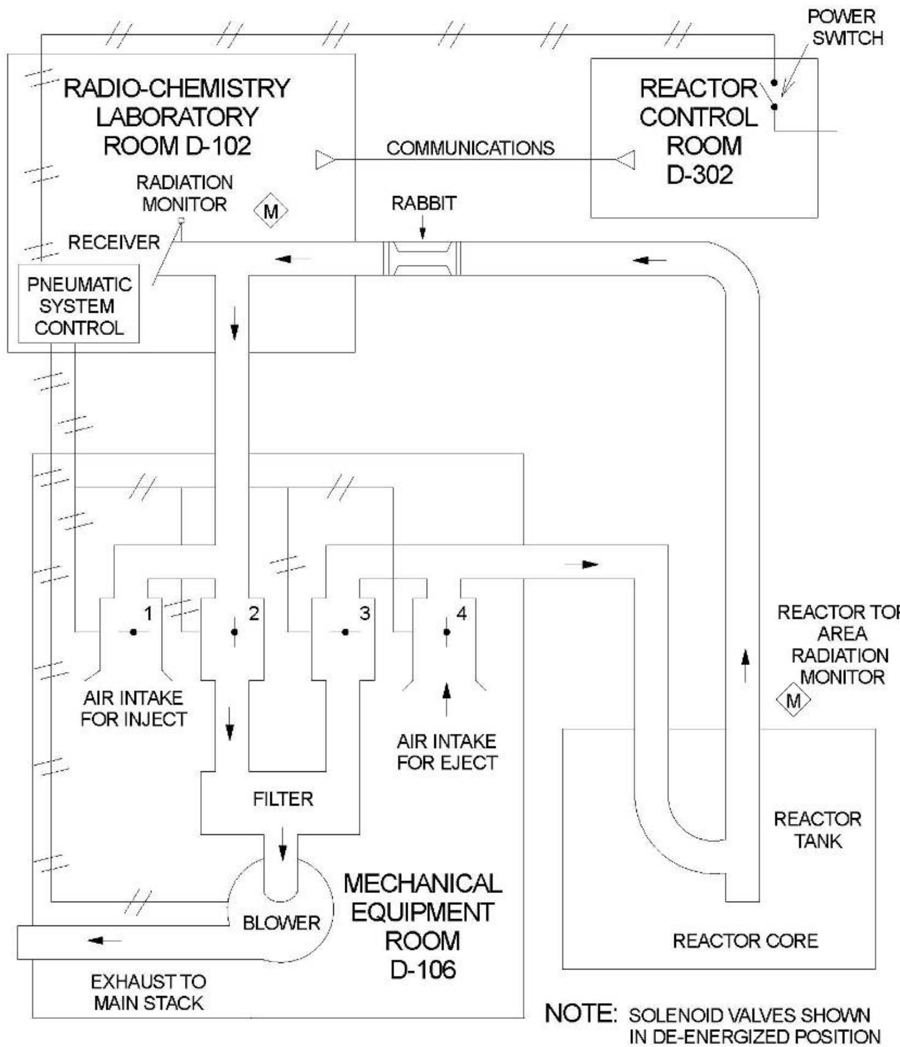
Sample insertion

- Fixed location within or adjacent to core where samples can be placed for irradiation
- Can be fixed or moveable experiments
- Moveable experiments can be inserted or removed while operating

Experiments

Pneumatic Transfer System

- Pneumatically moves samples in and out of the reactor
- aka “Rabbit” system



Experiments

Pneumatic Transfer System

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Experiments

Neutron Beam

Neutron beams

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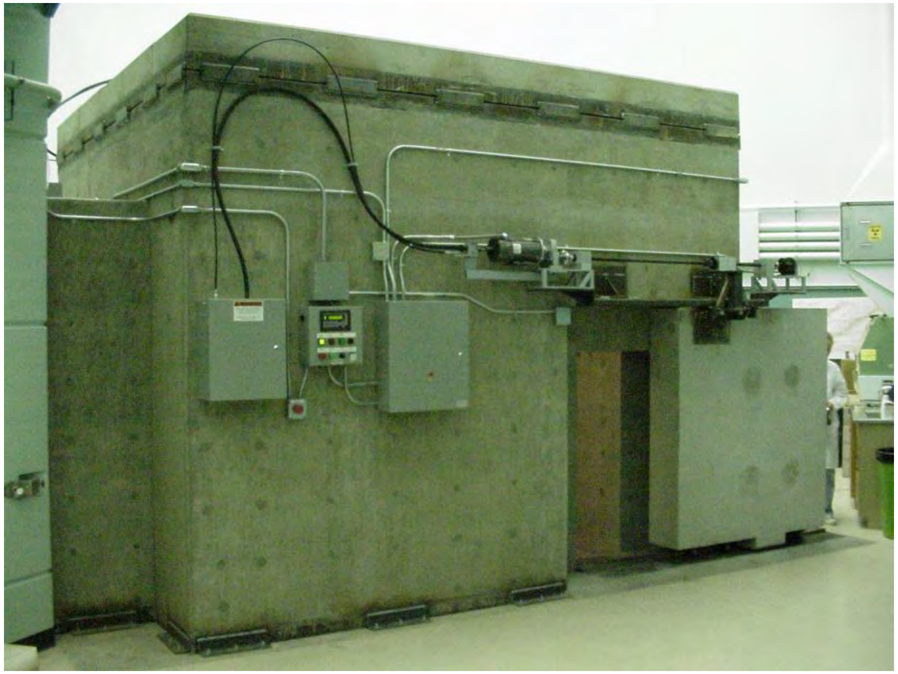
Experiments

Radiography Facility



NPUF Applications

- Neutron activation analysis (NAA)
- Neutron radiography
- Neutron scattering
- Neutron irradiations
- Radioisotope production
- Education

Neutron Activation Analysis Applications

- Environment – Measure pollutants vs time from tree rings, sediments and ice buildup
- Biology – Measure uptake of nutrients
- Anthropology – Determine trading practices of early man
- Forensics – Link evidence to suspect
- Art – Determine authenticity of artwork
- Hydrology – Use stable tracer to verify source of pollution

Neutron Radiography Applications

- View inside metal enclosures
  – Fluid flow in automotive transmissions
  – Gaskets in valves
- Characterize artwork
- Dispersion of boron in Boral
- Presence of moisture or corrosion
  – Aircraft wings
  – Heat pipes
- Non-destructive quality control technique

Neutron Scattering Applications

- Studies of biological matter; neutron interactions with hydrogen
- Studies of condensed matter physics, chemistry, polymer science, material science and neutron physics
- Powder diffraction used to study magnetism, superconductivity and material science
- Polarized neutron beams used to study electron spin in magnetic atomic structure
- Practical applications in ferro-fluid studies, stress analysis and fracture/flaw characterization

Material Irradiation

- Irradiation
  - Radiation effects studies
    - Biological effects
    - Metal embrittlement
  - Medical treatment (BNCT)
  - Transmutation
    - NTD silicon
    - Gemstones
- Simulation
  - Electronic hardness
  - Nuclear blast environments

Material Irradiation (Cont.)

- Radioisotope production
  - Tracers
    - Biological
    - Engineering processes
  - Medical
    - Diagnostics (Mo-99/Tc-99m generators)
    - Therapy (I-125 seed implants)
  - Sealed sources
    - Medical
    - Educational
    - Industrial

Public Involvement

- Opportunity for hearing tied to licensing actions
- Other means of involvement available
  - 10 CRF 2.206 Petition
  - Allegation process
  - Public availability of FSAR updates
- Historically, only one hearing request in last 30+ years

Constraints and Limitations

- Identified Constraints and Limitations (C&Ls)
  - Renewal = Relicensing (initial licensing)
  - Lack of periodic SAR updates
  - Timely Renewal (10CFR 2.109)
  - Existing Rule Language
    - General organization and presentation
    - Definitions & terminology
    - Technical basis for Testing facility
    - 50.59 applicability to permanently S/D facilities
    - Accident Dose criteria for research reactors

Regulatory Basis Options

- Five options and Five sub-options
  1. Do Nothing
  2. NUREG-1537 update to incorporate a streamlined license renewal process (Short-term plan)
     - extend the ISG concept to license renewal applications
     - *guidance* to periodically update SARs
  3. Rulemaking adopting streamlined license renewal process
     - Codify the ISG concept to license renewal applications
     - requirement for periodically SAR updates
     - change the current timely renewal provision
     - Segregation of non-power reactor license renewal regulations
  4. Eliminate license terms (and license renewals) and mandate PSRs
  5. Eliminate license terms (and license renewals) and mandate an enhanced NRC inspection program

Regulatory Basis Sub-options

- Low-hanging fruit:
  6. Revise 50.59 applicability
- Clarity of regulations:
  7. Update definitions & terminology
  9. RTR Dose criteria
- Out of Scope
  8. Document Technical basis for Testing Facilities
  10. Segregate NPR licensing regulations

Rulemaking Path Forward

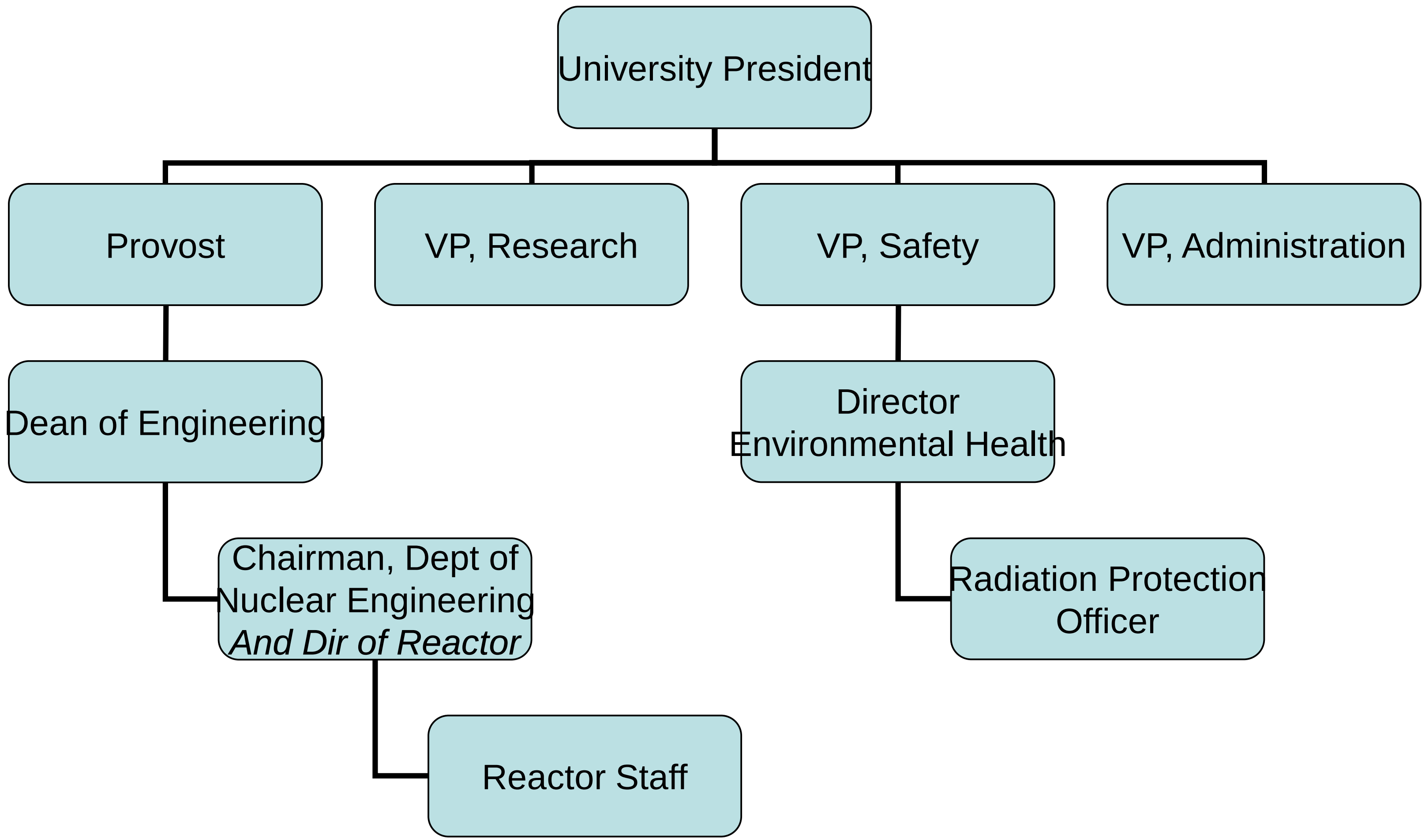
Proposed rule invokes option 5 through 9:

- Eliminate license terms (and license renewals)
  - Discarded notion of an enhanced NRC inspection program

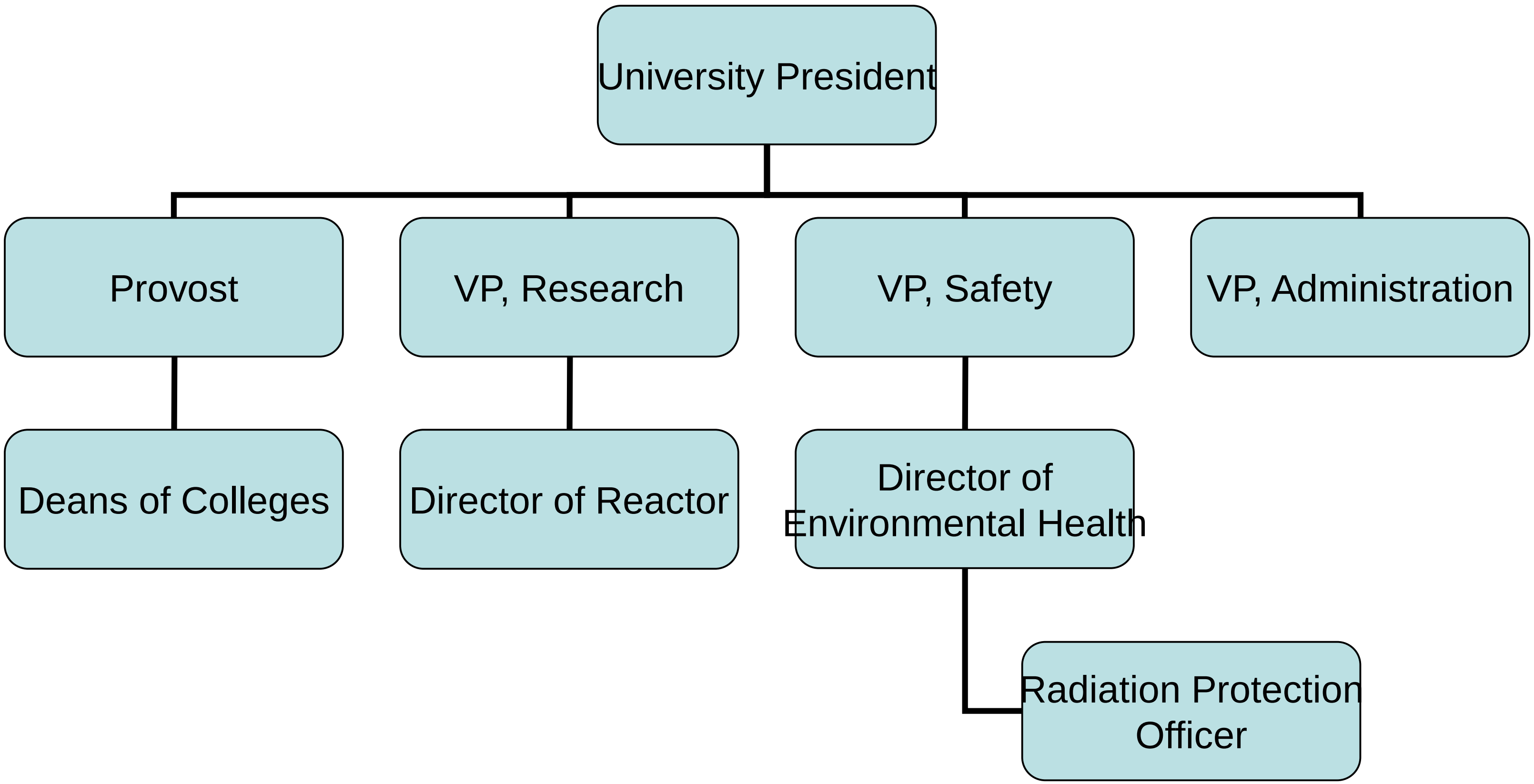
6. Revise 50.59 applicability
7. Establish “NPUF” definition
9. Establish NPUF Dose criteria *

* *Excludes testing facilities under Part 100*

Typical Organizational Structure - Small NPUF



Typical Organizational Structure - Large NPUF



Regulatory Policy

The policy for regulation of Class 103 NPUFs is described in the Atomic Energy Act of 1954, as amended, Section 103.

Sec. 103. Commercial Licenses

a. The Commission is authorized to issue licenses to persons applying therefor to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use100 import, or export under the terms of an agreement for cooperation arranged pursuant to section 123, utilization or production facilities for industrial or commercial purposes.101 Such licenses shall be issued in accordance with the provisions of chapter 16 and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purpose and provisions of this Act.

c. Each such license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years from the authorization to commence operations and may be renewed upon the expiration of such period.

AGN Fuel Characteristics

- Solid Homogeneous core research reactor
- fuel:
  - UO_2 enriched to 20% ^{235}U
  - 10” diameter polyethylene disks
- Clad: None (tank)

Plate-type Fuel Characteristics

- **MIT**: U-Alx, 93% enrichment, Al Clad
- **NIST**: U_3O_8-Al, 93% enrichment, Al clad
- **MUS&T**: U_3O_8-Al cermet MTR type fuel, < 20% enrichment, Al clad
- **Ohio State**: U_3Si_2-Al alloy, 20 elements with 16 MTR-type fueled plates per element, < 20% enrichment, Al clad
- **Purdue**: U_3Si_2-Al, 13 MTR-type elements with 14 plates per element, < 20% enrichment, Al clad
- **RIAEC**: U_3Si_2-Al < 20% enrichment, Al clad
- **UMass Lowell**: U_3Si_2, < 20% enrichment, Al clad
- **UFTR**: U-Al, 11 rectangular plates per fuel bundle

TRIGA Fuel Characteristics

- Initial fuel:
  - Al clad, 8.5 w/o U enriched to 20 % ^{235}U
- Later fuel for higher power RTRs:
  - 12, 20, or 30 w/o U, 20 % ^{235}U, and SS clad
- 19.75% ^{235}U is used to remain <20% (LEU)
- FLIP (Fuel Life Improvement Program) fuel was 70% enriched (HEU)
- Fuel may contain burnable neutron poisons

TRIGA Reactor Design

- Design objective was for an inherently safe reactor (no fuel melting or fission product release if all control rods were instantaneously removed)
- Most common core type for small to mid-sized NPUFs
  - ($100\ kW_{th}$ to $2.3\ MW_{th}$) today
- UZrH fuel element/moderator provides large prompt negative reactivity feedback
  - Pulse with \$3 pneumatic reactivity insertion
  - Attain $2000\ MW_{th}$ for 10 msec from $1\ MW_{th}$ reactor

One-of-a-kind Fuel Characteristics

- **RPI**: UO_2 sintered pellets in stainless steel tubes 4.8% enriched, SS clad (SPERT)
- **NCSU**: UO_2 sintered pellets in stainless steel tubes, 4% Enrichment, Zircaloy clad
- **GE**: U-Al alloy, 16 fuel assemblies with 40 skewer-type disks per assembly, 93% enriched, Al clad
- **MURR**: U-Al or U-Al_x curved plates, 93% enriched, Al clad

RTR Ageing Degradation Experience

- Buried piping corrosion; replace or insert internal flexible sleeve
- Metal lined pool weld defect; locate and repair weld
- Metal lined pool corrosion; replace tank liner
- Concrete pool leak; apply polymer coating
- Consider primary coolant leakage as an SAR pre-analyzed event

AGN Reactor Accidents

- Maximum Hypothetical Accidents
  - Insertion of fissionable material (U-235) into reactor core
- Consequence
  - Meets 10 CFR 20

Argonaut Reactor Accidents

- Maximum Hypothetical Accidents
  - Fuel damage
  - “Core crushing accident” is the initiating event
- Consequence
  - Meets 10 CFR 20

Pulstar Reactor Accidents

- Maximum Hypothetical Accidents
  - Fuel pin cladding failure
- Consequence
  - Meets 10 CFR 20

Pool Reactor Accidents

- Maximum Hypothetical Accidents
  - Purdue: failed fuel experiment
  - MUS&T: failed fuel experiment
  - Ohio State: failed fuel plate
  - UMass-Lowell: failed fuel plate
  - RIAEC: fuel cladding failure
- Consequence
  - Meets 10 CFR 20

Tank Reactor Accidents

- Maximum Hypothetical Accidents
  - Melting fuel plate
- Consequence
  - Meets 10 CFR 20

Critical Assembly Accidents

- Maximum Hypothetical Accidents
  - Failed experiment with radioactivity
- Consequence
  - Meets 10 CFR 20

TRIGA Reactor Accidents

- Maximum Hypothetical Accidents
  - Failed fuel element in air
- Consequence
  - Meets 10 CFR 20

Testing Facility Accidents

- Maximum Hypothetical Accidents
- Melting fuel plate
- Consequence
  - Meets 10 CFR 100

Exposure Events

- A primary objective of the NRC is to protect the health of the public, as well as the health of those involved in the nuclear industry
- Radiation exposure is expected to be As Low As Reasonably Achievable (ALARA), as well as conforming to regulatory limits
- Radiation exposure events are closely reviewed and analyzed

Exposure Events

- Texas A&M University – 2006
- MIT – 2007
- Kansas State University - 2010
- University of Maryland – 2011
- North Carolina State University* – 2011
- Rhode Island Nuclear Science Center – 2012

*Will be covered in another section

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Texas A&M - 2006

- A worker handling irradiated sample vials had an extremity dosimeter read a monthly total of 75.8 rem
- The yearly limit for extremity exposure is 50 rem
- No other workers had dosimetry results that were high, so the licensee determined that this was likely a defective dosimeter, and had it further evaluated
- The dosimeter was determined to be accurate
- Meanwhile, the worker had accumulated an additional extremity exposure of 37.54 rem in the following month

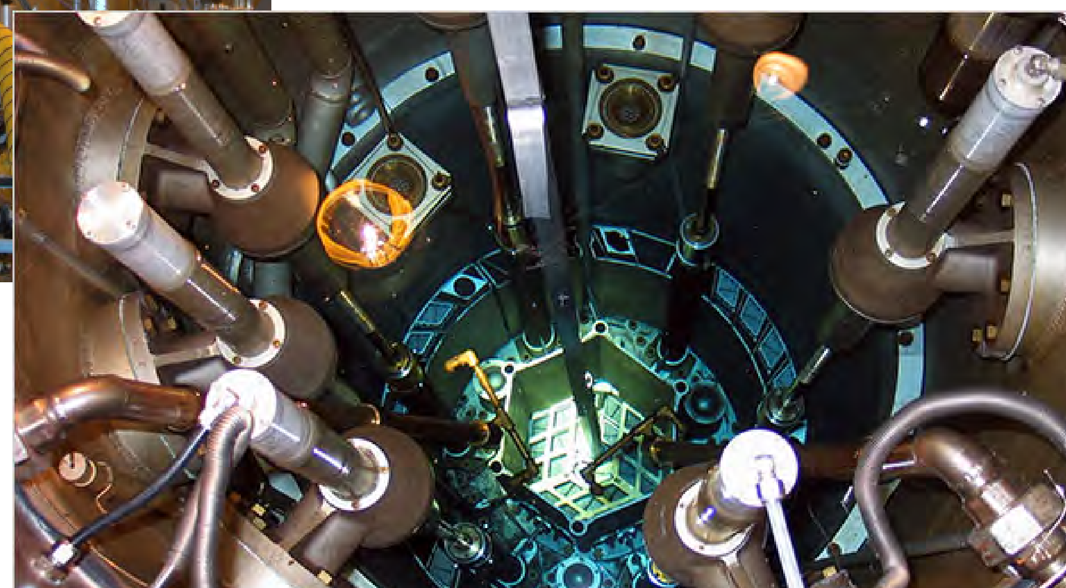
Texas A&M 2006

- A special inspection was conducted
- It was found that the worker was gripping the vials with both hands, unlike other workers
- The NRC issued a severity level IV violation, due to the licensee not properly assessing the risk of exposure
- Texas A&M made adjustments to their monitoring and training programs. They also developed new tools to perform this task safely.

Texas A&M – 2006, Extremity Exposure

- Maximum yearly extremity dose: 50 rem
- Dosimeter results: 113 rem
- Calculated average extremity dose: 17 rem
  - This value was accepted as the true dose

MIT - 2007



MIT - 2007

- An operator in training’s dosimetry reported a body dose of 4.04 rem in a quarter of a year
- An extremity dose of 5.81 rem was recorded, but the trainee was wearing his extremity dosimeter incorrectly
- The licensee determined that the majority of the dose was received while processing irradiated silicon ingots

MIT - 2007

- The trainee was not following procedure during the operation
- The licensee was issued two severity level IV violations for:
  - Failure to assess the radiation exposure during this operation
  - Failure to properly train the operator candidate in the use of dosimetry

Kansas State University - 2010

Kansas State - 2010

- A senior reactor operator (SRO) was withdrawing irradiated oil samples in a sample tray for an experiment
- A radiation monitoring device read off-scale, and all local radiation alarms were triggered
- The SRO picked up the samples and sample tray with bare hands (and no extremity monitoring), and placed them behind nearby shielding, to reduce the area radiation to normal

Kansas State - 2010

- The licensee was issued a severity level III violation for:
  - Failure to assess the radiation levels that this experiment would produce
  - Failure to supply and require the use of extremity monitoring
  - Failure to have an adequate written procedure for the experiment

University of Maryland - 2011

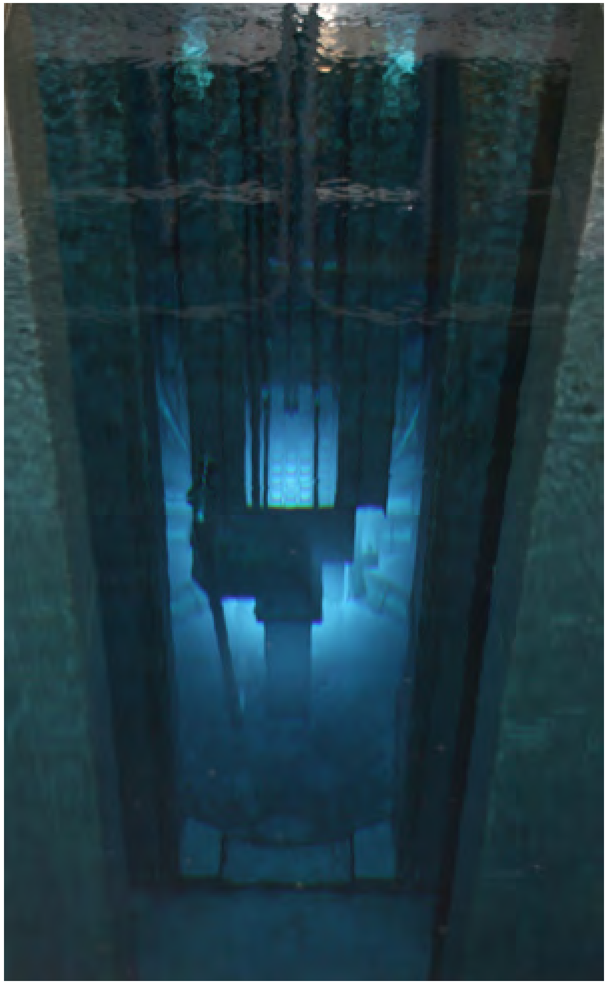
University of Maryland - 2011

- Sensing equipment deteriorated by exposure
- Powder from irradiated insulation spilled and became airborne while removing graphite samples
- One individual experienced skin contamination from the powder and was successfully decontaminated.

University of Maryland - 2011

- Exposure due to skin contamination was estimated to be 3 mrad (equivalent to exposure to 3 mrem)
- No exposure was found in the other individuals
- The licensee was cited with a severity level IV violation, due to not having this experiment reviewed and approved, despite its similarity to previous experiments.

Rhode Island Nuclear Science Center - 2012



Rhode Island Nuclear Science Center - 2012

- Senior reactor operator asked student trainee to lock the gate on a room adjacent to the reactor core
- The student entered the room instead of locking it, being exposed to a dose calculated to be 115 mrem
- NRC issued a non-cited violation for this incident

Operator Error

Unintentional:

- University of Missouri-Columbia – 2000
- Reed College – 2008

Intentional

- Reed College – 2005

Operator Absences

- U Texas - 2006
- U Wisconsin - 2011
- UC Irvine – 2012
- Reed College – 2013
- Texas A&M University – 2014

Unintentional Operator Error

- University of Missouri-Columbia – 2000
  - Reactor was shut down, and a regular refueling process began
  - A pump seal started leaking, and became the main focus of maintenance
  - A control blade was removed from the reactor, but the minimum required number of fuel elements required by the technical specifications had not been removed

Unintentional Operator Error

- Reed College – 2008
  - The reactor had been operating with a vacant space for a fuel element at a reduced power level
  - A new fuel element was being installed in a vacant position, during calibration the reactor operated above the licensed power level
  - A severity level III Violation was issued

Intentional Operator Error

- Reed College - 2005
  - Operator removed a jumper related to the control rod system, and did not inform anyone
  - Licensee was issued a severity level IV violation for unauthorized modification of a safety system

Operator Absences

Severity level III:

- MIT – 2003
  - Operator asleep

Severity level IV:

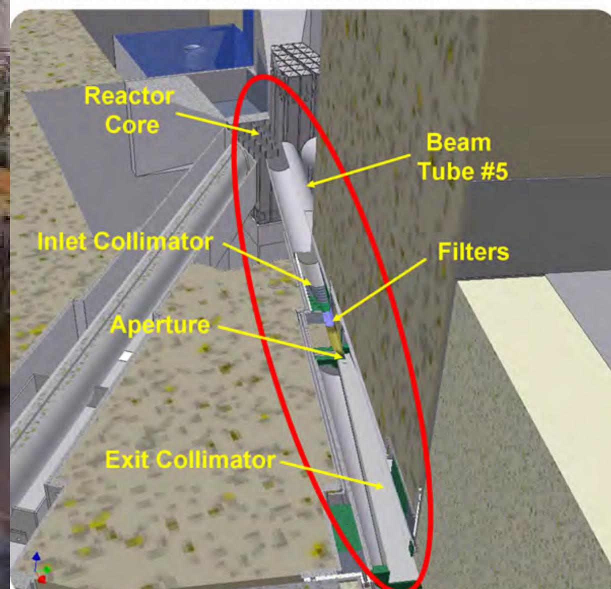
- U Texas - 2006
- U Wisconsin - 2011
- UC Irvine – 2012
- Reed College – 2013
- Texas A&M University – 2014

System Failure

- Penn State - leak – 2007
- North Carolina State University – July 2011 – technician exposure due to open beam port
- Aerotest - fuel failures – 2011
- North Carolina State University – September 2012 – reactor pool leak

North Carolina State University, 2011

Beam tube #5 – cutaway view of NIF collimator assembly



North Carolina State University, 2011

- A radiography technician entered the beam cave during reactor operation. A beam port shutter was meant to be closed at the time.
- A mechanical failure prevented the shutter from closing
- The technician noticed the open port and left the beam cave after 18 seconds
- The total exposure was about 150 mrem
- All violations were non-cited

Aerotest - 2011

- In 2011, during a fuel inspection, Aerotest discovered cracks in four fuel elements
- It was found that 27 aluminum elements and 11 fuel-less graphite elements could not be removed from the core
- The fuel in the Aerotest reactor had been in a former General Atomics reactor, and had also been shipped and operated in a demonstration reactor at a worlds fair in India
- Upon returning from India, the fuel showed signs of damage, possibly from poor water conditions there

Aerotest - 2011

- A contractor was hired to remove the fuel elements, but the fuel lid could not be removed completely
- In 2012 the lid was pried partially open, and tools were developed to carefully angle the fuel elements out of the core
- Upon inspection, 22 fuel elements showed signs of damage
- In 2013 another contractor was hired to enclose the damaged fuel elements in sealed helium-filled canisters.

History of NPUF Oversight

- 1989
  - Non-power reactor licensees were being inspected by power reactor inspectors
  - Commission formed “Research Reactor Directorate”, and project managers for RTRs worked at headquarters
  - Inspections were still conducted by regional inspectors from the power reactor groups
- 1991
  - NRC hired RTR specific examiners, who worked at headquarters but not for the RTR group
- 1995
  - Regional RTR inspectors and RTR examiners joined the RTR group
  - Inspectors continued to work from the regions, new inspectors worked at headquarters