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34TH REGULATORY INFORMATION CONFERENCE (RIC)

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TECHNICAL SESSION - W13

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY TEST REACTOR EVENT: THE RESPONSE, REVIEW, AND STATUS

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WEDNESDAY,

MARCH 9, 2022

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The Technical Session met via Video-Teleconference, at 1:00 p.m. EST, Jeremy Bowen, Deputy Director, Division of Advanced Reactors and Non-power Production and Utilization Facilities, Office of Nuclear Reactor Regulation, presiding.

PRESENT:

JEREMY BOWEN, Deputy Director, Division of Advanced Reactors and Non-power Production and Utilization Facilities, NRR/NRC

THOMAS NEWTON, Deputy Director, Center for Neutron Research, National Institute of Standards and

Technology

TRAVIS TATE, Chief, Non-power Production and Utilization Facility Oversight Branch, Division of Advanced Reactors and Non-power Production and Utilization Facilities, NRR/NRC

JOSHUA BORROMEO, Chief, Non-power Production and Utilization Facility Licensing Branch, Division of Advanced Reactors and Non-power Production and Utilization Facilities, NRR/NRC

ANDREW WAUGH, Reactor Inspector, NPUF Oversight Branch, Division of Advanced Reactors and Non-power Production and Utilization Facilities, NRR/NRC

P R O C E E D I N G S

1:00 p.m.

MR. BOWEN: Everyone, thank you for joining us for today's RIC session on the National Institute of Standards and Technology Test Reactor event. The response, review and status.

My name is Jeremy Bowen. I'm the Deputy Director for the Division of Advanced Reactors and Non-Power Production in Utilization Facilities, in the NRC's Office of Nuclear Reactor Regulation, and, I'll be chairing this afternoon session.

On February 3, 2021, an event occurred at the NIST Center for Neutron Research, in which a safety limit was exceeded, and nuclear fuel was damaged.

The facility itself was designed for the possibility of such an event, and all safety systems functioned as intended.

As a result, there was no impact to the public, or to the environment.

Despite this lack of impact, the event itself was a significant event for the NIST facility, the research and test reactor community, and the nuclear industry as a whole.

The objective for the discussion is to provide an overview of the event, to outline the actions taken by the NRC over the past (telephonic interference), and assess the licensee's response, and to provide information on the latest stats.

The panel of three experts with us this afternoon to walk us through the discussion. First, we'll hear from Tom Newton, (telephonic interference) of the NIST Center for Neutron Research.

He'll provide a presentation on the event itself, and an update on the status of the facility.

After Tom, we have Travis Tate, the Chief of the NRC's Non-Power Production and Utilization Facilities oversight branch. And, Travis will outline the agency's response to the event, and our increased oversight of the facility itself for the past year.

(Telephonic interference) Borromeo, the Chief of the NRC's Non-Power Production and Utilization Facility Licensing Branch, will provide an overview of the NRC's ongoing technical evaluation of the facility, and our assessment of NIST's plans for eventual restart.

Before we begin, I'd like to point out

that the NRC remains focused on the safety of the NIST reactor. The reactor itself remains shut down, and the NRC's review of the event and the activities following are ongoing.

NRC approval is required to restart the facility, and no decision or timeline for authorization has been made at this time.

Travis and Josh will provide more details to the (telephonic interference).

As we go through the discussion, we would appreciate providing any questions through the chat function, and we look forward to an opportunity to address those at the end of the presentations.

So, I'd like to thank all of presenters for being with us again today, and a special thank you to our Session Coordinator, Andrew Waugh.

With that, I will go ahead and get started, and I'll introduce our first (telephonic interference).

So, Thomas Newton. Thomas Newton is the Deputy Director for the NIST Center for Neutron Research, and the Chief of Reactor Operations and Engineering.

He's held these positions since August

2015, and prior coming to NIST, Tom was the Director of Reactor Operations for the Massachusetts Institute of Technology Research Reactor.

Tom earned a Ph.D. in nuclear science and engineering from MIT in 2006, and he holds bachelor's and master's degrees in mechanical engineering from the University of Arkansas.

He is the author or co-author, of over 60 publications on research reactor design and operations, experiment design, and (telephonic interference).

Tom, thank you again for joining us. I'll turn it over to you, sir.

MR. NEWTON: Thank you, Jeremy.

First thing I'm going to do is talk about the design of the reactor, and the fuel in the reactor. Then go over the event in a bit of detail, and talk about root cause and corrective actions.

So, if you'd go to the next slide, please.

This is the overview of the NCNR, and the Center for Neutron Research. We are three major neutron science centers in the United States. The other two being at Oak Ridge National Laboratory.

We have it shown in the picture here, we have 30 neutron instruments that are used for a variety of science applications. And, we host over 1,000 participants every year at NCNR, in the typical year.

So, there's a very high demand for our instruments. They are oversubscribed by about a factor of two or more.

Funds of course, are supplied by the reactor, a 20-megawatt research test reactor. The reactor operates on a 38-day fuel cycle.

So, next slide I'll you a bit about the reactor itself.

This is a cut-away view of the reactor. We have 30 fuel elements in the reactor, and the fuel is actually we have a split core, and upper and lower fuel sections, with a gap in the middle. That's a flux trap.

The flux trap in the middle, of course, is a peak where thermal neutrons are. And, so all of our beam tubes and our co-neutron sources, are pointed to that flux trap. For peak of neutrons.

The reactor is a heavy water reactor. Heavy water moderated, cooled and reflected. You can see that we have lower (telephonic interference) below the reactor there that circulates the heavy water through the core at about 9,000 gallons a minute.

The reactor is controlled by four shim arms, some made of cadmium. Shim arms are run in a simafor shape. You can see kind of one toward the middle there. There's a rotational shaft right outside the core that, that moves those shim arms.

And, the fuel elements, refuel elements are inserted into the lower grid. There's an upper and lower grid. It holds the (telephonic interference) together and the elements are fitted into the bottom good plate with the nozzle.

The nozzle accepts the heavy water flow through the, through the fuel element. And, then of course, it's lashed to the top, the top grid plate. And I'll go through that in some detail.

Next slide.

Okay, the fuel is HEU fuel. Our fuel mete is a uranium (telephonic interference) with aluminum dispersant. We also have aluminum cladding on the outside, so it's plate (telephonic interference).

You can see the diagram over there on the right. We have 17 fuel plates inside the element. Actually, if you do upper and lower fuel section, there's a total of 34 fuel plates in the fuel elements. The outer plates are not fueled.

So, loading in a fuel element is about 350 grams of uranium. When we do a ring, which is every 38 days where they go through a 38-day fuel cycle, we put in four new fuel elements at the time, and then discharge four.

And, the four that are discharged have been in for either seven or eight cycles. Typically, that's about a year through the core before they are discharged.

Next slide, please.

It's a heavy water. You can't mix heavy water and air because of two reasons. You degrade the head water and second, you get tritium exposure to the folks doing the refuel.

And, so all fueling is done by feel only. You don't, you're not able to see what you're doing. So, we have a unique mechanism by which we refuel the reactor.

We have each fuel position, each of the

30 fuel positions has a transfer tool above it that will lower the element in place. And, so you can see the middle picture there, there's a mock-up of the refueling tool that's on top of the fuel element head.

Once the element (telephonic interference) and move the transfer arms to transfer it to different locations around the reactor, then lowered by the tool above that position and put into place, and then latched.

And, the picture over on the right shows a mock-up of a latch. Right below that sign there, you can see there's a latch bar that's rotated out. And, that latch bar once it's rotated out, latches into a slot underneath the upper grid plate of the reactor.

The reason I'm kind of going through this in detail is because latching was a key contributor to the event that happened, which I want to talk about now.

So, next slide.

This is a synopsis of what happened on February 3. We started a normal startup at about 9:00 a.m., and go to 10 megawatts and leveled off there for a bit.

At 9:06 we began an ascension to full power. Before we got to full we had a sudden drop to about 7 megawatts or so, followed very shortly thereafter by a release of fission products.

These fission products made it to the stack less than a minute later, and tripped the stack radiation monitor, which the trip point was 50,000 counts per minute. Which did a major scram.

What we mean by major scram is it, scram the reactor, shut the reactor down. And, also seal the confinement building to limit release.

At 9:16 we declared an alert and (telephonic interference) more about why we did that in a minute.

We evacuated the control room shortly thereafter, because of high radiation levels in the control room, and notified the NRC at (telephonic interference).

Next slide, please.

Okay, this is a graph of the events. This is taken off a program we call React at Your Desktop, which is a program that samples. It doesn't show all the data points, but at least it's fairly good for showing the trending.

And, so I'm going to orient you here a little on this slide here. The green line is the shim arm position. The black line is the reactor power, as indicated by a nuclear instrument channel. The red line is radiation monitor in the stack, and the blue line is the radiation monitor in the fission sweet gas system. We have a monitor, that's the first thing that indicates when it comes out of the reactor.

So you can see we've leveled off a little earlier at 1 megawatt, with very little indication of any issues.

Then we power to 10 megawatts and you can see that happens and there's a bit of a jagged line there through the oscillations.

We think after the fact, that was due to nuclear boiling in this unlatched (telephonic interference), departure from nuclear boiling.

This was also seen somewhat on the nuclear instruments in the control room, but it didn't rise to a threshold by which the operator would have taken action to shut the reactor down.

Then we raise power as you can see in the black line, and once it started approaching full power, we saw a sudden drop there.

And, right after that sudden drop, we see a big increase in the fission product, the higher the blue line there.

And, then once that fission product gas has made it through to stack monitor, then we can see the red line goes up. Followed, and you can see the scram there where the green line of the shim arm position is scrammed in the reactor. And, the confinement building is sealed.

Then you see the peak drops off quite precipitously, because there's no more gas escaping the confinement building.

So, next slide, please.

So, as mentioned before, all the systems that operated like they were supposed to, in addition to that, the operators and health physics staff responded as they were trained, and did appropriate actions.

As I've mentioned before, the radiation levels in the control room necessitated evacuation right after the event happened. We had a couple people that stayed behind, couple of operators that stayed behind to start shut down activities.

And, later that day, we had another building entry to reenter to start to complete the shut down activities.

As a result of those activities, we had a total of 10 staff members that were contaminated. They were successfully decontaminated, that they went home without incident.

Total dose to the mecta personnel during the event was well within the NRC limits. Matter of fact, the official doses are I think, something like 1.1 rem.

A lot of that was due to contamination of dose symmetry. We had during the event, collected all the dose symmetry together. This is a lesson learned we had, that those contamination levels we think, resulted in higher doses being assigned to the people than they really, than they really accepted.

But we were conservative there, and that's, we want to have a (inaudible) of all the dose we saw there to the operators.

The control room just so you know, the control room is, is right outside the reactor top area. So, this is fairly typical in research reactors.

So, that's why they had the radiation levels rose so quickly in the control room. But that's taken care of in the safety analysis report, that we actually account for that in emergency planning.

Next slide, please.

Okay, when we declared an alert, this is a copy of the emergency instructions for the criteria for declaring an alert. The initial criteria for an alert is the stack monitor, which is, there's RD 4-1 at, reaching 50,000 counts per minute, which it did.

At that point, then the operator would then go down to the action level criteria to, whether or not to really, actually declare an alert.

At 2.2.2., when you have indication of fuel cladding failure, that was the blue line you saw in the graph, of High Helium Sweep Activity being above 50,000 counts per minute. That's when the operator declared the alert.

Now, the hard part is now going to 2.2.1., and actually figuring out what the doses of the boundary are, and the effluent concentrations. And, so I'll talk about that here next, in the next slide.

So, as part of the emergency instructions are to go out and take samples not only at the stack, but also at the site boundary downwind. And, so that was done.

And, at that point, many samples are brought back to the health physics staff to then ascertain what they, the activity levels are.

We had several samples at the site boundary, and several samples at the stack. None of the samples showed any iodines, radio iodines they stayed in the primary coolant system primarily.

Saw very small almost unquantifiable amounts of (telephonic interference) but we saw a (telephonic interference) stack, you have a lot better data there.

So, because of those lower, high uncertainties in the stack, from the site boundary measurements, we decided to go ahead and use the stack monitors, and the stack counts, to determine what the levels were.

It took us a little time to do that, and so by about mid-afternoon at 1532, we were able to downgrade the alert to, to a NOUE, a notification of unusual event.

And, further analysis we were able to determine and terminate the emergency at 19 (telephonic interference).

Further analysis after that confirmed that the boundary doses were well below .5 millirem. NRC and DOE both confirmed these independently and so the dose, well, as mentioned before, the boundary doses were negative.

Next slide, please.

So, it took us a couple of weeks to get a camera in to see what had caused the issue. But we saw that there was an element as is shown in the picture here, that was lodged.

We did a review of all the activities that had happened prior to the event. There was a refueling done on January 4.

We viewed the video of the personnel doing those procedures then. They did do the latch and latch checks, but when we reviewed them and indicated, we found that the latch checks were not done correctly. And, may have, in fact, unlatched the element.

After the refueling January 4, we delayed start up for about a month because of COVID concerns.

So, we decided to wait to start up the reactor until February.

And, because of that and we, we started and stopped the primary pumps roughly daily after that because we wanted to keep the primary system cool, and the secondary system warm.

And, in speculation, this is of course speculation only. And, that we pushed this element out from the flow area there. You can see the bottom circle there. The nozzle of the element is actually resting on the lower grid plate, which did not allow it to have any flow.

And, this element by the way, was, had been in the reactor for one full cycle before without incident. We also reviewed QA documents and things, and found there were no manufacturing error, or rejection issues either. So, it was a normal element.

Okay, so next slide, please.

After review of that, and we also indicated that the fuel elements had sustained some (telephonic interference) damage, we made the conclusion that fuel element had exceeded the fuel safety limit of 450 degree Celsius.

And, we made a report on March 5 to NRC indicating that, and as mentioned before, the part of that is that we cannot resume operation until NRC agrees, and you'll hear more about that from the NRC folks, but I'll talk about that here in a bit, too.

Next slide, please.

The first thing that we did after that was to institute a root cause investigation, an internal one with the Technical Working Group, to find out what the root causes for this were.

It took us a month to go through this in quite a bit of detail. And, we found that there were several inadequacies we had identified throughout the process. And, inadequacies in training, and inadequacies in the procedures in the fuel action process itself.

We had inadequate procedure compliance of the folks doing the refuel, and we had inadequate management oversight of the refueling process.

We also continued to investigate after this report was done, and we made another finding that there, it's possible that if you lower the fuel element, fuel handling tool onto the element with a bit of force, you could inadvertently unlatch a fuel element.

And, that's important because one of the things we do, had done as part of height checks, was, as part of latching checks, was what we call a height checks.

So, you have a tool on top of the fuel level head ,and you check the height to see if that is actually the fuel element's latched or not.

And, so inadvertently, you could unlatch element while you're checking to see if it's latched. So, that was important to find, and things we've corrected since.

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The second root cause investigation was our reactor oversight Safety Evaluation Committee. They formed a committee right after the Technical Working Group had finished, to look at root causes, and also investigate the response, and come up with proposed corrective action.

So, this was both internal and external to the NCNR. They completed their August, and they found that there were two additional root causes that led to the event.

One was a lack of change management

program, and the other was a culture of complacency in reactor operations group.

They came up with 24 recommended corrective actions, all of which we've agreed to do. And, I'll go through those in some kind of high-level detail next.

So, next slide, please.

First of all, management corrective actions. Change management was a big, has been a big focus. We're doing program improvements top to bottom to address these.

We have a New Aging Reactor Management program in place that track changes, and keeps track of all the change management (telephonic interference).

We're also doing a fundamental organization realignment, including addition of a fifth shift of, because we have four shifts right now. We're adding a shift dedicated for training, and for procedure compliance.

We're overhauling all of the procedures and I'll talk about that in a minute. And, we're also synthesizing all the existing change management programs we have now with ECMs or anything, change notices, trouble tickets which are when things are broken, and the corrective action program altering the synthesized as part of this program.

In addition, we're doing assistance for skills management. In addition to the fifth shift, we're doing operator incentives to incentivize operators for safety improvements, and hired a permanent CO, which I'm happy to say was done several months ago.

Next slide.

The other thing we're looking at in management is, is assessment of the tools we use for refueling. Not only the refueling tools themselves, there's a picture here of the index plate. The index plate is a plate we put on top of the reactor to, to position the fuel. And, the dimensional measurements are done here to verify there's complete fidelity in the fueling index plate.

We're also setting standards for supervisors for (telephonic interference), and also making sure that their supervisor oversight is adequate by training them.

We're instituting a continuous improvement program for, particularly for staff ownership of corrective actions not only for this event, but in going forward.

We have several teams of folks that are involved in this. So that actually all the director operations group, all the director engineering group, all the health physics, and all of safety, industrial safety, are focused on these corrective actions and recovery paths.

We are integrating safety culture throughout our entire process, and we're bench marking ourselves not only with U.S. facilities but international facilities as well, to find out what good looks like, and get there.

Next slide, please.

In addition to management, we're corrective actions and training program, we are requiring proficiency training for every operator that moves fuel. That includes standard, setting qualification standards for fuel movements, and documenting those prior to folks being able to move fuel.

We are also rewriting the training programs for better knowledge transfer. We previously had sort of an apprenticeship program, which was not that great for knowledge transfer. Now, we're making sure the expectations are clearly spelled out at all, all the training program.

Developing standards for supervisors for how they train folks, and periodic management reviews of the training programs.

Next slide.

We are also revamping all of our 500+ procedures to upgrade them to make sure safety is integrated into the procedures. And, also revising them to meet INPO 11-003 standards, which are nuclear power plant standards for procedures.

Refueling procedures themselves are being rewritten to capture details. It used to be when we, the refueling procedures like move the element from A to B. And, now, it's much more detail about every single movement has to be made for the fuel, how you move it, and how you latch it.

There's a picture over here on the right of a reader-worker program we've instituted, so that there's a person outside reading the procedure, the folks inside doing the actual movements will repeat back to the reader saying, okay, this is what, this is what I understand I'm going to do, and this is what I'm going to do.

And, then once it's verified back to the reader, then he documents that was done and moves on to the next step. So, that's integrated now in our procedures.

Additional training, changing in the refueling procedure is latch checks are going to be done prior to the final pumping start. And, we're doing a redundant rotation check.

Once we do that rotation and get that latch in place, we're going to have (telephonic interference) mark in place that verifies that that's indeed, in a latch position and then redundantly checked by a second individual.

In addition to that, we are instituting new procedures for visual check. We're going to be lowering a camera into the reactor after all the latching has been done, do a visual check, make sure it'll go across every single fuel element position to verify it's in place, download those images, and then analyze those images by fuel redundant folks also, to make sure that latches are set in place, and you're not allowed to touch the fuel anymore after that so you know that the latches are in place, and are not going to move.

Next slide.

This is a picture of the refueling camera we're going to be putting in the reactor. We have tested that, tests have done quite well. We're finishing up the procedures now to actually do those visual check. That's going to be implemented and put in place, probably the next couple of weeks or so.

We are making sure that latch checks certify adequacy, and making sure the elements are latched. As I mentioned, we're modifying the index for fiduciary remarks, and dimensional analysis to make sure that they're set in place correctly.

We're no longer going to be doing the height checks, as I mentioned problems there with that. The other two are completely adequate to make sure we're latched.

We're modifying a training stand test, and this is a test stand used to train the reactor operators in how to, how to move fuel, how to latch fuel. So, that's going to be fixed up a bit.

In addition to that, another thing we're putting in place is a noise gate for the nuclear instrument.

Before it was pretty subjective as to whether or not the signal is something you should take action on or not.

Now, we're going to take the subjectivity out of all that, and make sure that the noise gate will analyze that signal, and then alert the operator if it detects the signal is abnormal in any way.

Next slide, please.

So, just one more slide about the, our interactions with NRC, and you're going to hear more about this here from Josh and Travis.

We have a Special Inspection Team that began on February 8 right after the event. And, that special inspectors have been present either virtually or physically, pretty much daily ever since then, particularly for special evolutions.

Written reports have (inaudible) here. February 16 was the first written report on the event. March 5 was the, as I made before, the conclusion that we exceeded the safety limit.

May 13 was a report on the inadequacies from the root cause investigation. In July we have started bi-weekly calls with the NRC management. Those have since changed to weekly, so, matter of fact, we met this morning and we meet every Wednesday.

And, then October 1, we submitted a report to NRC on the root causes, our planned corrective actions, and a request for permission to restart on the condition that we complete the corrective actions.

Now since then we've been going back and forth with NRC with supplemental information and furnish for their process, which you'll hear about.

And, one thing I didn't put in here is we have license amendment request we submitted in December, that basically codifies the new latch check procedures. It requires that not only the location, but also visual checks after we touch the fuel.

So, all that's going to be put in place and solidified so that we can't change it.

Next slide, please.

The status of the reactor, let's see, once we, I think we have one more slide. There we go.

The status of the reactor. All but three fuel elements have been removed from the floor, including the damaged fuel element. There's a picture there of the, of getting ready to move the fuel element in August that we did last year.

So, all but three have been moved. The three were left in place to make sure that no debris fell below the lower grid plate. So, those are, since the vessel clean up has been completed now, those elements are going got be removed probably within a week of so.

And, then we will start the clean up process.

Next slide.

The next step in our clean up procedure is going to be a primary clean up of the (inaudible) primary system. This is a gamma scan we took of the primary system early on to look for hot spots, and where the problems might lie in the primary system.

So, the next thing we're going to do after we get everything out of the reactor, is put in filter elements. Instead of 30 fuel elements, we're going to put in 30 filter elements and (telephonic interference) and get them caught up into the filters.

That may require a little bit of education, but we're prepared for that. So, we'll see how that goes.

And, parallel to that, we're going to be looking at all the elements that were in the core, to see if they're okay to be reused.

We're going to be doing a back flow, so we're going to be flowing reverse through the top of the element down through the bottom, to flush out any debris that might be present.

And, then do a visual inspection of all the element channels, and then certify them for reuse. And, that should happen hopefully in the next month or so.

So, next slide. This is my last slide and conclusions.

Our February 3 event was an unprecedented event for research reactors, and we recognize that. NIST has committed to restart the reactor when all necessary corrective actions are done, and not until then, and when NRC allows and agrees that those necessary corrective actions have been completed.

Shout out to NIST Public Affairs. They've been invaluable in helping with communication throughout the whole time here.

External reviews I want to mention too here, but there are several other external reviews, found no issues with the event response. That was all done adequately.

And, the last thing I want to leave with is frequent and open communications has been, we think is going to be the key to recovery and the reactor restart.

Okay, back to you, Jeremy.

(No audible response.)

MR. NEWTON: You're muted.

MR. BOWEN: Sorry, just realized I was on mute.

So, appreciate that, Tom. Thanks for the presentation, and thanks to everyone who's submitting questions so far. We'll get to questions for Tom here after the rest of the presentations.

So, next we'll move over to Travis Tate.

So, Travis is the Chief of the Non-Power Production and Utilization Facilities Oversight branch in NR's Division of Advanced Reactors and Non-Power Production Utilization Facilities.

Travis joined the NRC in January 2001 as a licensing project manager, and he's held numerous staff and management positions since then.

Prior to joining the NRC, Travis was

employed as a staff engineer and science, with Science Applications International Cooperation in Oak Ridge, Tennessee.

While at Oak Ridge, he provided nuclear facility safety analysis, excuse me, transportation package safety analysis, and nuclear criticality safety analysis support for the Department of Energy.

Travis was the recipient of the NRC's meritorious service award, for equal employment opportunity excellence in 2012.

And, he is a graduate from the University of Tennessee-Knoxville, with a bachelor's of science in nuclear engineering.

Travis, I will turn the presentation to you.

MR. TATE: Thank you, Jeremy.

Good afternoon, everyone. My presentation today will discuss the NRC's oversight response to the February 3 event that occurred at NIST.

Before I get into, I'm sorry, next slide, please.

So, before I get into our response activities, I think it would be helpful to provide an overview of the non-power reactors regulated by the NRC.

Research and test reactors may be classified by their moderator. Typical moderators include water, heavy water, which is what NIST has, polyethylene, and graphite.

The NRC has primarily licensed water moderated reactors, which can be further classified as either pool-type, or tank-type.

Pool-type reactors have a core immersed in an open pool of water. The pools typically have about 20 feet of water above the core, to provide cooling and radiation shielding.

At pool-type reactors, the operator, the operating core can be observed through the pool water.

Tank-type reactors have a core that is in a tank with water, sealed at the top.

Reactors may also be classified by the type of fuel used, such as plate type, or trigger. Trigger fuel is unique in that a moderator's hydrogen is chemically bonded to the fuel.

All NRC licensed research and test reactors have a built-in safety feature, which reduces reactor power during potential accidents before an unacceptable power level, or temperature could be reached.

Research and test reactors are typically licensed by the NRC, according to the total thermal energy produced by the reactor. These facilities range in size from 5 watts to 20 megawatts thermal.

In contrast, a typical commercial nuclear power reactor is rated at 3,000 megawatts thermal. Because of this large difference in power generated, the consequences of an accident at a research and test reactor, is limited when compared to a commercial power reactor.

For this reason, research reactors' emergency planning zones are often the boundary of the room in which the reactor is housed.

Unlike power plants, research and test reactor control rooms are usually in the confinement or containment area, where the reactor is located.

Facility staff and personnel work in the reactor room or building, during operation. Most research and test reactors are in rooms or buildings, that have a dedicated ventilation system. And, all have systems that control the release of radiation.

Because of the low power levels at which research and test reactors operate, they require no, or minimal cooling for short periods after shut down.

In addition, many of these reactors operate on a very limited schedule.

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So, the regulatory functions for research and test reactors are performed by two branches in NRR. The licensing branch conducts licensing reviews, develops licensing guidance, and interfaces with outside organizations.

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The oversight branch conducts activities such as safety and security inspections, operator licensing, develops inspection and operator license guidance, and coordinates enforcement activities and event response.

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The authority under which the NRC performs its regulatory functions for non-power reactors, is provided by the Atomic Energy Act.

The key principles within our authority is provided in bold text in this slide. This language in the Atomic Energy Act recognizes the vital research and development that non-power reactors provide, the inherent low risk of these facilities, while also recognizing the importance of appropriate regulatory oversight, to ensure the protection of public health and safety.

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Additionally, the Commission applies the principles of good regulation in executing our activities for non-power reactors.

Next slide.

So, immediately following notification of the event, the NRC exercised response procedures to assess the conditions at the facility.

The NRC remained in monitoring mode, and maintained communications with NIST throughout the following days.

The NRC staff conducted a reactive inspection evaluation, and determined that a special inspection team would be established.

A charter was issued and the special inspection team began on-site inspections on February 8.

The team was chartered to evaluate the consequences of the event, the licensee's response to the event, the consequences of the event, the maintenance activities and outage actions related to fuel movement, the licensee's root cause determination, and the licensee's completed and planned corrective actions.

On March 2, NIST reported that during the event, they violated tech spec, technical specification 2.1, safety limit, which states, the reactor fuel cladding temperature shall not exceed 842 degrees Fahrenheit, or 450 degrees Celsius, for any operating condition of power or flow.

Following this notification, the NRC reevaluated the reactive inspection decision, and determined that additional resources and expertise, would be added to the special inspection team.

As well as we included additional regional input for independent insights, into the special inspection.

In a follow up 14-day report, NIST indicated that evaluation of the root cause for the event would take several months.

In order to be responsive and provide timely information regarding our special inspection activities, the NRC issued an interim special inspection report on April 14, 2021.

Since February following the event, the NRC special inspection team has maintained both onsite, and remote inspection presence of the NIST event.

NIST completed a root cause analysis and corrective actions report, and on October 1, NIST submitted a request to restart the reactor.

And, our response to that request will be covered by Josh in his presentation.

The NRC has completed the special inspection activities in accordance with the charter, and is preparing to issue the final inspection report, which will include any findings related to NRC requirements.

Following the issuance of the final report, the NRC will also issue related enforcement actions deemed appropriate, in accordance with our enforcement process and policy.

We will discuss the results of the special inspection during a public exit meeting with NIST, on March 16.

Next slide, please.

So, a summary of our response determined that the reactor safety systems functioned properly during the event, and that public health and safety were protected during, and following the event.

The NRC is satisfied that the surrounding community remains safe, while the reactor remains shut down.

The reactor has remained in a stable shut down condition, and monitoring systems are operating properly.

As stated previously, NIST has completed a root cause analysis and provided responsive corrective actions.

Josh will discuss the request for authorization to restart the reactor in his presentation. And, the special inspection will, which the special inspection will inform the NRC's response to the restart request.

Next slide, please.

Although our special inspection objectives have been accomplished, it is important to note that we have a significant number of additional inspections to conduct.

We are currently developing our plan for inspection activities necessary to support the restart decision, as well as any future inspections to ensure corrective actions can be sustained, should the reactor receive authorization to restart.

Thank you. I'll be happy to answer questions during the Q&A period, and I'll turn it back over to Jeremy.

MR. BOWEN: All right, Travis, thanks very much.

Finally, we'll hear from Josh Borromeo. Josh is the Chief of the Non-Power Production and Utilization Facility Licensing branch, in NRR's Division of Advanced Reactors and Non-Power Production and Utilization Facilities.

Josh joined the NRC in 2015 as a reactor systems engineer in the Office of Nuclear Reactor Regulation, and he has worked on a number of complex projects, including the NuScale Design Certification application, and accident tolerant fuel.

Prior to joining the NRC, Josh worked at Westinghouse as a safety analysis engineer, focusing on loss of (telephonic interference) accident analyses, and methodology development.

Josh received his bachelor's degree in mechanical engineering, from Penn State.

Okay, Josh, the floor is all yours.

MR. BORROMEO: Great, thanks, Jeremy.

So, as Jeremy said, I'm Josh Borromeo, Chief of the NPUF Licensing branch in NRR. And, my branch is responsible for all of the licensing aspects of NPUFs, including the NIST test reactor.

And, I think Travis did a good job of explaining what my branch does.

With respect to the NIST restart request, we're not only responsible for the licensing aspects with respect to that, but also its overall coordination of the restart request effort.

So, today I'm going to be talking about NRC's approach to considering the NIST restart request. And, there's a few key takeaways that I hope you get from my presentation today.

The first is I hope you come away with an understanding that this is an agency-wide effort. And, an understanding what the NRC is considering for a restart decision.

The second is a high level of understanding of the process that we're using to support the restart decision.

And, the third and probably the most

important thing I think you heard from Travis, I think you also heard it from Jeremy, was that the NRC is not going to make a decision on restart until we have reasonable assurance that this event, or a similar event, will not happen again at NIST.

So, next slide, please.

Okay, so I think Tom did a really good job of providing an overview of the event, but I'm going to provide a quick recap so it's fresh on your minds.

So, as the NIST test reactor was coming up to power, the reactor scrammed on high exhaust radiation levels.

And, this was a result of an element becoming unlatched. That element becoming unseated, and it was starved of coolant flow, and the element was damaged.

And, a safety limit was exceeded as a result. And, I'll talk a little bit more about safety limits here in the next slide.

And, the reactor was shut down and remains shut down today.

So, there's a couple additional points I want to make regarding the event.

So, the first is that there was radiation release during the event, and that radiation release was bounded by the maximum hypothetical accident analyzed as part of the NIST licensing basis.

Now, a maximum hypothetical accident, is a postulated accident that is intended to bound all credible accidents, and is part of the regulatory framework for research and test reactors.

I say this to point out that the event was not beyond what the systems at NIST were designed for.

And, the second point I want to make, which kind of dovetails into the first one is, while there was radiation released to the environment, the safety systems functioned properly and offsite doses were near background levels, which are well below the regulatory limits.

And, the NRC was satisfied, and remains satisfied, that public health and safety was protected, and the surrounding community remained safe, and continued to remain safe.

Now, I do want to reiterate that this was a very serious event, and the NRC is taking this event very seriously. And, the NRC will not authorize restart until we have reasonable assurance that public health and safety will be protected.

Next slide, please.

Okay, so this slide provides an overview of the regulatory basis for why NRC authorization is needed to restart the reactor.

First, I'm going to touch on what a safety limit is, and what the safety limit is for NIST. I think both Tom and Travis spoke to that a little bit, but I'll reemphasize here.

So, in general, safety limits are limits on variables that are necessary to protect the integrity of a physical barrier, that guards against the uncontrolled release of radioactivity.

For NIST, the safety limit is a temperature limit that's put on the fuel cladding to ensure it can maintain its integrity, to prevent the release of fission products.

So, during the NIST event, the cladding temperature went above the safety limit, and that fuel element was damaged, and fission products were released.

Now, because of the importance of the safety limit, if a safety limit is exceeded, the NRC regulations will not allow operation of a reactor until authorized by the NRC.

And, you can see that, I listed the regulation here in the first sub-bullet.

Also, I want to point out that the NIST license, the NIST tech specs, require NRC authorization to resume operations if a safety limit is violated. And, that's in the second sub-bullet here on my slide.

So, the key takeaway here is that the NRC's regulatory framework, requires NRC authorization to resume operations if these important safety limits are exceeded.

Next slide, please.

Okay, so since NRC approval is required for restart, I wanted to highlight the documents submitted to the NRC to support that decision.

So, so far we've seen two documents, the request to restart reactor from NIST, right, and this request contained an evaluation of the event, the root cause, the root causes identified by NIST, and the NIST initiated corrective actions.

We also have the license amendment request that requests a change to the tech spec, to bolster the requirements to ensure that a fuel element is latched. And, Tom touched on this in his slides a little bit.

So, the NRC staff has accepted both documents, right, and they are currently under NRC review. The staff has performed a number of audits to gain a better understanding of the technical material in these submittals.

In addition to these documents, I do want to highlight that the SIT reviewed many more documents to support the inspection report. And, that inspection report is planned to be issued in the next couple of weeks.

Next slide, please.

Okay, so we touched on what NIST submitted. Now I'm going to discuss what the NRC is looking for to support the restart decision. And, there are three key areas that the NRC will base its decision on.

And, I'm going to read these because I think they're very important. So, the first is, ensuring that that event, and the reasons it occurred, are fully understood.

So, that's having a robust root cause

analysis that the NRC staff agrees with.

The next is confirming that NIST has adequately identified and addressed the impacts, to the test reactor.

So, one of the, for example, one of the areas that we're looking at is the other fuel elements that were in the core whenever the event happened. And, evaluating if those can be reused during the restart.

And, the third is ensuring that NIST has made corrections to prevent this event, and similar type of, types of events from happening again.

And, this is ensuring that NIST has taken the appropriate corrective actions, to ensure that this event will not happen again.

Now, this decision is not only with the licensing actions related to the submittals from NIST. And, you're going to see some more detail on that in the coming slides, but it's a coordinated effort across many areas of the NRC, including inspections, and enforcement actions.

Now, I'm going to reinforce that the NRC is moving efficiently to try to move through this review, but we won't make a restart decision until we have determined that the restart will be protective of public health and safety.

Next slide, please.

Okay, this slide provides an overview of the key areas of consideration for the restart decision.

Now, these areas are not only vital to ensure that we make a sound regulatory decision on a very complex and significant event, but also to ensure that we're communicating appropriately with our various internal, and external stakeholders.

Now, each area has representatives on the restart team, and this team meets regularly to ensure that we're considering all the appropriate aspects for the restart decision. And, as well as staying aligned with all the activities that we have going on in parallel.

Slide, please.

Okay, so this slide provides an overview of process the NRC is using for the restart decision. And, a couple things I want to point out first here.

There are three major sub-processes that support the restart decision, and you can see these listed on the left-hand side. Licensing, inspection, and enforcement actions. And, this figure contains the major actions for each one of these areas.

The other thing I want to highlight is this gray trapezoid at the very top of the figure here that has the arrows to the left and the right. That indicates that the reactor, restarted reactor. And, you can see the restart decision comes just before, just before the restart of the reactor.

And, the last thing I want to point out on this is that the x-axis on this is time, but it's not to scale and these actions may shift in order relative to one another.

This is just a tool that we're using to describe the high, high level and general approach to the restart decision.

Now, some additional items on this. You can look at the restart decision process I've made up of these sub-processes, interacting with one another.

And, the NRC is closely coordinating all these efforts to ensure that we don't have any gaps, or significant overlap between all of these efforts.

And, you can also see how each of these areas will feed into the restart decision, and it's not only in the licensing world to make the decision on the restart.

Also, for each one of these sub-processes, the NRC is using already established processes to the extent practical, in lieu of developing new processes just for, just for the restart effort.

And, the last point that I do want to highlight here, and Travis touched on it, but for the oversight and inspection activities in the blue here, those activities will continue following the restart of the reactor, to ensure that performance levels at NIST remain at acceptable levels.

So, one last thing on this slide before we move on. I do want to touch on where we're at in this process.

So, with respect to the licensing review, NIST has submitted the restart request, as well as the root cause, root cause and the corrective actions.

The NRC staff is currently completing its technical review, and docking in it's technical evaluation report. Like is said before, we're performing audits and we're starting the documentation of that report.

With respect to the inspection activities, we are the special inspection team has drafted its special inspection report. And, as I mentioned before, that's due out, due to be released to the public in the near future.

And, we also have a public exit meeting scheduled for March 16.

And, with respect to enforcement actions, we have begun the enforcement process, and we are just in that first box there.

So, that's where we are as far as the overall, with respect to the overall restart decision process.

Next slide, please.

Okay, so on this last slide I wanted to highlight some of the key documents that the NRC will be producing to support the decision.

So, we're producing NRC inspection reports, as well, NRC inspection reports and we've already released an interim special inspection team report, and the final is due soon.

With respect to the licensing actions, the staff is developing a technical evaluation report that will document the design, and the licensing basis impacts of the event. And, like I said before, the staff is currently drafting that now.

And, it's going to incorporate results from the license amendment request that we are currently reviewing, as well as some, as well as potentially some input from inspection reports.

And, then we'll be producing documents relative to the outcomes of any enforcement actions that we have.

So, that's all I have on my presentation material today. And, I hope this overview helped you understand the steps the NRC is taking, to come to a restart decision.

And, the final thing I'll leave you with before I turn it over to Jeremy, is that the NRC is not going to make a decision on restart until we've determined that the restart will be protective of public health and safety.

Thank you.

MR. BOWEN: All right, thanks, Josh.

So, appreciate again all the presentations, and all the questions that have come in.

So, we have about 30 minutes left in the session, have several questions have come in. I'm going to try and combine a few so there are, that are kind of similar so that we're able to get to most of the topics that have been brought up.

Several questions for Tom, so we'll start there with him and then a couple for the staff, actually the NRC staff, and we'll go from there.

So, Tom, the first one, there were several questions about the release and it wondered if you wanted to elaborate on that a little bit more.

Multiple questions about whether there was any indication of tritium release. So, I guess we'll start there.

MR. NEWTON: Okay, keep in mind that there was no loss of coolant here. So, tritium releases were normal. There was no release of tritium during the event above and beyond what we normally release as our routine operations.

Are there specifics on releases?

MR. BOWEN: No, that was it. It just, you know, there were questions about elaborations so the, and then the only specific was about the tritium.

So, just wanted to give you that opportunity to provide that clarity.

Probably the first grouping of questions we have here relates to the design basis accident for the NIST facility.

So, again, trying to combine a few here. So, is there a design basis accident scenario for the reactor, as there would be for a commercial reactor?

If so, how did this incident compare to what was considered in the design, and the licensing of the facility?

MR. NEWTON: Yes, with research reactors, the design basis is actually what's called a maximum hypothetical accident.

And, our MHA is melting of a maximum activity fuel, complete melting of a maximum fuel activity, fuel, maximum activity fuel element.

And, if you compare the doses to an MHA to what happened here, we are about two orders of magnitude, or maybe even more, below the MHA. So, we're well bounded by that.

MR. BOWEN: Let's see, one more question for you, Tom, and then we'll give you a break and I go to a couple for the NRC staff.

Let's see. Can you elaborate on the fuel latching process? Are the latch checks redundant, or are they individual?

Were visual inspections considered before the February 2021 event, and have you considered any modifications to the latching mechanism or the process?

MR. NEWTON: Okay, I'll see if I can get all those in one shot, but you'll probably have to help me.

So, latching mechanism prior to the event was a redundant, a singly redundant check of rotation using that, a high check was sort of a check but not a real, didn't meet the tech spec requirement.

The rotation check was the official check, and that was a singly redundant check. And, again as I mentioned, that was done incorrectly before. So, it contributed to the event there.

Now I've already lost the rest of the questions. Let's see. Oh, modifications.

We have looked pretty hard at modifying the mechanism by which we latch things. We're still looking at that, but we don't want to start to, you know, get to the point where we have unintended consequences and we mess something else up by modifying it. So, we're looking at that pretty hard.

But one thing to point out is that we have these new corrective actions we have. Once we put the latch in place and visually verify it, then there's no mechanism by which it will unlatch itself, or any mechanism, credible mechanism by which the fuel element can be unlatched.

So, once the visual check is in place, that's the be all end all. There's no possible way for an element to come become unlatched after that.

MR. BOWEN: Yes, on the --

(Simultaneous speaking.)

MR. BORROMEO: Can I jump in on that response, too?

MR. BOWEN: Certainly.

MR. BORROMEO: Yes, so I mean the NRC staff is currently reviewing a license amendment request that speaks directly to the latching, right?

So, we're currently reviewing the change to the tech specs, but we're also auditing the underlying procedures that are going to support those tech specs.

So, we are currently reviewing that, right, and that's definitely going to be an important change to support our restart decision.

MR. NEWTON: Thanks, Josh.

MR. BOWEN: All right, Tom, we'll give you a break and come back to you in a minute.

So, Travis, question about minimum regulations. So, folks want you to elaborate a little bit on the minimum regulation principle for non-power reactors.

MR. TATE: Okay, thanks.

So, minimum regulation in practice, I think the thing to highlight is that, that principle comes from the Atomic Energy Act.

What I'll say about minimum regulation is there are instances throughout the regulations that do not apply to research reactors, only that things are applicable to power reactors.

So, basically the minimum regulation in practice, I think is consistent with where the agency is right now. And, I think you've heard a lot if you've been participating in the RIC, about the be risk smart concept that we apply in the agency.

And, I would say in practice, minimum regulations just, they're the practice of being risk smart in the application of our regulation, which recognizes the risk associated with non-power reactors. The low risk in comparison to power reactors.

So, that's what the Atomic Energy Act is, is really getting to. And, I think the key part to remembering that is the Act does give us, the NRC, the agency, the authority to apply appropriate amount of regulation to ensure the public health and safety.

So, that's a piece that's also a part of it. So, it doesn't preclude public health and safety by applying that principle of minimal regulation.

MR. BOWEN: Okay, thanks, Travis. I think well said.

Josh, anything you'd like to add or elaborate on?

MR. BORROMEO: Maybe I'll provide an example of what I, when I think of minimum regulation.

So, for research and test reactors in renewal space, if a reactor is above 2 megawatts, right, we'll provide a higher level of scrutiny for that. If it's below 2 megawatts, we'll do a much more streamlined review, right.

So, I agree with everything that Travis said, right, there's certain regulations that do not apply to research and test reactors.

But also how we treat the relative risk in review space, for each one of these reactors also plays into the minimum regulation.

MR. BOWEN: Okay, thanks. Thanks, Josh, I appreciate that.

All right, Tom, I'll come back to you.

Couple questions about culture. You mentioned some of the root cause assessments, and the findings there.

So, I guess probably the question that summarizes a lot of the questions well was, what cultural assessment tool did you use in your corrective actions, and what was the, what were the most significant conclusions?

And, there's a couple questions about any of the reports being available asked, and that might be from some of your colleagues potentially interested in learning from some operational experience.

MR. NEWTON: Sure.

So, we're basing all our safety culture on INPO 12-012, the traits of a healthy nuclear safety culture.

We just recently finished a safety

culture survey of the staff here, to basically see how things are going. This is a baseline. Course you got to do it over time to see if things have changed.

But messages from that is we've made some progress. We see some good folks in terms of their questioning attitude, and the way they look at things, and are able to communicate up the chain if they see some issues.

We have some communications issues we still need to work through, but we're certainly making progress and I think we've made, we didn't get a culture assessment right away, but we think we've made quite a bit of progress now in that.

One of the big contributing factors to the event was experience, and the loss of experienced folks. And, as I mentioned before, inadequacy in training of folks to make sure they can do this right.

So, that's all part of our cultural shift to better train, to have better procedures, and better compliance with those procedures.

Oh, in terms of publicly available. A lot of the stuff we've submitted to NRC already which will be publicly available.

I think the reports themselves are not publicly available yet, but I'll talk to the public affairs folks just to see how publicly available they want it to be. And, if anybody needs an individual copy, just reach out to me and I can get it to you.

MR. BOWEN: Thanks, Tom.

And, Travis or Josh, maybe you all want to touch on some of the information that we received, and kind of presentations that we provided.

I know Travis, you were just presenting to an ANS conference, I believe a month or two ago. So, I think there's, you know, good across the entire nuclear industry, there's always a desire to kind of share operational experience.

So, Travis or Josh, either of you want to elaborate on that?

MR. TATE: So, I would say one of the things that the, you mentioned the ANS conference. That workshop or panel for that presentation also included a presentation by DOE related to the HFIR event that happened.

And, so that was a good opportunity to kind of share information. The NIST spoke on their activities, and the event itself, and it was a good opportunity just to share across the community, similar type events.

And, learn from what each facility involved, and the response from both the operators and the regulator, in each of those situations.

So, I think that was a good opportunity as well.

MR. BOWEN: Okay. Thanks, Travis.

So, maybe we'll go back to you, Travis. I kind of timed the last question to Tom about culture.

There is a question for the NRC staff. Since contributing factors to the event included safety culture, procedural use and adherence, management oversight, is the NRC considering any changes to the NRC's oversight and inspection program, more generically across the U.S. and test and reactor sites?

MR. TATE: So, I think it's just important to point out that the contributing factors that were discussed, were, you know, provided by NIST. And, those things are still under evaluation by the staff.

And, so we want to complete, and have a full evaluation by the staff, to assess, you know, any of our programs or anything that we could have done.

I think we continuously do that. We continuously as an agency, assess our programs, identify ways to get better. And, our plan would be to do as we currently do as an agency.

Once we get through our total assessment of NIST and what happened, we'll go back and take a look at our programs to see if there's any areas that we need to consider in our oversight.

MR. BOWEN: Thanks, Travis.

Tom, a couple questions about, similar to the questions about the reports and the availability of the reports. There's interest in seeing either pictures or infographics, or stuff like that of the damaged fuel.

Anything that you all are able to, that's out there in the public or that you're able to share, I think we might actually have some of that information, it's in the NRC's public documents. Quite honestly, I can't recall at the top of my head right now what is public or not.

But anything you're able to, any information you're able to provide on that?

MR. NEWTON: Well, we certainly shared those with NRC. I need to talk to the public affair folks here as to what they, how they want to communicate this.

It's not secret or anything, the fuel was heavily damaged. So, I think we can probably work a mechanism by which people could see that.

MR. BOWEN: Yes, and I'll, and Josh and Travis, that's something maybe we'll have to go back and take a closer look at.

I think some material we have certainly has some, if nothing else some infographics and some shots of the damaged fuel.

We'll have to confirm that that's available in the public forum for us right now. So, we can actually take that back.

Let's see. Just checking to see if there's some other questions. I think we've gotten through most of the topics.

MR. BORROMEO: So Jeremy, if you want me to touch on, I didn't get off my mute button fast enough to come in after Travis about the other presentations that we've been doing, right?

But we've been presenting internally,

externally, right, about to best of, as much as we can about the process that we're using, right. How we're coordinating our efforts, right.

In my mind, I'm thinking the next phase is like, you know, okay, we'll be able, we've gathered a lot of the information and I think in the very near future, we'll be able to provide some more concrete milestones, right, actions, right, for the NRC staff to hit, and NIST to hit, to help support our restart decision.

MR. BOWEN: Okay, thanks, Josh.

And, kind of a good more of a comment than in the questions, but relating to the minimum regulations and the connection of the safety limits between the two.

So, Josh, this might actually be a good thing for you to elaborate on as the licensing branch chief.

So, the connection that Travis was talking earlier about, the minimum regulation aspect and the fact that as part of the licensing of RTRs, that we look at establishing the safety limits and the event, and how this event was probably bounded by the design of the facility itself, so.

MR. BORROMEO: Right. So, safety limits, right are required by NRC regulation, right. So, 5036 requires each licensee (inaudible) in Part 50 to have safety limits, right.

And, I touched on this, and in NIST case it was a fuel temperature, or a cladding temperature limit was their safety limit.

With respect to MHA, right, the maximum hypothetical accident that I touched on as well, NUREG-1537, right, is the overarching guidance for licensing and research and test reactor. Outlines what research and test reactor licensees need to include, to develop these maximum hypothetical accidents that bound, you know, credible accident sequences, right.

So, you know, the 5036 right, is, requires the safety limit right, but then I think of it as going the next step down. We have NRC guidance right, to support what an appropriate maximum hypothetical accident analysis should be.

MR. BOWEN: Okay, thanks, Josh.

So, I just took another quick scan through the questions. I think we pretty much touched on every question, or the topics have come up. So, give folks one more chance if they've got another question.

And, while we're waiting on that, I do want to go back and highlight to Travis some, one thing that he mentioned in his presentation.

So, we do have the SIT inspection itself is complete and we're having a public exit with NIST next Wednesday on that. And, that will be at NRC headquarters, and there will be an option to participate in that meeting virtually.

So, the meeting itself is posted on our public meeting notification system on our, the NRC's public website.

So, I encourage folks if you are interested in hearing a little bit more about the findings from the inspection, please tune into that meeting.

And, with that it doesn't look like we've had any other questions come in. Several compliments and thanks from folks. So, echo my appreciation to you all as well Tom, Travis, Josh. Great information, great way to share the operational experience with folks.

So, continue to do so. This is not the

first time we've talked about this in a public forum, and certainly we'll continue to do so going forward.

So, thank you all again for being here today with us. Thank you all in the audience for your questions and for your participation.

And, with that we will close the session.

MR. NEWTON: Thank you.

(Whereupon, the above-entitled matter went off the record.)