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UNITED STATES NUCLEAR REGULATORY COMMISSION'S ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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REGULATORY POLICIES AND PRACTICES SUBCOMMITTEE

+ + + + +

WEDNESDAY

AUGUST 22, 2018

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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 1:00 p.m., Walter L. Kirchner, Chairman, presiding.

COMMITTEE MEMBERS:

WALTER L. KIRCHNER, Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

MICHAEL L. CORRADINI, Member

JOSE A. MARCH-LEUBA, Member

JOY L. REMPE, Member

MATTHEW W. SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

QUYNH NGUYEN

ALSO PRESENT:

ANNA BRADFORD, NRO

MICHELLE HART, NRO

ARCHIE MANOHARAN, TVA

BRUCE MUSICO, NSIR

RAYMOND SCHIELE, TVA

DANIEL STOUT, TVA

MALLECIA SUTTON, NRO

KENNETH THOMAS, NSIR

SCOTT WEBBER, NuScale

ALEX YOUNG, TVA

*Present via telephone

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P R O C E E D I N G S

(12:59 p.m.)

CHAIRMAN KIRCHNER: The meeting will now come to order.

This is a meeting of the Regulatory Policies and Practices Subcommittee of the Advisory Committee on Reactor Safeguards.

I am Walt Kirchner, the Chairman of this subcommittee meeting. ACRS members in the room are Ron Ballinger, Dennis Bley, Matt Sunseri, Joy Rempe, and Jose March-Leuba. Quynh Nguyen, who is of the ACRS staff, is the designated federal official for this hearing.

The subcommittee will hear from representatives of TVA and the staff regarding a Section 13.3, Emergency Planning, of TVA's Clinch River early site permit application and the corresponding safety evaluation.

The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate for full deliberation by the full committee.

The ACRS was established by statute and is governed by the Federal Advisory Committee Act. This means that the committee can only speak through its

published letter reports. We hold meetings to gather information to support our deliberations.

Interested parties who wish to provide comments can contact our offices requesting time after the meeting announcement is published in the Federal Register. That said, we also set aside some time for spur of the moment comments from members of the public attending or listening to our meetings. Written comments are also welcome.

In regard to early site permits, 10 CFR 52.23 provides that the Commission shall refer a copy of the application to the ACRS and the committee shall report on those portions which concern safety.

The ACRS section of the U.S. NRC public website provides our charter, bylaws, letter reports, and full transcripts of all full and subcommittee meetings, including slides presented at the meetings.

The rules for participation in today's meeting were previously announced in the Federal Register. We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting. Is that still true? Yes, okay.

We have a bridge line established -- you can hear the static -- for interested members of the

public to listen in. To preclude interruption of the meeting, the phone bridge will be placed in a listen-in mode during the presentations and maybe discussions. We will unmute the bridge line at a designated time to afford the public an opportunity to make a statement or provide comments.

At this time, I request that meeting attendees and participants silence their cell phones and any other electronic devices that are audible.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the subcommittee. The participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard. Make sure the little green light of the microphone is on before speaking and off when not in use.

Before we proceed with the meeting, we have been joined by our chairman, Mike Corradini.

Do we have Pete on the line?

MEMBER CORRADINI: He was. I do not think he is.

CHAIRMAN KIRCHNER: Okay. So at this

point, I think I can turn to Anna Bradford, who is the Deputy Director over in NRO.

MS. BRADFORD: Thank you. Again, my name is Anna Bradford. I am the Deputy Director of the Division of Licensing, Siting, and Environmental Analysis in the Office of New Reactors.

This morning, you heard from the staff on a proposed rule for emergency planning for small modular reactors and other new technologies. In the SRM for SECY-15-0077, the Commission directed the staff to use its existing exemption processes with changes to emergency planning zone sizes, where requested by an applicant prior to the rule being completed.

This afternoon, we will discuss an exemption request from the TVA Clinch River Nuclear Site that was reviewed against the current regulations and guidance.

The TVA early site permit application includes a proposed methodology that, if approved, could be used by a future combined license applicant to establish a plume exposure pathway emergency planning zone at the site boundary or a plume exposure pathway emergency planning zone with a two-mile radius if certain conditions are met. If these exemptions

are approved as part of the ESP, they will be accompanied by permit conditions specifying the circumstances under which they can be used by the combined license applicant.

As you will hear, the NRC staff evaluated TVA's proposed methodology for determining a plume exposure pathway emergency planning zone, the proposed major feature's emergency plans, and the associated exemption request to determine whether they would be protective of public health and safety.

It is important to note that the plume exposure pathway emergency planning zone size itself for the site will not be finalized in the early site permit, if approved. The appropriate plume exposure pathway emergency planning zone size for the site will not be determined until a combined license application that references a specific small modular reactor design is submitted and reviewed for the Clinch River Nuclear Site.

Separately, other subcommittee meetings on the other chapters of the safety evaluation report for the early site permit application are currently planned for October 2018 and our goal is to have the ACRS full committee in November or December of 2018.

I will now turn the presentation over to

TVA. Thank you.

MR. STOUT: Thank you, Anna.

So on behalf of TVA, I want to thank you for the opportunity to come and present. I'm Dan Stout, Senior Manager, Small Modular Reactors for TVA. I've been working in the nuclear business for about 33 years at TVA, managing SMRs for about six years.

I also have Archie Manoharan and Alex Young, who are going to cover part of the presentation. Ray Schiele, to my left here, is our Licensing Manager. And we have a number of TVA employees and contractors able to support.

I do want to make the point that protecting public health and safety is our highest priority and we take our responsibility with respect to emergency preparedness very seriously.

Here on slide 2 I want to acknowledge the Department of Energy is a partner in the work that we do. They not only support us in terms of programs and resources, but they have been reimbursing roughly 50 percent of our costs in the work that we're doing. Nevertheless, the views that are expressed are TVA's alone.

Slide 3: The work that TVA is doing on small modular reactors and on emergency preparedness

is consistent with TVA's mission to make life better for the people in the Tennessee Valley by providing safe, clean, affordable, and reliable electricity. Nuclear energy, in general, is important to our environmental stewardship and economic development missions.

TVA provides electricity to 154 local power companies who serve the 900 -- I'm sorry -- nine million customers of the Tennessee Valley throughout about seven states. We also directly serve 54 industrial customers and that includes the Department of Energy.

Slide 4: TVA's nuclear fleet generates roughly 40 percent of our electricity. We have seven nuclear units at three sites: Browns Ferry, a three-unit plant in Alabama; Sequoyah and Watts Bar, both two-unit plants in Tennessee.

The blue star in this figure is located on the Watts Bar Reservoir and the nearest large city is Knoxville. It is actually within the city limits of Oak Ridge in Roan County, Tennessee.

On slide 5 I have a high-level overview of the NRC review schedule. I wanted to provide this to give you the frame of reference of where we are. We submitted the application in May of 2016. It was

accepted at the end of 2016 and in March 2017, the NRC issued its review schedule. One of those milestones is the ACRS review March 26, 2019.

We have completed one subcommittee meeting. This is the second. We anticipate one or two more and then hoping that the full committee meeting is in advance of that milestone date.

The second line down shows environmental review. The NRC's published schedule calls for the final EIS in June of 2019. The NRC did issue the draft environmental impact statement about five weeks early. We're hoping that that trend continues there as well.

Moving down to the last row is the hearings. And a point of note on July 31st, the Atomic Safety and Licensing Board dismissed the last contention, denied two others that were proposed, and terminated the contested hearing.

Slide 6.

MEMBER CORRADINI: So the hearings are concluded?

MR. STOUT: The ASLB has terminated the contested hearing. There will be a mandatory hearing after the NRC concludes the final safety evaluation report.

MEMBER CORRADINI: Okay, thank you.

MR. STOUT: So now I turn to the development of the early sit permit application and emergency preparedness content, in particular.

TVA used a plant parameter envelope in formulating the early site permit application, consistent with 10 CFR Part 52 and it's based on the design information that was supplied to us from the four light water small modular reactor designs under development at that time. Those include NuScale, Holtec, mPower, and Westinghouse.

Now TVA has not selected a design for the Clinch River Site yet. That is something that is necessary for future licensing action in the COLA. These new designs do include significant advances in safety, such as smaller source terms from postulated accidents, slower accident progression, and more reliance on passive safety features. With this in mind, TVA developed a dose-based consequence-oriented approach to determine the EPZ size, which considers the unique design and safety features of the SMRs.

NUREG-0396, which introduced the concept of emergency planning zones is about 40 years old. TVA's approach to determining the EPZ size uses the same dose criteria as the NUREG. The approach that we

have proposed does not ask for a change or an exemption from this dose criteria. The dose criteria is based on the EPA protective action guidelines: one rem.

TVA's approach is also consistent with SECY-15-0077, where the staff proposed a consequence-based approach. TVA analyzes a spectrum of accidents, both design basis and beyond design basis, and considers defense-in-depth to ensure public health and safety protection at the EPZ boundary.

We're applying more precise analysis to ensure that public dose is below the dose limits at the EPZ boundary. The establishment of a site boundary or two-mile zone remains the same basis for level of protection as an existing ten-mile zone provides for operating plants.

So as TVA evaluated the design information from the four SMR designs, we concluded that it was likely that all four would be able to meet the dose criteria at a two-mile radius and at least one would be able to meet site boundary, which is roughly 1,100 feet.

So TVA developed two distinct major features emergency plans and included them in the early site permit application and sought NRC's review

and approval of both. There remains this additional licensing step at COLA phase, where a specific design must be selected and analyzed. In that potential future licensing step, TVA could include one of these two major features emergency plans if the detailed analysis confirms their applicability that the public dose is below the dose limits.

MEMBER CORRADINI: So if I might just clarify, you used information from the four candidates to help define the two miles, or you had defined the two miles and you did some sample calculations, or are we going to get into that?

MR. STOUT: It's more the former. We looked at the information that we got, made a determination that two miles ought to be sufficient.

MEMBER CORRADINI: Okay.

MR. STOUT: Two miles is essentially a surrogate for scalable. That's kind of how we viewed it. We think that so by having approval of it, let's suppose in the COLA phase we end up determining, through analysis, that we reach the PAG at one mile. Well, we can't use site boundary. We have to use two-mile. So that's how it would work.

Last --

MEMBER BLEY: And that's all based on a

single module.

MR. STOUT: No, we considered both design basis and beyond design basis. Multi-module would be in the design basis phase.

MEMBER BLEY: Okay and you still come up -- okay.

MEMBER CORRADINI: Well I guess that leads me to the non-bulleted sub thing, which is combined nuclear generating capacity for Clinch River Site is not to exceed 800 megawatts or 24 --

So you took combinations that would look as large of a thermal output and an associated source term as that limit? That's I think where --

MR. STOUT: So we have a number of detailed slides and we're going to walk through the methodology --

MEMBER CORRADINI: Okay.

MR. STOUT: -- and we'll provide an example calculation for information.

MEMBER CORRADINI: Okay, thank you.

MR. STOUT: All right. So with that, consider this as all background. Now, let's jump into the details of TVA's emergency preparedness content in the ESPA. And I'm going to turn it over to Archie.

MS. MANOHARAN: Thank you, Dan.

Good afternoon. My name is Archie Manoharan. I have been part of the licensing team at TVA's Clinch River as the mod project for over a year. Prior to that, I've been in licensing for over ten years. And thank you for having us and giving us this opportunity to present today.

As Dan said, we would like to present details of the emergency preparedness information in the application -- in the early sit permit application. I would first like to begin with an outline of the presentation we have for you today.

To fully understand the emergency preparedness approach for a small modular reactor at the Clinch River Site, information in three parts of the application needs to be considered. Today we are going to discuss and present information from Part 2, the Site Safety Analysis Report, and Part 5, Emergency Plan, Part 6, Exemptions and Departures.

Specifically in Part 2, in Section 13.3, Emergency Preparedness Information and Section 13.3.3, which discusses the dose-based consequence of methodology that Dan had alluded to in the slide before.

This methodology and the small modular reactor design features are the basis for the

emergency preparedness approach that we are proposing in the application. Based on this methodology, two distinct emergency plans have been put together in Part 5. In Part 5A, major features of an emergency plan that would support a site boundary EPZ are discussed. In Part 5B, major features of an emergency plan for a two-mile EPZ are discussed.

As Dan already mentioned, an SMR design for the Clinch River Site has not been selected yet. So in Part 2, we are seeking review and approval of the methodology and in Part 5, we are seeking review and approval by the staff of the major features of these emergency plans.

In a future COLA, once the reactor design -- once a small modular reactor design has been selected, the dose-based methodology will be implemented to show that the dose criteria is either met at site boundary or two-mile. If it's met at site boundary, then the Part 5A emergency plan, major features emergency plan, will be utilized to create a complete and integrated emergency plan and COLA. If the dose criteria is met at two-mile EPZ, then the Part 5B major features emergency plan will be utilized to create a complete and integrated emergency plan in COLA.

To support the information in Part 5, a set of exemption requests have been described and submitted in Part 6 of the ESPA. We will go over these in detail in the next slides. But just to avoid any potential confusion, unless stated otherwise, the terms emergency planning zone, EPZ, refers to plume exposure pathway emergency planning zone. We will try our best to use the entire term but when we say EPZ, we are referring to plume exposure pathway.

Next slide, please.

MEMBER SUNSERI: Archie, could I ask you to move your microphone a little closer?

MEMBER CORRADINI: Yes, can you repeat what you just said at the end? I didn't catch it.

MS. MANOHARAN: Oh.

MEMBER CORRADINI: And closer still for your mike.

CHAIRMAN KIRCHNER: Thank you.

MS. MANOHARAN: To avoid any potential confusion, we are going to -- the terms emergency planning zone or EPZ, when we use those terms, we are referring to plume exposure pathway emergency planning zone.

MEMBER BLEY: Not ingestion.

MS. MANOHARAN: Not ingestion and my next

slide explains why.

MEMBER BLEY: Okay.

MS. MANOHARAN: So in the course of the staff's review of the emergency preparedness information in our application, several requests for additional information were issued. You see a few listed here. In addition to the two that are listed, RAI-9227 was also issued earlier this year, which is not listed on this slide. But as a response to that additional RAI, we withdrew our request for ingestion exposure pathway exemption requests. And, therefore, EPZ refers to plume exposure pathway.

Two audits were held to review the dose-based methodology described in Section 13.3 and also focused on reviewing the example analysis that was conducted by TVA to show that the dose criteria can be met at Clinch River Site boundary. Alex Young is going to walk through the example analysis in a few slides.

Starting with our information in Part 2, Section 13.3.1, Physical Characteristics, this section describes information concerning site description and area population. As the figure here illustrates the site vicinity, you can see the Clinch River Site in the central of the figure there north of Interstate I-

40. The Interstate I-40 is located about a mile away from the site. The gray shaded area to the northeast of the site is the DOE Oakridge Reservation. And two towns are visible in this figure, Kingston to the west about 6.8 miles away, and Lenoir City to the southeast about 8.8. miles away.

Next slide.

MEMBER CORRADINI: So is there where Clinch River Breeder Reactor, is that the same site we're talking about?

MS. MANOHARAN: That's it.

MEMBER CORRADINI: Okay. So this is irrelevant but curiosity. So when CRBR was being considered, what was their emergency planning zone? It was only 40 years ago. I don't see what's the problem.

MR. STOUT: I don't know.

MEMBER CORRADINI: Yes? Oh, they submitted to the NRC. Okay.

And then the second part of it is, if you're within the EPZ -- if your EPZ is within -- I can't remember the distance -- 1200 feet, it's all within the red.

MR. STOUT: Yes, sir.

MS. MANOHARAN: That's correct.

MEMBER CORRADINI: And just for the sake of thinking it through, what is two miles from the red dot -- the red star?

MS. MANOHARAN: I have a slide that is coming up that actually shows the exact size.

MEMBER CORRADINI: Okay, fine. All right, sorry.

MS. MANOHARAN: So that will answer that question.

MEMBER CORRADINI: Okay, thank you.

MS. MANOHARAN: Okay. Section 13.3.3 in Part 2 describes a dose-based consequence or entered methodology for determining an appropriate EPZ size for a small modular reactor at the Clinch River Site. This approach, this methodology uses the same approach and is consistent with the NUREG-0396 approach.

NUREG-0396 provided a basis for federal, state, and local government agencies preparedness organizations to determine the appropriate degree of emergency response planning efforts in the area surrounding a nuclear power plant. The report introduced the concept of a generic EPZ as the basis for planning of response actions which would result in a dose savings in areas surrounding a nuclear plant in case of a serious reactor accident.

The NUREG concluded that the objective of an emergency plan -- emergency response plan should be to provide dose savings for a spectrum of accidents that could produce offsite doses in excess of protective action guides, PAGs.

Consistent with this recommendation, the dose-based methodology that is described in the ESPA analyzes a spectrum of accidents and uses the same dose criteria that is used in NUREG-0396, which is the one rem total effective dose equivalent limit established in the EPA PAGs.

What the dose-based methodology does is take into consideration the unique SMR design features which vary significantly from large light water reactors. For example, SMRs have smaller cores. Their source terms are expected to be several magnitudes lower than large light water reactors, which results in reduced accident consequences, as demonstrated in the example analysis that we'll go over in a minute, and also are expected to have reduced likelihood of accidents. Their core damage frequency is expected to be several magnitudes reduced, compared to large light water reactors and also are expected to have slower accident progression, which allows for more time to take mitigative actions.

Next slide.

CHAIRMAN KIRCHNER: This may be, on my part, maybe just quibbling with the words in the previous field graph that rigorously, it doesn't ensure protection for doses above one rem. The one rem is the trigger point to start your emergency planning. And that's no guarantee that it's less than one rem exposure. That's the intent.

So it's more trigger than it is -- and it's a measure to protect the public against dose aversion but it's not a guarantee that a member of the public wouldn't get 1.5 rem or whatever total dose, right?

MS. MANOHARAN: Yes.

CHAIRMAN KIRCHNER: Okay.

MS. MANOHARAN: The intent of that supplement was to show that we are using one rem TEDE. But I do -- your point is noted. Thank you.

Next slide, please.

The technical criteria for determining a plume exposure path for the EPZ has three criteria, A, B, and C.

Criterion A encompasses those areas in which projected dose from design basis accidents could exceed EPA PAGs. Criterion B encompasses those areas

in consequences -- for which consequences of less severe core melt accidents with intact containment could exceed the EPA PAGs. For C, it ensures that this EPZ is of sufficient size to provide substantial reduction in early severe health effects in the event of severe core melt -- in more severe core melt accidents with containment by this failure.

Next slide, please.

MEMBER MARCH-LEUBA: Tell me what a less severe core melt is. I mean on B, you said the consequences of a less severe core melt accident.

MS. MANOHARAN: Yes.

MEMBER MARCH-LEUBA: What is that?

MS. MANOHARAN: So the less severe core -- just one second here. Yes, so the accident scenarios would include core melt accidents with intact containment beyond design basis scenarios and accident scenarios with core damage frequencies greater than 10 to the negative six, which I will explain in the next --

MEMBER MARCH-LEUBA: You'll explain later?

MS. MANOHARAN: Yes.

MEMBER MARCH-LEUBA: I'll wait.

MS. MANOHARAN: And there is a distinction between each of them, which we will go over.

MEMBER BLEY: So there is both a frequency component to this and it is a contained melt.

MS. MANOHARAN: That is correct.

MEMBER CORRADINI: Did you really want to say yes to that? In other words, you're assuming at all times the containment is intact? Because I got the impression you're looking for the collection, I thought the collection of sequences that are both for intact containments, which might have an unphysically -- I'll use the word unphysical -- a prescribed source term with an intact containment as well as PRA sequences that would have a variety of source terms but the containment could be bypassed.

MEMBER BLEY: It has the frequency element on it, right?

MR. YOUNG: So I'd just like to clarify. The criterion B portion, the less severe core melt accidents is only looking at the intact containment.

MEMBER CORRADINI: Okay.

MR. YOUNG: The containment failure bypass is handled in criterion C, which is the early severe -- or the more severe core melt accident.

MEMBER CORRADINI: Okay, that's fine. And then I thought you had said, I want to make sure, that you have a frequency cut-off.

MS. MANOHARAN: Yes, which is coming up in the next slides.

MEMBER CORRADINI: Okay, fine. Thank you.

Okay, so we are at the frequency cutoff slide, so the criterion A and B methodology implementation. To verify that the dose consequences beyond the EPZ do not exceed the EPA early phase PAGs, the methodology starts with selecting appropriate accident scenarios. The accident scenarios would mean core damage frequency of 1E to the negative 6 per reactor year is being selected.

Based on the accident scenarios that I've selected, the source terms I calculated and the dose consequence for the selected accident scenarios are evaluated.

MEMBER BLEY: Now you're in category C, right?

MS. MANOHARAN: This is still 1E to the negative 6 per reactor year and then intact containment. So we are in --

MEMBER BLEY: Oh, so you're still in B.

MR. YOUNG: Yes, so the blue box is important.

MS. MANOHARAN: Yes, so we group A and B together and this slide discusses how criterion A and

B are evaluated. The next slide talks about how criteria C is evaluated.

MEMBER CORRADINI: And then -- okay. I'm not sure how to ask the question so let me ask it this way.

So you're assuming that the containment is intact during these -- in criterion A and B, regardless of the accident sequence or is it interwoven with the sequence itself tells you whether the containment is in or out?

MR. YOUNG: The latter.

MEMBER CORRADINI: The latter.

MR. YOUNG: So if it meets the cutoff frequency we've established here, we're only looking at those accidents that are intact containment that meet this cutoff frequency.

MEMBER CORRADINI: Okay. So my second part of the question is where did you get 10 to the minus 6 mean? Because as you get to these -- I'm waiting for Dr. Kirchner to say this but I'll steal his thunder. The uncertainty is such that is mean the right value? Is 10 to the minus 6 with the mean the right? Why? Why 10 to the minus six? Why mean?

MR. YOUNG: Sure. So the main core damage frequency cutoff criteria we've established for

criterion B and C is established by a significant amount of industry documentation. A lot of that industry documentation identifies E to the minus 6 as a point that most accidents are encompassed by that. An example of that would include the SOARCA analysis.

MEMBER CORRADINI: Yes, well, don't point to them. I'm looking at our resident PRA expert because that surprised me.

MEMBER BLEY: I don't quite get this. If you've done a PRA, if you had a plant, there are a great many accidents at lower frequency and, depending, some or a lot above this. I don't quite understand it.

MEMBER CORRADINI: But you put everything -- I guess what I'm trying to understand is you put everything into two baskets. First, regardless of the basket, you're only looking at things that pop at 10 to the minus 6 or larger. And then, depending upon the sequence, if the containment fails or not fails, you have it in two bins.

MR. YOUNG: And so if the containment fails, it would not be considered in the criterion B greater than 1E-6. We have a cutoff frequency that is further down line for criterion C. So if you did have a cutoff frequency, you would have to evaluate that in

criterion C.

MEMBER CORRADINI: Okay, I think I got it.

MS. MANOHARAN: So the very last step in the methodology, implementation for criteria A and B is to take the dose consequences calculated and compare them to the EPA early phase PAG to ensure that they are not exceeding.

So next slide, Criterion C. So EPZ should be of sufficient size to provide substantial reduction in early severe health effects in the event of a more severe more melt accidents with intact containment.

So the first three steps are similar to criteria A and B in that appropriate accident scenarios, as selected, the cutoff here is mean core damage frequency greater than 1E to the negative 7 per reactor year. And source terms are calculated for the selected accident scenarios and dose consequences from those were evaluated.

There are two additional steps in criterion C, which is to calculate the distance at which the conditional probability to exceed 200 rem whole body exceeds 1E to the negative 3 per reactor year, consistent with the basis provided in NUREG-0396 and, finally, to compare the distance to the EPZ to ensure that it is of sufficient size.

Next slide, please. I would like to turn it over to Alex Young, who is going to walk through the example analysis that was conducted as a result of an RAI request.

MR. YOUNG: Thanks, Archie. My name is Alex Young. I'm part of the engineering team working design engineering for the Clinch River project for TVA. I've been working on this project for about four years now.

Over the course of the review, one of the things that was requested of TVA was for us to provide some additional information that demonstrates that the methodology we've just described can be implemented and that the criteria for both the EPA early phase PAG limits and the substantial reduction early health effects can be met by an SMR design considered in an OSI permit application.

To demonstrate this methodology, Clinch River Site-specific example calculation was performed. At the COLA, the applicant will still need to perform an evaluation of whichever design is chosen for COLA. This is just an example to demonstrate the methodology.

This example calculation utilizes a NuScale design that is assumed to be sited at the

Clinch River Site. So we used NuScale-specific design information like PRA and source terms and applied it to Clinch River Site's specific information like meteorological data and conservative assumptions like the 1,100 foot distance from release boundary to site boundary.

To summarize the evaluation, we start with criterion A, looking at design basis accidents. We utilized the design basis source term determined in NuScale's Chapter 15 of their design cert to calculate a dose of 0.104 rem and that leaves a significant amount of margin compared to the one rem limit that was established.

And we after we evaluated the design basis accidents, we considered the less severe core melt accidents, which are those of the criterion B evaluation. For this criterion, we look at accident scenarios with the main core damage frequency greater than the 1E minus 6 and they have intact containments. But for the NuScale design, there are no accident scenarios that meet this cutoff frequency.

However, there is a note in our methodology that if no accidents meet that cutoff frequency, we will develop a surrogate source term and analyze that source term to the limits.

MEMBER BLEY: What kind of -- sorry, go ahead.

What kind of guidance have you given yourself on how you define a scenario? A clever analyst can break up the scenario into many sub-scenarios, each one of which has a lower frequency. So what kind of rules do you have to make sure these 10 to the minus 6 and 10 to the minus 7s are meaningful?

MR. YOUNG: Sure so I'll start by making a statement and then I'll hand it over to help from Scott Webber, who can give some more detail about how we did that in our example analysis.

But we look at various timing aspects and equipment availability aspects.

MEMBER BLEY: So you may be grouping things from a PRA --

MR. YOUNG: Yes.

MEMBER BLEY: -- or from higher level set that have to meet these criteria?

MR. YOUNG: Yes. And it would be design-specific. Scott can speak to how we handled this in the example.

MEMBER BLEY: Okay.

MR. WEBBER: I'm Scott Webber, PRA Group

at NuScale responsible for severe accidents and emergency planning zone.

So towards what Alex was saying, in the example work that was done here, there was no need to distinguish between accident scenarios and accident sequences because the as-submitted NuScale PRA has a total CDF that is below the screening limits. And so the question of --

MEMBER BLEY: Does that include external events --

MR. WEBBER: That's correct.

MEMBER BLEY: -- and fires?

MR. WEBBER: All PRA that was part of NuScale's design certification is included and that's everything -- external events, internal, except for seismic, which was not required at that time.

So the total core damage frequency is greater -- sorry -- less than the screening limits and, therefore, the grouping of accidents is redundant.

MEMBER REMPE: Okay, I got confused in your response. You said you did include external events but then you said excluding seismic. Is that what you said? So how could you do that?

MR. WEBBER: Right so the seismic PRA is

not required for design certification PRA.

MEMBER REMPE: Okay.

MR. WEBBER: And so there is no seismic here available at this time.

MEMBER REMPE: Okay.

MEMBER CORRADINI: So I'm waiting for other people to ask the question but I'm the least competent.

So what did you pick to get 0.158?

MR. YOUNG: Sure so as we will continue on in the slides, we will get to that point.

MEMBER CORRADINI: Okay. And then let me make sure I understand. So bin A is design basis accidents that are Chapter 15 related and with containment intact. And based on that collection, you got a number. And then B, there was an empty set. So you assumed something and got a number.

And C was an empty set?

MR. YOUNG: Sure, so --

MEMBER CORRADINI: They never broke containment?

MR. YOUNG: So there are -- well, we'll cover C here in just a second about how we exclude that one. I would first like to cover the what accident was selected for B.

MEMBER CORRADINI: Okay.

MR. YOUNG: So as we mentioned for criterion B, there were no accidents that SCRAMed in, based on the cutoff frequency we said but we are going to evaluate a surrogate source term. The source term we evaluated is the most frequent accident that is used to develop the Chapter 15 design basis source term for the NuScale design.

Utilizing that source term from that accident, that event, we determined the 0.158 rem.

MEMBER CORRADINI: What was that sequence? What was the event?

MR. YOUNG: Sure. So the sequence is a loss of DC power with an ECCS failure. To give you -- it is several orders of magnitude below what the cutoff frequency is.

MEMBER MARCH-LEUBA: And it results in core melt?

MR. YOUNG: I'm sorry?

MEMBER MARCH-LEUBA: You end up having a core melt?

MR. YOUNG: It does result in core damage.

MEMBER MARCH-LEUBA: Core damage? How severe?

MR. YOUNG: Scott, can you speak to how

severe the core damage is on that accident?

MR. WEBBER: The severity of the accident is somewhat of a vague definition. There is a core damage threshold that the PRA Group uses, which is a peak cladding temperature of 2200 Fahrenheit that is reached in all portions of the core.

MEMBER MARCH-LEUBA: A hundred percent of the core --

MR. WEBBER: Exceeds --

MEMBER MARCH-LEUBA: -- exceeds the 2200 --

MR. WEBBER: -- the peak cladding temperature.

MEMBER MARCH-LEUBA: So this is a complete meltdown.

MR. WEBBER: Well based on the NuScale design, it is not -- it does not necessarily melt.

MEMBER MARCH-LEUBA: But your initial do cladding.

MR. WEBBER: There is definitely fuel failure and relocation of fuel. Melting is a sort of variable, depending on the amount of cooling in the scenario.

MEMBER MARCH-LEUBA: So the oxide doesn't melt but all of the cladding disappears.

MR. WEBBER: There is significant oxidation in the fuel relocation, yes.

MEMBER CORRADINI: So now let me ask the question that I've bene waiting for.

If I put the alternative source term up with categories in terms of the seven radiological groups and then I have the timing, there is a conical graph of that, and I put your source term up and mapped it into that, what would it look like? Because I assume this is much smaller than the alternative source term on the percentage basis of the core.

MR. YOUNG: Which -- what are you asking is smaller?

MEMBER CORRADINI: If I take NUREG-1465, which is the alternative source term, it has categories in terms of halogens, alkaline metals, blah, blah, blah, and then it has timing -- when to release gap release in-vessel, ex-vessel, et cetera.

I'm kind of curious if you've mapped in the source term you used based on the discussion we just heard, that comparison.

MR. YOUNG: I'll point to Scott to talk about the specific source term and how that compares.

MEMBER CORRADINI: Do you have a slide somewhere that we could look at or something we can

read later?

MR. YOUNG: We don't provide -- in this presentation, we don't provide the specific source term for this. That would be NuScale proprietary.

MEMBER CORRADINI: Ah.

MEMBER BLEY: We might see it in our review.

MEMBER CORRADINI: Okay. Okay, that's fine. That's good enough for the moment.

MS. MANOHARAN: I wouldn't say that there is an RAI response that has the source term information. It is NuScale proprietary, so it was treated appropriately.

MEMBER CORRADINI: Okay so then we'll turn to the staff and ask them. Thank you.

CHAIRMAN KIRCHNER: Now just to clarify for the record, A on this slide and B both assume that the containment leaks at the design leakage rate. Is that correct?

MR. YOUNG: Yes, so the leakage rate for A would be based on the assumptions in the NuScale Chapter 15 analysis.

CHAIRMAN KIRCHNER: Sure. Right. Right.

MR. YOUNG: And the way NuScale has specifically analyzed those accidents, those will be

reviewed in more detail at the COLA stage or during the design certification.

CHAIRMAN KIRCHNER: Sure. An B, the same assumption for containment performance?

MR. YOUNG: Scott, can you speak to containment performance for criterion B in the leakage rate?

MR. WEBBER: You were right, Alex, the tech spec leakage is assumed for both.

CHAIRMAN KIRCHNER: For both. That's what I assumed.

Then -- well, this is not a review of NuScale. So perhaps going into it in detail is not appropriate. But I'm just looking at the ratio of the numbers from A to B.

A suggests and I'll just guess it's some kind of LOCA kind of event or equivalent. I wouldn't expect complete core failure. And that number is 50 percent higher for B. So it doesn't suggest that you've lost the entire core. I just was a little concerned, for the record, and I don't have enough information to back up my intuition.

MR. YOUNG: So I'd like to clarify that the criterion A design basis accidents is based on NuScale's Chapter 15 --

CHAIRMAN KIRCHNER: Right.

MR. YOUNG: -- which is based on a spectrum of accidents and not just a single LOCA event.

CHAIRMAN KIRCHNER: Okay.

MEMBER MARCH-LEUBA: Now is the related Chapter 15 accident analyzed in the results in core failure?

MR. YOUNG: I'm sorry.

MEMBER MARCH-LEUBA: In any Chapter 15 event results in cladding damage?

MR. YOUNG: Not for NuScale.

MEMBER MARCH-LEUBA: Then why is it not zero?

MR. YOUNG: I'll let Scott answer the question on NuScale's Chapter 15 analysis.

CHAIRMAN KIRCHNER: Okay, sure.

MR. WEBBER: Yes, so as has been stated, the NuScale analysis is an example based on best available. But as of the design that has been submitted, there is no fuel failure in any design basis events for the NuScale design. So, therefore, for the purposes of design basis source term to be used for siting and other purposes, it was necessary to already go beyond the design basis. So NuScale has

come up with what is called a design basis source term, which is based on a set of five beyond design basis accidents that include both LOCAs and losses of power.

And so the design basis source term, which is used for criterion A as a surrogate of all those sequences that incorporates worst timing and new releases.

MEMBER MARCH-LEUBA: I understand what it is. I don't know why you did it. I mean it should be sealed.

CHAIRMAN KIRCHNER: Okay, you may proceed.

MR. YOUNG: Okay, moving on to the criterion C portion --

MEMBER MARCH-LEUBA: Sorry. Is this for one NuScale module or 800 megawatts electric worth of emollients, which of the two?

MR. YOUNG: This is for a single NuScale module.

MEMBER MARCH-LEUBA: So no need to put failures.

MR. YOUNG: No, not for this analysis.

MEMBER MARCH-LEUBA: But see if you have a full plant, you will have two of those and then you will be over one.

MR. YOUNG: Well the multi-module question will be addressed in the specific PRA results of the design that is chosen at COLA.

For this analysis, using the NuScale plant at this time, multi-module events were not -- were below the threshold for consideration in the analysis.

MEMBER MARCH-LEUBA: So was this one.

MR. YOUNG: But criterion A is based on a Chapter 15 analysis. So and NuScale considered the design basis source term in their Chapter 15 analysis. We used that for the example calculation.

MS. MANOHARAN: Maybe I didn't provide a little bit of context. We did the example analysis as the result of an RAI that asked us to demonstrate that the methodology can be implemented and dose criteria can be met. NuScale being the only SMR design available to us with the design certification application that is in review with the staff and the design maturity enough for us to go and use them for this example. That was the intent of this example analysis, to show that those criteria can be met.

MEMBER MARCH-LEUBA: Okay, so we assume that there was 100 percent fuel failure of all the cladding in which 2200 Fahrenheit. And it is robbing oxidation of everything and the whole things goes to

the bottom of the core.

The containment remains closed. How did you get any releases?

CHAIRMAN KIRCHNER: In design basis leak rate -- tech spec leak rate of containment would give you --

MEMBER MARCH-LEUBA: For NuScale?

CHAIRMAN KIRCHNER: Sure.

MEMBER MARCH-LEUBA: Well the first thing to do is depressurize. There is no leakage. I guess this is another possibility approximation.

MR. YOUNG: So moving on to criterion C, this is the evaluation of the substantial reduction in early health effects. When we performed the accident screening, there were no accident scenarios for the NuScale design with the main core damage frequency greater than 1E minus 7.

MEMBER BALLINGER: Let me pull the string a little bit more from Jose's. If you have 100 percent of the fuel -- of the cladding oxidized, what is the pressure inside that vessel?

MS. BRADFORD: Can I -- this is Anna Bradford from NRO. We're in a little bit of a gray area here because we are not talking about the NuScale design today. We will be coming to you with the

NuScale design certification SE in the future, where we can get into these details. But TVA is not the designer of NuScale. They used some of NuScale's design information because we asked for details to show that this was even possible, given possible designs. You know show us that such a thing could even occur.

So I just don't want TVA or maybe even NuScale, who is I guess accommodating here today, to have to get into the details of what was assumed in the design by the designer because they are not the designer.

You will be seeing that in the future when we come to ACRS with those details and with our analysis of those details.

MR. YOUNG: So criterion C, no accident scenario screened in based on the cored damage frequency of 1E minus 7 and, therefore, there is no dose evaluation for criterion C.

All this is to say that we met the criterion A and B EPA early phase PAG dose limits and did not screen any accidents for consideration in criterion C. All this evaluation concludes that a site boundary EPZ is possible at the Clinch River Site.

Next slide.

CHAIRMAN KIRCHNER: Okay, mindful of Anna Bradford's comments that this is not a NuScale review, but let me just -- so let's neutralize that.

Say you put the source of this number aside. Multiply this number by the number of modules that you might have and then, as was pointed out by one of my colleagues, then you're above the one rem trigger point.

So how do you plan going forward to deal with the multi-module issue or you believe that you can convince the staff that in PRA space, common mode, common cause failure wouldn't require you to take all X modules into consideration?

MR. YOUNG: So I'll say that our methodology would consider multi-module events. The inclusion of multi-module events is a design-specific consideration that at COLA will be evaluated for the particular design chosen.

So if we choose a particular design where multi-module events need to be considered, those will be considered in the methodology.

MEMBER REMPE: That's your hope is that it will fall below the frequency is what I would guess.

MS. MANOHARAN: Yes, if the dose -- if I

could just add to that point, if the dose criteria is not met at site boundary, then we would not be able to use site boundary. That's why there is a two-mile emergency path. We definitely wanted to move that boundary and have some confidence that at least one reactor design would meet it.

MEMBER REMPE: And again, I am kind of coming to this without the background because I'm not inside the subcommittee but this A and B is a little misleading because the staff asked you to do it. But I'm guessing that if you really had picked the NuScale design, you'd say hey, no, I'm not going to do this because it all falls below, right?

MR. YOUNG: Well, just to clarify that point, criterion B, whether anything screens in or not, requires us to evaluate a surrogate source term and come up with a perspective dose.

For criterion A, that would be very technology-specific because our methodology requires us to consider the same evaluation that the design would consider in their Chapter 15 of their design cert or equivalent.

MEMBER REMPE: If they can't get a dose in any other design basis accidents, then you'll put a big zero there.

MR. YOUNG: Yes. If the --

MEMBER REMPE: Which means no circulating release or whatever but, yes.

MR. YOUNG: If the design could prove that the accident did not have to consider those design basis accidents and the equivalent, those would be zero and we would put a zero there.

Moving on to the next slide, so we just discussed the example analysis that we performed. In addition to this, we established an EPZ plant parameter. This is separate from the plant parameter envelope described in Chapter 2 of the site safety analysis report. It is specific to the EPZ exemption request. It does not apply to the rest of the site safety analysis.

This is used to demonstrate or to ensure that the exemption request would be applied appropriately in the future at COLA. Even though this is not an EPZ plant parameter envelope, as in Chapter 2, it would be applied very similarly in that at COLA we will have to evaluate to ensure that the selected design is bounded by the source terms established in this plant parameter.

MEMBER REMPE: Well I have questions about this, too. First of all, from this morning I asked a

lot of questions about this four-day thing. And I was told after the meeting this morning it's a rolling four-days. It shouldn't be at t equals zero, which wasn't conveyed this morning.

Is your thing going to be a rolling four-day, as long as there is a release?

MR. YOUNG: So the way we look at the 96-hour period is we look at from the start of release, not the start of accident. So different accidents may have different release timings.

So we start at the release time, not at the accident start time. So we consider the initial part of the release.

MEMBER REMPE: If I had a plant that had a circulating release and they vented, and then they managed to keep the core damage going for another 95 or 97 hours, and then they had core damage and, kaboom, a lot of stuff came out, that's you know, again, at the worst four hours would be start after the event and do it later. So that's something.

And I would think, Ken Thomas, if he's still here, can elaborate on this because if it is the worst four days, then that won't work if you do it at t equals zero. You should pick the most severe four days is what you said is in the regulation and it was

just what was in the draft rule was incorrect.

MR. THOMAS: So this is Kenny Thomas from NSIR DPR, technical aid for this morning's discussion. It's not in the current rule. That is part of the confusion that we had this morning is what is the necessary intent of the 96 hours.

So the 96 hours is an homage to the four-day integrated dose and that's ongoing from the point of when you start doing your dose projections you start looking at what is the consequence impact to the public and do you exceed one rem forecast over the next 96 hours for the release and so forth.

So that is not in the current rule. It is not in the guidance and it's one of the points of confusion that we had this morning.

MEMBER REMPE: What is the legal requirement for what they are doing? Do they have to pick the most severe four days of a release so that you can let the circulating release go on and then start timing when you have the most severe? What is the current requirement?

MR. THOMAS: Well, with respect to my rule, it is not in it.

MEMBER REMPE: Not in your rule. That's the current --

MR. THOMAS: Not yet.

MEMBER REMPE: I thought at the end of this morning's -- or this afternoon when you got me before this meeting and said this, I thought you said the intent was to have the most severe and that's what in the regulation. What's in the regulation?

MR. THOMAS: It's not in the regulation.

MEMBER REMPE: Oh, the guidance.

MR. THOMAS: Right or it's not even in the guidance yet.

We don't have the proper people. I don't see the research individuals who do -- or Michelle Hart -- who do the consequence analysis.

So I would have to approach the consequence analysis folks for that.

MS. BRADFORD: This is Anna Bradford, NRO. We can go over this during the staff part of this presentation, if that would be helpful.

MEMBER REMPE: Yes, again, because I don't know about your four plans you've picked but to me it seems like you might be able to have something more severe if you --

CHAIRMAN KIRCHNER: Well, for the record, they are not considering that technology.

MEMBER REMPE: Well I don't know the four

that they've picked if they've picked the most severe for all four days.

CHAIRMAN KIRCHNER: But let's ask them how they define your four days.

MEMBER REMPE: They've already told me they start --

CHAIRMAN KIRCHNER: From the start of release.

MEMBER REMPE: Yes, that's what they've said. So did you look beyond?

MR. YOUNG: I'll make a quick clarification of that. This is for a plan parameter that we've established based on certain accidents. We considered that we did use the first four days from the start of release. For established -- for implementation of the methodology, we will evaluate the most appropriate source term based on the accident scenario that needs to be considered.

So the way our methodology worked, it does not preclude us from having to consider the worst four days or the early four days. That will revolve around the accident selection and source term selection for implementation of methodology but this is separate from the example and separate from actual implementation of the methodology.

MEMBER REMPE: Okay, that helps, as long as I know somebody is going to think about the most severe four days. Thank you.

MR. YOUNG: Continuing on with this slide, this is the plant parameter. We'll have to evaluate it at COLA to ensure that the selected design meets the source term we've developed.

To establish this EPZ plant parameter, we developed the four-day atmospheric release source term. This allowed us to account for various SMR designs, and accident types, and the total four-day release that was required for the EPA early phase PAG dose limits.

The four-day atmospheric release source term is a composite of three different source terms, which includes the ESPA PPE Chapter 15 source terms and the two source terms evaluated in the example calculation. This accounts for various SMR designs and various accident types to be considered.

The worst activity from each isotope considered for each major time period, which we considered to be the zero to 8, 8 to 24, and 24 to 96-hour time period is then accumulated into a composite. We summed those up over four days and come up with a total four-day atmospheric release source term.

We then applied 25 percent of discretionary margin to that total. From the four-day total composite source term with the 25 percent discretionary margin, we evaluate the dose consequences. We determined that with this source term, the four-day total composite plus 25 percent we would be in compliance with the EPA PAG dose limit of one rem.

At COLA, we will compare this source term to the criterion A and B source terms for the accident selected to this four-day atmospheric release source term for EPZ exemption request applicability.

MEMBER REMPE: So you only considered the species or the isotope. Did you consider like the form, whether it is a particulate, whether it's a -- I mean what did you do with respect to the form of the isotopic release?

MR. YOUNG: So we utilized the atmospheric -- the gaseous release source terms that were determined from the two example analyses source terms and the PPE source term. Specific percentages or breakdown of particulate versus aerosol, et cetera, is specific to those source terms for the reactor designs.

And where we're at, we don't have all that

information but the vendors consider that proprietary. So we're just evaluating a known isotope with a known activity.

MEMBER REMPE: Thank you.

MR. YOUNG: For the rest of the presentation, I'll turn that back over to Archie.

MS. MANOHARAN: Thank you, Alex.

The last topic we have for Section 13.3 in Part 2, we are on slide number 17, is information concerning contacts and agreements.

In support of the ESPA, letters of support from State of Tennessee, Anderson County, Roane County, and City of Oak Ridge were submitted to the staff. If a future combined license application is pursued, TVA will pursue the appropriate certification letters and letters of agreement with the local emergency medical and law enforcement agencies to ensure that there is enough emergency response organization support available.

Most important before we leave Part 2 information is TVA would continue to work with state and local support organizations to establish an emergency preparedness at Clinch River that is commensurate to the reactor design but selected at COLA and the potential consequences resulting from

that reactor design to the public health and safety.

Next slide. Moving on to information in Part 5 Emergency Plans, as I had mentioned at the beginning of this presentation, in Part 5 the ESP contains two major features -- two emergency plans major features for a site boundary EPZ and major features of an emergency plan for two-mile EPZ.

Both of these plans consider and address the 16 planning standards of NUREG-0654. They contain the amount of information available to us during the ESP development. So design-specific information such as that would be required to develop accident analyses, or staffing levels, or EALs are not addressed in Part 5.

You also need to consider the information in Part 5 with the exemptions request in Part 6, which I will summarize later in the presentation. Next slide.

There was a question earlier about what does the site boundary EPZ look like. This figure here in red shows the EPZ site boundary for Clinch River. The layout of the information in Part 5A for site boundary EPZ has two parts. One is the main plan, which builds on the generic emergency plan used by TVA for the current nuclear operating plants

already approved by the staff and an appendix that has site-specific information concerning the site location and other site-specific features.

In addition to providing information concerning the necessary actions to safeguard on-site personnel and minimize damage, it proposes how the emergency plan is compatible with the site.

Next slide. Another question was what does the two-mile EPZ look like. The figure here, the blue circle is the two-mile radius from approximately the center of the site. The red is the exact size and configuration of the two-mile EPZ. As you can see, in most areas, it is actually larger than two-mile EPZ and never less than two.

The exact size and configuration of the two-mile EPZ was developed in relation to local emergency response needs and capabilities, as they are affected by conditions such as demography, topography, land characteristics, and access routes.

MEMBER MARCH-LEUBA: In that, what is the funny red line?

MS. MANOHARAN: The red line is the actual two-mile EPZ. So --

MEMBER MARCH-LEUBA: No, the two-mile is the circle.

MS. MANOHARAN: The blue line, which is a circle, is to show you the circle with the two-mile radius from the center of the site. But when you actually create your exact EPZ size, you take into account population, land characteristics, ease of access --

MEMBER MARCH-LEUBA: This is your imaginary line to two-miles, which is not two miles? This is something larger.

MEMBER BLEY: The actual EPZ is a little bigger. So it is probably roads and things it looks like.

MS. MANOHARAN: Yes, some rivers and roads.

MEMBER MARCH-LEUBA: You were following some existing roads and things like that?

MS. MANOHARAN: Yes, that's correct. Yes.

MEMBER MARCH-LEUBA: So basically, ORNL is outside the line, the extant plant?

MR. YOUNG: Yes.

MS. MANOHARAN: A site evacuation -- evacuation time estimate analysis was conducted to show -- to support information, in part, which I will go over in the next slide. Next slide, please.

So as I said, an evacuation time estimate

analysis was conducted to show that there are no physical characteristics unique to the Clinch River Site that would pose a significant impediment to development of emergency planning -- emergency plans at the site.

In addition to providing -- acting as a tool to TVA and state and local governments for specific -- site-specific information needed for protective action decisions, it also serves as a tool to show that there are no physical characteristics that would hinder emergency plans.

It was conducted in accordance with NUREG/CR-7002 and just to provide a clarification, there is no site evacuation time estimate for Part 5A because it is in the site boundary EPZ.

Next slide. That concludes our information that we had for Part 5.

Moving on to Part 6 of the presentation, to support the information in Part 5 of which has a two-mile EPZ and a site boundary EPZ emergency plans, a set of exemption requests were developed after reviewing the current emergency preparedness requirements and each set supports either Part 5A or Part 5B. I will go over the exemption requests in a summary in the next couple of slides. Next slide,

please.

In Table 1-1 of Part 6, exemption requests are described that support site boundary EPZ emergency plan. In addition to deviating from the current ten-mile plume exposure pathway EPZ size, certain elements of a formal offsite emergency plan are being asked to be exempt from, the logic being, at a COLA, after reactor design has been selected, the dose-based methodology that was described in 13.3 is implemented to show that the dose criteria is adequately met at site boundary. If that is the case, then these exemptions would be warranted.

But it is also important to note that TVA's emergency plans will describe the capabilities to determine if a radiological release is occurring, promptly communicate it to offsite organizations for their consideration.

Next slide. Table 1-2 of Part 6 describes certain exemption requests that support, again, site boundary EPZ emergency plan, specifically from evacuation time estimates, certain elements of offsite notification, and offsite exercises.

Following the same logic, the SMR design would have to show that it meets the dose criteria at COLA, it goes with the dose-based methodology review

and then these exemptions will be granted.

It is also important to note before we move on from here is that TVA is not seeking an exemption from the requirements to notify responsible state and local government agencies and, also, will continue to invite state and local support organizations to participate in periodic drills and exercises.

Next slide. The last table, Table 1-3 in Part 6, describes the exemption request that we put forth for the two-mile EPZ emergency plan. The only request or the only exemption request in place for a two-mile EPZ is to deviate from the current ten-mile EPZ size, which goes back to Dan's point at the beginning of the presentation that it is the surrogate to a ten-mile.

Next slide. Just to summarize the technical basis in TVA's opinion for the exemptions is the dose-based methodology consequence oriented methodology that is described in Section 13.3, which as we elaborated earlier, has the consistent approach to NUREG-0396, evaluates a spectrum of accidents, has the same dose criteria as EPA PAG and also ensures that the EPZ is of sufficient size to provide significant reduction in the case of severe health

effects.

Combined with this technical criteria and the dose-based methodology, and the SMR design features, we believe that there are special circumstances that exist that warrant granting the exemption and that if a selected SMR design at COLA is able to show that the dose criterias are met at either site boundary or two-mile, exempting from these requirements would still allow us to meet the underlying purpose of the regulations.

Next slide, please. In summary, I think it would be beneficial to go over what TVA is asking for review in the ESPA and how that might be used in a future combined license application.

So in Part 2 of the ESPA, we are seeking approval of the dose-based consequence oriented methodology for determining the plume exposure pathway EPZ size. In a COLA, that methodology will be implemented to develop a design-specific implementation of the methodology, if approved in ESPA.

In the ESPA in Part 6, we are asking to deviate from the current ten-mile EPZ requirements based on the dose-based methodology described in Section 13.3. In COLA, design-specific EPZ size will

be determined, based on the dose-based methodology.

In Part 5 of the ESPA, major features of two emergency plans are described and approval for these is being sought for site boundary and two-mile. In COLA, once the SMR reactor design has been selected, dose-based methodology implemented, and the design-specific EPZ sizes established, it could be site boundary, in which case Part 5A emergency plan -- major features of the Part 5 emergency plan will be used to create a complete and integrated plan. The same if the dose criteria is met at two-mile.

If the selected SMR design does not meet the dose criteria, a new EPZ size will be developed and a supporting emergency plan.

Okay, that concludes our presentation. Thank you for your time. If there are any questions, we will be happy to answer them.

CHAIRMAN KIRCHNER: Thank you.

Members, are there other questions?

Well, I should remind you that when you have questions or comments from us individually that doesn't necessarily represent the full committee.

And so with that, I will make a personal observation. It seems to me that your plan B, if you will, of the two-mile radius is prudent and a logical

backup to not being able to fit into your exclusion area boundary -- or your site boundary. Sorry, I misspoke.

How, given some of the examples that you have worked, how confident are you on your local weather patterns and other things such that you can, with some margin, and this would be an interesting thing to also ask the staff, to squeeze in your site boundary these up to your multi-unit -- what's your limit, 2,400 megawatts thermal?

MR. YOUNG: 2,420.

CHAIRMAN KIRCHNER: Yes. Do you have any feeling for that or is that the purpose for the two-mile backup?

MR. YOUNG: So I believe the question --

CHAIRMAN KIRCHNER: Because it begs some really detailed analysis over time of weather patterns and such.

MR. YOUNG: Sure, the question revolves around meteorology. We used Clinch River-specific meteorological data that we collected in accordance with the guidance, such as we did for the remainder of the application, the end-dose analysis.

We have a lot of confidence in that data because of some of the conservatisms we embedded into

our analysis, such as the 1,100 foot distance from release boundary to site boundary that's been mentioned and some of our other conservatisms in that analysis.

CHAIRMAN KIRCHNER: So the weather is going to accommodate your rather irregular shape, by and large?

MR. YOUNG: Right. We --

CHAIRMAN KIRCHNER: Do you see where -- I mean given, say it were one-mile instead of 1,100 feet and it was a circle, not your boundary, then variations in weather patterns and such are not as crucial as trying to make sure it shoehorns into that irregular shape of your actual site.

MR. STOUT: So we're pretty confident in 1,100 feet. The site is big enough that you have a lot of flexibility on exactly where you put the footprint within that, so that you have more than 1,100 feet.

And then we have the meteorology data in all directions, and all conditions, all seasons. So you know our analysis was built in the conservatisms to give us confidence that 1,100 feet is adequate.

CHAIRMAN KIRCHNER: Okay. All right, thank you.

MEMBER REMPE: I'm sure I didn't -- if I had done all my homework, I would know but did you do like 30 years of site data or how many years of site data did you consider?

MR. YOUNG: So we collected I believe three years of on-site data that was utilized and we did have data from the Clinch River Breeder Project that we did use.

Scott, can you tell us how much data we actually considered in the example analysis?

MR. WEBBER: Yes, so in the example analysis, we used about representative years' worth of data. It was I believe 2012 and '13, which was considered to be well-representative of the information that TVA had available for a larger spread.

And the analysis also did dose assessment for essentially every hour of that year so that there was a release going in every direction and every weather condition.

So what TVA was saying we have high confidence that the analysis captured the most severe meteorological conditions.

MEMBER MARCH-LEUBA: And the MA report is the evidence for that year or is it 95 percent? Which

is it?

MR. WEBBER: The numbers that were in the slide are 50th percentile.

MEMBER MARCH-LEUBA: You said 80th percentile?

MR. WEBBER: 50th percentile.

MEMBER MARCH-LEUBA: 50th.

MR. WEBBER: Yes. Mean and 95th were also provided but he 50th percentile was shown.

MEMBER MARCH-LEUBA: For future already in Knoxville you only get east wind when there is a hurricane. And I'm sure you have even considered it but there are hurricanes, I can assure you. So I don't see how -- I mean for a real analysis, you need to consider a hurricane. And you only get east wind with a hurricane, which didn't happen in your three years' of data.

MR. YOUNG: Sure. So we're many, many miles inland, compared from where we see the really high winds of met data. So from the averages of the met data we collect, you know there are significant meteorological events that get embedded into that.

MEMBER MARCH-LEUBA: But once every three, four, or five years, you get 50 mile an hour coming from the east. I know. I live there. And I know you

didn't consider that.

MR. YOUNG: Well you know --

MR. WEBBER: I'd just like to make a point that for perspectives of dose to site boundary, faster winds are not necessarily more conservative. The wind speed is too high. You can push the plume out so fast that you have almost no exposure.

So I think in this instance, actually, a hurricane would not be limiting.

CHAIRMAN KIRCHNER: Yes, it may be that an inversion is more limiting for them.

MEMBER MARCH-LEUBA: I just wanted to analyze. I think the worst and they entirely say I don't want to do it.

CHAIRMAN KIRCHNER: Okay. At this point, if there are no further questions of the applicant, let us take a quick break and we can reset and start at 2:30 on this clock. We are recessed.

(Whereupon, the above-entitled matter went off the record at 2:19 p.m. and resumed at 2:31 p.m.)

MS. SUTTON: Good afternoon. My name is Mallecia Sutton. I am one of the safety project managers for the Clinch River Nuclear Site early site permit application. With me today is Mr. Allen Fetter, the other safety project manager. Also with

me are the technical reviewers who will be presenting the topic area, Bruce Musico, from the Division of Preparedness and Response for Nuclear Security and Incident Response, also known as NSIR, and Michelle Hart from the Division of Licensing Site and Environmental Analysis in the Office of New Reactors, also known as NRO.

In the audience and on the conference bridge are representatives from the Federal Emergency Management Agency, FEMA, Technological Hazardous Division. Also, representatives from Tennessee Emergency Management Agency, TEMA, are on the conference bridge, including TEMA Director Patrick Sheehan.

TVA is asking approval for an early site permit for the Clinch River Nuclear Site. As part of the application, TVA described emergency planning topics for approval. You have heard from TVA what they submitted. The staff will be describing the review of the emergency planning information. Although the staff will be presenting its findings, the licensing action will not be complete until the Commission makes the decision whether to grant the early site permit and the exemptions.

The appropriate plume exposure pathway

emergency planning zone size for this site will not be determined until a combined license application that references a specific small modular reactor design is submitted for the Clinch River Nuclear Site. The staff will be using several acronyms and abbreviations in this presentation today. The presentation has a list of definitions on the last two slides for your reference.

Earlier today you heard the staff give a detailed presentation of the rulemaking for emergency planning for small modular reactors and other new technologies currently in process. The ACRS should recognize that TVA's Clinch River early site permit application was submitted in May 2016. This was before the staff started work on the small modular reactor and other technologies rulemaking. Accordingly, the application and review of the application by the staff is based on current regulations and guidance. The staff cannot review to regulations or guidance that is not yet approved.

I will now briefly describe the early site permit and the plan parameter envelope. An early site permit is an approval of safety and environmental suitability of a proposed site to support future construction operation of the nuclear plant. In an

early site permit application, the applicant doesn't have to commit to building the reactor or specify reactor design that would be built there. The early site permit reserves both site safety and environmental issues that are independent of the type of reactor design. An early site permit does not allow for construction and operation of a nuclear plant.

Before a nuclear plant can be constructed and operated at a site with an early site permit under Part 52, a combined licensed application referencing a specific reactor technology for this site must be reviewed and approved by NRC. It is possible to approve an early site permit site without a selected reactor technology.

An early site permit plant parameter envelope or PPE values are intended to bound a variety of reactor technologies, rather than one specific technology. The PPE values represent a surrogate nuclear plant for the purpose of siting determination. The PPE values are bound in criteria used by the staff to determine the suitability of an early site permit site for construction and operation of a nuclear plant. The safety evaluation report evaluates the site characteristics to include design basics,

tornado, flood, and groundwater moisture, just to give a few examples.

In the combined license application, when a specific technology is identified, the PPE values are compared to those of the selected technology. If design parameters of the selected technology exceed bounding early site permit PPE values, additional reviews are conducted to ensure that the site remains suitable from a safety and environmental standpoint for construction and operation of its selected nuclear plant technology. In addition, the site parameters for the referenced certified design must be bounded by the site characteristics in the early site permit.

In the development of a plant parameter envelope, an applicant typically draws data from a number of plant technologies under consideration to construct a bounding envelope. It is important to note that when issuing a permit, the NRC approves the PPE rather than the specific technologies that a PPE was drawn from. As such, any plant technology that can demonstrate to be bounded by the plant parameter envelope is suitable for use in a combined license application.

The safety evaluation report for Chapter 13, Section 13.3 for the TVA Clinch River Nuclear Site

application addresses the plant's design features, facilities, functions, and equipment necessary to a logical emergency planning that must be considered in an early site permit application that includes proposed major features of the emergency plans.

TVA early site permit application includes a methodology that, if approved in an early site permit, could be used in future combined license application referencing a specific small modular reactor design and early site permit to determine the appropriate site-specific plume exposure pathway emergency planning zone size for the TVA Clinch River Nuclear Site.

The submitted early site permit application requests two sets of exemptions from the current ten-mile plume exposure pathway emergency planning zone requirements if certain conditions are met: one set of 25 exemptions to support major features emergency planning based on the plume exposure pathway emergency planning zone at site boundary and one set of two exemptions plume exposure pathway emergency planning zone with a two-mile radius.

If these sets of exemptions are approved as part of the early site permit, it will be

accompanied by permit conditions specifying the circumstances under which these plans can be used in the combined license application. The combined licensed applicant would apply the methodology approved in the early site permit to the design selected for the combined license application in order to determine whether the conditions for either of the two sets of exemptions have been met.

Now, I turn the presentation over to Bruce and Michelle to discuss the technical review.

Bruce.

MR. MUSICO: Thank you. Good afternoon. My name is Bruce Musico. I am a Senior Emergency Preparedness Specialist. I and Michelle Hart reviewed the emergency planning information that TVA provide din its ESP application. Slide 2, please.

You're going to see somewhat of an overlap from our slides with TVAs because we cover common areas.

The ESP application requested a review of three key areas. First of all, the plume exposure pathway emergency planning zone, or EPZ, sizing methodology. And Michelle is going to address that shortly.

Secondly, TVA requested approval of two

major features on-site emergency plans. The first emergency plan assumed a site boundary plume exposure pathway EPZ. The second emergency plan reflected an approximately two-mile plume exposure pathway EPZ and this particular major feature of emergency plan included an evacuation time estimate.

And third, TVA requested approval of 25 exemption requests. And these are broken down into two sets. One set was associated with the site boundary emergency plan, major features emergency plan and the second set was associated with the two-mile plume exposure pathway EPZ.

The ESP proposes an exemption from the current ten-mile plume exposure pathway EPZ, which is currently in our regulations. The exemptions address portions of our regulations, including 10 CFR 50.33, .47, and Appendix E to 10 CFR Part 50. This is for both on-site and off-site emergency planning. Next slide, please.

This slide addresses the 10 CFR Part 52 licensing process in general. Upon issuance of an early site permit, the applicant acquires approval with conditions on: the plume exposure pathway EPZ sizing methodology, the 25 requested exemptions, and the two major features emergency plans, site boundary

and two-mile EPZs.

In the future, a combined license application that incorporates by reference the early site permit will identify a chosen small modular reactor or SMR technology for the Clinch River Nuclear Site. At that time, the applicant must demonstrate that the EPZ sizing methodology supports either the site boundary or two-miles plume exposure pathway emergency planning zone.

At that time, the COL applicant must also provide a complete and integrated emergency plan. For the two-mile plume exposure pathway EPZ, the COLA applicant must provide an on-site emergency plan -- I'm sorry -- provide an on-site and off-site emergency plan. For the site boundary plume exposure pathway EPZ, the applicant must provide an on-site emergency plan, which assumes that the site boundary, as defined for EP purposes in the COLA, will be within the applicant's owner-controlled area.

And in addition, the COL applicant must address the identified COL action items, of which we have identified 16, and the four permit conditions that we've identified in the application.

MEMBER MARCH-LEUBA: So Bruce, could I talk for a minute?

MR. MUSICO: Yes.

MEMBER MARCH-LEUBA: The ESP -- you will issue an SER or sign an ESP for them which has two options, the two-mile or the site boundary.

MR. MUSICO: Site boundary, yes, that's correct.

MEMBER MARCH-LEUBA: Is that correct? I mean you approved both of them?

MR. MUSICO: We are approving both major features emergency plan.

MEMBER CORRADINI: And they have to come back with a chosen technology and show that they fit into one of them.

MR. MUSICO: According to the methodology that what we've also reviewed we'll have approved. That's correct.

MEMBER CORRADINI: Okay.

MR. MUSICO: That's correct. This was a first of a kind application in which we received two emergency plans, rather than one with the application. So it is kind of interesting in that respect.

MEMBER MARCH-LEUBA: And on that ESP, will you have limitations about the methodology? Because on their methodology, on their example, they have this criteria for the frequency of 10 to the minus 6 and 10

to the minus 7, which are proposed. Will those become part of the approval?

MR. MUSICO: The short answer is yes and Michelle Hart is going to address that later.

The specific methodology is, however, defined in Section 13.3 of the site safety analysis report, which is Part 2 of the application, the ESP application. So they have identified specifically what the methodology is.

Next slide, please.

MEMBER BLEY: Quick question. They have given you two on-site emergency plans. Are they essentially identical?

MR. MUSICO: No.

MEMBER BLEY: Okay.

MR. MUSICO: They are very close. They are very close.

MEMBER BLEY: Some will have connections to off-site, I assume.

MR. MUSICO: Well, they're limited. First of all, since they are major features emergency plan, they are limited with respect to the extent that they address our current emergency planning regulations and guidance and they are permitted to do that. They can pick and choose the limited aspects that they want to

address at the ESP stage.

And they've provided us with two separate plans. We've reviewed them separately but we also compared them and, to a great extent, both plans are virtually identical, except to the extent that one plan reflects the site boundary of EPZ that they're proposing. The other one reflects the approximate two-mile EPZ that they're proposing and they also reflect the exemptions that are specifically requested for them.

For example, the site boundary major features emergency plan reflects the 25 exemption requests for that particular plant. For the two-mile major features emergency plan, there's not that much different than a ten-mile as far as the off-site requirements. So they only have two exemption requests that they are requesting for the two-mile major features emergency plant.

So the fact that they were, to a great extent, identical, made our job a little easier with respect to approving them or reviewing them and approving them, even though they are limited because they are major features, but we also distinguished the two plans, and you'll see that in the safety evaluation, between language in one versus the other

in that one would address various aspects of say the site boundary EPZ, where the other one would reflect and describe various aspects of the two-mile plume exposure pathway EPZ.

So there were differences and we called those out specifically in the safety evaluation.

MEMBER BLEY: Thank you.

MR. MUSICO: All right, slide 4, please. This slide reviews the staff's review of the specific exemptions. The NRC reviewed the requested exemptions pursuant to 10 CFR 50.12, which is entitled Specific Exemptions.

Specifically, 50.12(a)(2) states that the Commission will not consider granting an exemption unless special circumstances are present. And then in (ii), it states that special circumstances are present whenever application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule.

Now for exemption requests there are a number of special circumstances that are available to them. This was one that they identified as applicable to the application and the staff agree with that. This is appropriate.

Next slide, please. The underlying purpose of 10 CFR 50.33, 50.47, and Appendix E to Part 50 is to, first of all, ensure that licensee maintain effective on-site and off-site radiological emergency response plans; secondly, to ensure that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency; and third, establish a plume exposure and ingestion pathway EPZ as appropriate.

And then the second bullet is the ESP application serves to provide a basis for the establishment in the COL application of either a site boundary or two-mile plume exposure EPZ, and they can pick which one, which maintains the same level of protection, that is dose savings in the event of a radiological emergency, in the environs of the Clinch River Nuclear Site as that which exists in the basis for the ten-mile plume exposure pathway EPZ.

So the safety level is maintained. It's the same.

Next slide, please. Now, I'll turn it over to Michelle.

MS. HART: Hi. I'm Michelle Hart. I'm in the Office of New Reactors and I do look at siting analysis as well as I looked at the analysis that they

provided for the EPZ sizing methodology and criteria.

So TVA had stated that their plume exposure pathway EPZ size methodology is based on these following technical criteria. And I think they described them before but, to remind you, they are the plume exposure pathway EPZ should encompass those areas in which project dose from design-basis accidents could the EPA early phase protective action guides; that the plume exposure pathway EPZ should encompass those areas in which consequences of less severe core melt accidents could exceed the EPA early phase protective action guides; and plume exposure pathway EPZ should be of sufficient size to provide for substantial reduction in early health effects in the event of more severe core melt accidents.

Next slide, please. This is slide 7. So the features or the outline of the methodology that they provided in their site safety analysis report, the first step that you go through is the accident scenario selection. So you would use the bounding design-basis accident from the combined operating license final safety analysis report Chapter 15. And that is the analyses that you would use to look at the safety of the plant and also to look at siting. And so in addition to those accidents which do not have

core failure, you would have an accident used to assess your siting in the regulation and that, generally in the past, for the large light water reactors has been the LOCA with an intact containment and using the tech spec release rate from the containment. So you would use that same accident that's used for the siting analysis.

And then you would go to use the combined operating license application site- and design-specific probabilistic risk assessment to categorize the severe accident scenarios.

So this PRA and the assessment of severe accident scenarios should be all modes, include internal and external events, would also include applicable fuel handling and spent fuel pool accidents, and would have multi-module considerations, if those are applicable to the specific SMR design that they choose.

You would start with all sequences with a mean core damage frequency about 10 to the minus 8 per reactor year and then you would further categorize those scenarios, once you look at those, and determine the scenarios from that.

So the first category, which when TVA was talking that was the criterion B that they were

talking about, would be the more probable, less severe core melt scenarios. And those are with a mean CDF greater than 10 to the minus 6 per reactor year and include intact containment.

And the third category, or what they would call criterion C, is the less probable, more severe core melt scenarios. And those are with a mean CDF greater than 10 to the minus 7 per reactor year with containment bypass or failure.

CHAIRMAN KIRCHNER: Michelle, now let me ask a question. You specify a mean CDF. How much uncertainty do you consider beyond just a mean CDF?

I mean where I'm going with this, I've raised this point before, is that for the less mature concepts, let me say it that way, more still on paper, not any real operating experience, how do you assess the PRA and the uncertainties with that? Because I suspect that most design teams will come in with very low mean CDF numbers and then say well, I meet your criteria on this slide and we don't have to consider severe accidents.

MS. HART: Right.

CHAIRMAN KIRCHNER: How prudent is that and how are you going to interject some, how should I say it, regulatory certainty? Because that's one of

the things you're trying to do in all of your processes.

How do you see the staff approaching this?

MS. HART: Well how -- I mean certainly, it remains to be seen what will actually go through when we do the implementation, when the applicant goes through the implementation and when we review the implementation of it.

And so it does, as you are rightly saying, it does depend on the maturity of the specific design that they've chosen and the quality of their PRA, the acceptability of their PRA for this purpose. And we would review that in conjunction with the PRA reviewers in the Office of New Reactors to determine the usability of the information that they gave us.

So there's no specific -- I don't think -- I think there is room for us to make that determination at the time of implementation. We're trying to cut off, trying to make the appropriate decisions at that time.

Right now, we're saying that this looks reasonable to categorize your events using your PRA and mean seems to be a reasonable bound to use for that purpose, for the emergency planning purposes.

MEMBER BLEY: Well there are some things

you might want to consider and that is, at the time of COLA, at least from what we've seen on other designs that have come through, they typically have no operating experience. They might not -- they don't have to have all their emergency procedures in place. Those have to be in place before startup. They don't have real operators yet and they haven't had operators through training. So there is a lot of things not there.

On the site-specific side of it, by COLA, you should have a specific site but they typically don't upgrade their PRA to account for that, except with some purely loose bounding calculations that say yes, we meet the envelope of what was assumed in the design cert PRA. So those kind of things you need to give some kind of weight to along the lines of Walt talking, account for them as possibly giving you higher results than the existing work.

MS. HART: Right. I think it's we do recognize that the PRA for the design and the PRA use for the combined operating license, in general, may not include all the information or may not be the exact same quality that you would need to do this assessment. And so there may be some portions of it that they have to describe to us why that's

appropriate. And I think that that's -- it's a discussion that we've been having with the licensing modernization project also about the applicability of the PRA and how you show that that's appropriate to use for the purposes --

MEMBER BLEY: Well, I'm glad they're talking to you.

MS. HART: Yes. So there is some discussion along those lines that what you -- what we have said in some of our guidance about what is required for a PRA, for the design certification especially, is that it's appropriate so that we don't have to do a detailed analysis of -- or a detailed review of their PRA. And so there may be some further step that has to come here, depending on the design and what they say in the PRA.

So a lot of this, unfortunately at this stage, we have to kind of rely on how we would implement it later. And I know it may not seem like it gives enough information or enough detailed information but I think you know this is a first of a kind thing and if TVA does choose to go forward, if they get their early site permit and then just decide to go forward with the COL, we've been discussing this with them -- not maybe necessarily this specific topic

but the idea of this analysis. And they helped develop this analysis. They based it off of the information in NUREG-0396. And so, generally, they're trying to recreate what was done in NUREG-0396 for their specific site at some future point, when they specific design.

MEMBER BLEY: Yes, I don't have any real qualms with the general approach but you will be the first specific one looking at this, it appears to me. So some kind of compensation for the things that aren't there and can't be there yet ought to be on the table.

MS. HART: Right and I think uncertainty analysis is very important and it's something that we will review carefully, the uncertainty, when we get to the implementation stage.

MEMBER BLEY: Yes, it's not just parametric uncertainty here. It's uncertainty in things that aren't there that you can actually see that aren't there yet.

MS. HART: That's correct.

Okay. So then of course, after you categorize your events and select your scenarios, you may group them, as you sometimes do in PRA but you would determine source releases to the atmosphere for

each of the categories, the design-basis accident, more severe, less severe, you know if there are more severe accidents. You would calculate the dose consequences at distance from the plant and then you would determine the plume exposure pathway, EPZ size that would meet the dose-based criteria to be used in further determination of the actual emergency planning zone.

Next slide, please. So slide 8, so the dose-based EPZ size criteria is a dose to an individual from exposure to the airborne plume during its passage and also to groundshine, using average atmospheric dispersion characteristics for the site. This is very similar to the way that it was done in NUREG-0396 using average atmospheric dispersion characteristics was one of the features that they used.

And for the design-basis accident and for the more severe less -- more probable, less severe accidents, the dose criterions is one rem total effective dose equivalent from a 96-hour exposure. And that one rem over 96 hours is at the lower end of the dose range for the EPA PAG for early phase protective actions, for example, evacuation and sheltering. And this is to verify that dose

consequences do not exceed the EPA PAG beyond the site boundary, which is within the owner-controlled area, for the two-mile plume exposure pathway EPZ.

For that last category, the less probable, more severe accidents, you would calculate the distance at which the conditional probability to exceed 200 rem whole body from a 24-hour exposure would exceed 10 to the minus 3 per reactor year. And the 200 rem whole body is an acute dose at which radiation-induced early health effects may begin to be noted. For example, one of those effects is nausea. And this is to verify that the plume exposure pathway EPZ supports substantial reduction in early health effects.

Next slide, please. So for the staff to review the plume exposure pathway EPZ size methodology that TVA provided, we did compare TVA's methodology and the dose criteria to the study used as the technical basis for the current 10-mile plume exposure pathway EPZ requirement. And that study was NUREG-0396.

And the features of TVA's methodology are consistent with NUREG-0396, in that it considered a range of accidents. It performed accident consequence analyses, and it determined an area outside of which

early protective actions are not likely to be necessary to protect the public from radiological releases.

And, therefore, the staff concludes that the applicant's proposed methodology is reasonable and consistent with the analyses that form the technical basis for the current regulatory requirement of a plume exposure pathway EPZ of about ten miles in radius.

MEMBER BLEY: If these are based on PRA, do you have a sense for what not likely means, quantitatively?

MS. HART: Quantitatively, there is nothing in NUREG-0396 that would give you a clue to that. I mean it did use NUREG -- I mean it used WASH-1400 as its basis.

MEMBER BLEY: WASH-1400, which you could look at.

MS. HART: Yes. Yes, and so in general, I think in general we talk a lot about the cutoff. I know that that was a discussion this morning, the cutoff for what the frequency of the events or the sequences should be that you should evaluate. And 10 to the minus 8, 10 to the minus 7, 10 to the minus 6, those all have been numbers that have been floating

around. And as TVA had stated, the specifics for like the 10 to the minus 6 per reactor year for the more probable accidents in that category has been discussed in several different areas. In industry, they have used that number a lot.

Ten to the minus seven, maybe not quite as often, has been discussed but it seems reasonable, at this point. I think it's when we get to the implementation phase, if there is some special case or there is something like we were talking about NuScale's PRA, their design PRA doesn't have anything in that category of 10 to the minus 6 or higher but do they have a backstop that they would provide some other analysis to bound any potential severe accidents.

So I think it's a reasonable good bounding assessment.

MEMBER MARCH-LEUBA: When in slide 7 when you say 10 to the minus 7 per reactor year, you mean module or multi-module year?

MS. HART: Well that is actually the quote from TVA's methodology. It does depend on the design that is used. And so I think we will definitely look at that. I think in general, though, we would say it is equivalent to a module year, unless there is

something in the design that would show that there would be multi-module events that would occur.

MEMBER REMPE: So when you reviewed their analyses, what made you decide it was acceptable to use one year of site-specific meteorological data from TVA and use a 50 percent value?

MS. HART: I will be discussing the example calculation and it's just an example to evaluate the usability of the methodology. I did not use their analysis to approve anything, per se. You know I am not approving an EPZ size at this time.

MEMBER REMPE: Okay.

MS. HART: So it's just to say you know how they used the methodology.

But the methodology does include the feature that they would use average meteorological conditions for the site and that was something that was also done in NUREG-0396. So I think when you're looking -- when you're doing projected analyses for licensing purposes, in general, you want to use -- for these purposes you want it to be a little bit more representative than bounding in this case.

MEMBER REMPE: And is one year enough to decide that something is representative?

MS. HART: That I can't say for sure.

We'll look at the implementation. I think we will look at multiple years of data because they are required to provide multiple years of data. And so we'll determine if the information they are using in their analyses is representative of the site, whether it is that specific year or not.

MEMBER REMPE: Okay, thank you.

MS. HART: Okay, next slide, please, so slide 10. In their request for the exemptions -- so now we've moved on from the methodology to the exemption requests -- they did describe that there are features of small modular reactors that support the exemption requests. And TVA stated that special circumstances exist at the Clinch River Nuclear Site, due to the anticipated enhanced safety features of the SMR designs under consideration. And those things are such as: smaller radionuclide inventories and source terms; projected accident progression rates are anticipated to be slower; that various design features are expected to eliminate several historically-considered design-basis events, for example, you wouldn't have a lock rotor accident if you don't have reactor coolant pumps; and advanced design features would minimize accident consequences.

MEMBER BLEY: Are you saying this has to

be confirmed when they come in for a specific design or just the results of the calculation?

MS. HART: Well that is -- I think the results of the calculation are what tell you the emergency planning zone size. That would be the actual proof of that.

I think for the purposes of requesting the exemptions, they had to make general statements about SMR designs and why they thought they were special.

MEMBER MARCH-LEUBA: For the record, I don't agree with the point number one, a smaller inventory. Per megawatt, because their refueling is longer, it is not accumulating only two years of inventory. It will accumulate ten years of inventory. So the inventory is larger per megawatt.

MS. HART: Yes, some designs, that's true.

MEMBER MARCH-LEUBA: But it has to be plant-specific.

MS. HART: I think in general that idea is just that they are at smaller power in the first place.

MEMBER MARCH-LEUBA: Right.

MS. HART: So the stuff in the core is less --

MEMBER MARCH-LEUBA: If you want to do it

my module, then you take advantage of the lower power.

MS. HART: Yes.

MEMBER MARCH-LEUBA: But specifically NuScale, if you are going to have an accident that melts the core, it is going to be an external event with a high probability of killing all 12 of them.

So the multi-module thing has to be addressed properly.

MS. HART: Multi-module accidents do need to be considered and that would be in your source terms, if that is something that is appropriate to the design that's been chosen.

MEMBER MARCH-LEUBA: If you look at those sequences, to damage the core, it has to be an external event and it will hit all of it.

MS. HART: I don't know if that is true. That is something to discuss with NuScale.

MEMBER BLEY: And we don't know what they are going to plan.

MS. HART: For the TVA Site, we do not know which design they are going to choose. It may not be NuScale. You never know.

Next slide, please. So, as you expressed some concern about the statements that were made, I also had some questions about them. So I asked them

to provide some information about what they mean by these things.

And so in my request for additional information, I did ask for specific technical support related to those statements and a comparison to large light water reactors. And in their response, TVA did provide tables with several parameters, comparing the smallest and largest SMRs, by that I mean based on unit-rated thermal power, in the Clinch River Nuclear early site permit application plant parameter envelope to the large and medium currently operating pressurized water reactors, one example of each one of those, and the AP1000, as well.

And some examples of the parameters that they had comparisons was the internal events CDF and large release frequency for the designs or for the operating plants; the source term total activity -- so that was just a total curie amount within the core of each of those designs; the primary coolant liquid mass to power ratio; and some severe accident progression information, you know the length of the releases, the timing of the releases, things like that. And there were some additional parameters and I didn't describe them all here but they are in the response to the first RAI.

And in general, they showed that the SMRs do have better characteristics, if you look at these specific parameters.

Next slide, please. So I also asked them to give -- them being TVA -- to give me a demonstration that the proposed plume exposure pathway size criteria could be met at a given EPZ boundary distance for potential reactor facilities that would be represented by the surrogate design in the plant parameter envelope.

And as you know, the plant parameter envelope had several different designs that were used to develop this envelope for the plant, surrogate plant.

So in response to this request for additional information, TVA provided an example analysis using design information for a specific SMR design -- as they described earlier, it was NuScale -- as input to their plume exposure pathway EPZ size methodology.

And the example analysis did show that the design could support a site boundary plume exposure pathway EPZ, however, it was not intended, either by TVA nor interpreted that way by the staff, to prove the case for the early site permit application to

justify a specific plume exposure pathway EPZ size. And that is because it was based on preliminary design information for an SMR at the lower end of the rate of power that is part of the basis for the Clinch River Nuclear Site ESP plant parameter envelope.

It used internal events design PRA only. It did not include external events. And it did not do a detailed uncertainly analysis. And the most important reason, which of course I didn't put on the slide, is that they are not asking for a specific EPZ size at this time.

Next slide, please. So as TVA had described, for use of the exemptions themselves in the combined operating license, they did develop a non-design-specific accident release source term that would meet the plume exposure pathway EPZ size criteria to be used as plant parameters. And those are listed in our safety evaluation report Table 13.3-1. It's the same idea as a plant parameter envelope design-basis accident source term and it's used to envelope an unknown design.

And this non-design-specific accident release source term is reference in Permit Condition 1 for adoption of the EP exemptions by a COL that references the ESP.

This non-design-specific accident release source term is an isotopic total release activity over 96 hours, which results in a total effective dose equivalent of around 0.9 rem at the site boundary. And as TVA had described earlier, it was based on three core melt intact containment accidents, two were design-basis accidents and one was a severe accidents, from two different SMRs from the NuScale design and also from the design that they used as the basis for their early site permit siting analysis.

And they used the maximum activity release for a specific nuclide from any of the three accidents over a specific dose averaging period. They assumed that would be the maximum release activity. And they lined up the start of the release. Each time equals zero at the same time of the release. So there was no -- like if one started releasing at five hours and the other one started releasing at ten hours, they moved those both to the same starting period. And by dose averaging period I mean those dose averaging periods that we used in meteorological analysis, the zero to 8 hours, 8 to 24 hours, and 24 to 96 hours.

Once they determined the maximum release for each radionuclide -- and the different radionuclides may have a release from a different

plant or a different accident; they were all a composite together -- they added a 25 percent margin. And then they did a back calculation to ensure that they fit within the dose criteria at the site boundary. And there was an additional adjustment to some of those values. So there was at least a 25 percent margin over top of the maximum release for any of those three accidents that was included in this non-design-specific accident release source term.

Next slide, please. So as I said, this was referenced in Permit Condition 1. And in Permit Condition 1, COL applicant referencing the ESP, if approved, would perform an analysis using the plume exposure pathway EPZ size methodology with site- and design-specific input to justify the plume exposure EPZ size for the combined operating license application.

In addition to the output of the EPZ size basis, it would also include the source term releases to the atmosphere. So an outcome of that analysis would give you what was released to the atmosphere, isotopic activity over time.

You would compare that release characteristics to the environment to the SER Table 13.3-1 non-design-specific plant parameter source

term. And then you fit within -- if all of their releases were less than what's in that table that was developed in the ESP, then the COL applicant can adopt the emergency planning exemptions.

And so that table, if you've looked at it is a four-day total activity release to the atmosphere for 71 separate isotopes.

So do you have any questions about that?

CHAIRMAN KIRCHNER: Yes, please. I was just going back to the inventory is based on the largest thermal unit that they were --

MS. HART: It included the largest thermal unit as one of the accidents.

CHAIRMAN KIRCHNER: One of the accidents.

MS. HART: Yes, and the other one was the NuScale examples that they provided in the RAI response.

MEMBER REMPE: So just to make sure about this four-day question that I keep harping about, if they finally come in, you will be -- there is some clue to tell people hey, I'm not just going to look at from the first of the release, I'm going to look at the most severe time.

MS. HART: We'll look at the characteristics of the entire scenario to determine if

they've evaluated the appropriate release characteristics.

MEMBER REMPE: Thank you.

MS. HART: Okay, next slide, please.

So as a reminder, we've been talking about the plant parameter envelope. It does include the four different SMR designs, preliminary designs, the mPower and NuScale, Holtec SMR, and Westinghouse SMR. And the plant parameter envelope, itself, you could include a different reactor design in the COLA that falls within the following PPE information range and that's two or more SMRs with a maximum 800 megawatts thermal for a single unit and a combined site capacity not to exceed 2,420 megawatts thermal or 800 megawatts electric.

So next slide, please and I will turn it back over to Bruce.

CHAIRMAN KIRCHNER: Michelle?

MS. HART: Oh, I'm sorry.

CHAIRMAN KIRCHNER: I was just thinking about Table 13.3-1 and the condition, permit condition. Different reactor vendors might have different accident sequences and might get their release from different isotopes. Do you see where I'm going?

MS. HART: Yes.

CHAIRMAN KIRCHNER: So how does this fit back to making that a condition that they live within all of these four-day activity curie limits? Does that always equate to still being below one rem at the --

MS. HART: Right. So --

CHAIRMAN KIRCHNER: Do you see what I'm going with?

MS. HART: Right, I see what you're saying. So one of the reasons that this is a four-day total integrated dose, so if there were different characteristics to the rate of release, that's not going to be a problem for them. But if there are different isotopes that are included in this envelope or if there is one isotope that is just really different for a new design, it may not fit within this table.

So, therefore, they don't automatically get to use the exemptions but that doesn't mean that they can't have a site boundary, a plume exposure pathway EPZ because their analysis would prove that.

CHAIRMAN KIRCHNER: Okay.

MS. HART: This table is really only to tell you that this is the information that we had in-

house at the time that we evaluated their exemption requests. And so these are the conditions on the exemption, as we understand it now. So we're not trying to bound everything.

CHAIRMAN KIRCHNER: But when it really came to an actual COLA with an actual plant, and if something --

MS. HART: They could take a variance.

CHAIRMAN KIRCHNER: -- say that -- I'll pick something like xenon-133, which is a biggie here.

MS. HART: Right.

CHAIRMAN KIRCHNER: We're a little higher, a little lower. Lower is okay but I mean say it were higher, you would just analyze that as a variance.

I'm assuming it's not off the charts different but it would be --

MS. HART: Right. Right and I think the implementation is still to be seen as well. I mean a permit condition should be, as the lawyers have told us, it should be ministerial. So you don't assess the information. You just verify that the information has been met --

CHAIRMAN KIRCHNER: Okay, all right.

MS. HART: -- if that makes sense. But they still may be able to justify a site boundary EPZ.

It's just they may have to take a variance or --

CHAIRMAN KIRCHNER: Yes, they may, for whatever reason, fuel choices or something, have a different mix come out of their accident scenarios.

MS. HART: Right.

CHAIRMAN KIRCHNER: Okay.

MS. HART: Right.

Any additional questions on that?

Okay, so I will turn the presentation back over to Bruce.

MR. MUSICO: Thank you. Slide 16, please.

This slide merely identifies some of the key standards and guidance that the staff used to perform its evaluation. There are additional requirements and guidance documents that the staff also used and those are identified within the safety evaluation but these are the key ones.

Next slide, please. This slide deals with the Federal Emergency Management Agency, FEMA, and our consultation with them.

The NRC performed its review in consultation with FEMA, pursuant to the FEMA-NRC Memorandum of Understanding. FEMA's review was limited in this case because, first of all, the ESP application did not include any off-site emergency

plans and, in addition, the major features plans only addressed a limited aspect of the on-site emergency planning features.

In FEMA's January 24, 2018 letter, FEMA stated that, working with TEMA, and that's the Tennessee Emergency Management Agency, FEMA did not identify physical characteristics of the proposed site that could pose a significant impediment to the development of emergency plans, including evacuation from the two-mile emergency planning zone.

In addition, the boundary established for the proposed two-mile plume exposure pathway EPZ was established relative to local emergency response needs and capabilities, as they are affected by conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries.

And at this time, FEMA's finding does not endorse or determine the adequacy of a proposed two-mile plume exposure pathway EPZ for the site if proposed during the licensing process. And these are statements directly out of their letter.

In FEMA's June 12, 2017 letter, FEMA further stated that it did not review or analyze the feasibility and assumptions for the site boundary emergency planning zone but, if requested in the

future, would provide comments and recommendations to the NRC.

CHAIRMAN KIRCHNER: May I make an observation here, Bruce?

If I remember correctly the rules under Part 50 and Part 52, the applicant is not required to have this at this ESP juncture. Is that correct?

MR. MUSICO: Not required to have what?

CHAIRMAN KIRCHNER: The way -- the fully-developed emergency plans.

MR. MUSICO: No. No, they are permitted to come in with a major features emergency plan with limitations.

CHAIRMAN KIRCHNER: Right.

MR. MUSICO: However, they are required to come in and show that there are no physical characteristics that could pose a significant impediment to development of an emergency plan.

CHAIRMAN KIRCHNER: Yes.

MR. MUSICO: And also with respect to -- let me see -- the boundary established for the proposed two-mile plume exposure pathway EPZ, they looked at that as well. And that was defined in the evacuation time estimate.

CHAIRMAN KIRCHNER: Right.

MR. MUSICO: Now, if the applicant chose not to submit an evacuation time estimate at this time, it would be very limited with respect to what we could evaluate and what finality they would get at this time. So again, that is one of the advantages of the major features emergency plan that they could come in with and that they could pick and choose what aspects of emergency planning they choose to address. And it was limited, in this case, but it included various aspects that they reflected and we reviewed.

CHAIRMAN KIRCHNER: The reason I brought it up is I'm not an expert from alpha to omega on all the details. But the implication from the slide, it just it's like negative you know but actually I think the applicant has met all of your requirements --

MR. MUSICO: Well I -- I'm sorry.

CHAIRMAN KIRCHNER: -- or in Part 52 for the ESP.

MR. MUSICO: I would characterize the slide as positive in that --

CHAIRMAN KIRCHNER: Okay. All right.

MR. MUSICO: It doesn't say no.

CHAIRMAN KIRCHNER: It only addressed limited features and so on but --

MR. MUSICO: An unbiased opinion here but

what the slide represents is that there were two key aspects that we are required to consult with FEMA. If you look at the regulations from 10 CFR Part 52, there are two areas where it specifically directs the staff to make determinations in consultation with FEMA.

CHAIRMAN KIRCHNER: Right.

MR. MUSICO: And that's reflected in their letter.

CHAIRMAN KIRCHNER: Yes.

MR. MUSICO: What the letter does reflect, also, is that there are limitations that FEMA has identified that they would still look at in a further licensing process and they are not approving an emergency planning zone at this time.

So I think it's an appropriate balance in the response, where they did respond to the two in consultation with requirements that are required for us to work with them on in an early site permit but, also, in addition, reflected an area of concern that they had going forward in the licensing process.

CHAIRMAN KIRCHNER: Yes, that's fine. It's just that when you went through the list, as you did -- I'm sure this is quite accurate -- I just come away with a feeling like they maybe they didn't do something correctly. But as far as I can tell, the

read from this slide is that they've done everything that's needed at this point.

MR. MUSICO: That's correct. That's correct, they did.

CHAIRMAN KIRCHNER: Okay, thank you.

MR. MUSICO: So we satisfied the two in consultation with requirements in the regulations --

CHAIRMAN KIRCHNER: Right, that's what I thought. Okay, thank you.

MR. MUSICO: -- as well as identifying the path going forward and their concerns going forward.

MEMBER BLEY: So you weren't approving an EPZ at this time. You're approving an approach to define.

MR. MUSICO: We are not approving an EPZ at this time, a plume exposure pathway EPZ at this time. We are approving a methodology for determining dose that would be used to determine which of the two major features emergency plans they can utilize in the COLA application.

We are approving the two major features emergency plans, which are reflected by the site boundary EPZ and the two-mile EPZ.

MEMBER BLEY: Right.

MR. MUSICO: But in approving those, as

they relate and are reflected in the respective major features emergency plan, does not approve those for the site because that choice will be made at the COL application stage.

MEMBER BLEY: Right.

MR. MUSICO: And at that stage, let's say they picked the two-mile plume exposure pathway EPZ in the COLA, while they get the benefit of finality and the approval of the two-mile major features plan that we approved, it is a major feature plan. It is limited aspects of emergency planning. At that time, they do have to come in with a complete and integrated emergency plan.

So there is a delta between the limited aspect of EP that we approved now, versus what the final, all the EP requirements that they have to show in the COLA.

CHAIRMAN KIRCHNER: Right.

MEMBER BLEY: When we get to the COLA stage, before you approve the COLA, does FEMA have to agree? Do they have to approve it or do they just have to not -- you just have to consult with them and they shouldn't have any major objections.

MR. MUSICO: Well, it depends. It depends on which -- naturally, we would consult with them on

the application, whatever came in. But as far as the requirement for any approval from them, it depends on which major features emergency plan is chosen by TVA. And I'll discuss that in the upcoming slide.

MEMBER BLEY: Okay.

MR. MUSICO: Next slide, please, it would be slide 18.

In the safety evaluation, the staff identified 16 COL action items and we identified four permit conditions. This merely distinguishes between what a COL action item is and what a permit condition is.

For the COL action items, what they do is they track information that is needed before granting a COL but is not required in the early site permit application. They reflect the SMR design that may be identified in the COLA and they require NRC evaluation, further analysis, as part of the COL application review.

What these primarily come from is the fact -- this is similar to the PSEG site application that we reviewed, which came in with a plant parameter envelope, where they didn't identify specific reactor technology. So there are certain areas that deal with emergency planning that are reactor-specific. And so

for those particular areas, that information just isn't available yet because they haven't identified the reactor.

So the TVA identified a number of areas where this information is not available now. It will be identified and addressed at the COL application and, at that stage, we will review it in detail. And we captured that as COL action items.

In short, COL action items request information that they choose not to provide or is not available at this time but will require a subsequent analysis in the COL application. So we will be doing a detailed analysis on that information at that time.

In contrast, we identified four permit conditions and Michelle mentioned for Permit Condition 1 ministerial aspect of confirmation of whether they met the permit conditions. We identified four, one of which was Permit Condition 1 that Michelle addressed, and these all have that characteristic.

An ESP is granted subject to permit conditions, which address required detailed information that is not yet known but will be available in the COLA and subject to NRC confirmation.

Next slide, please. The next two slides, 19 and 20, merely list the 16 COL action items. And

I won't read through those. You can read through them yourself. But the details associated with why these were identified and how the staff recommended that there be COL action items, this is detailed within the safety evaluation. You can look for detail in the SE.

Slide 21. Slide 21 lists the four permit conditions that the staff identified and also we identified one confirmatory item, which reflected TVA's withdrawal of one of their exemption requests. And this will be closed out when we receive the ESP Application Revision 2. So this is just a minor issue, as far as a confirmation in Rev. 2 that they actually withdrew it in Rev. 2.

Next slide, please. This deals with the COL application, the combined license application. n the COL application, the COL applicant will identify an SMR technology which must meet the plume exposure pathway EPZ sizing methodology approved in the early site permit for either the site boundary or two-mile plume exposure pathway EPZ, or if they choose, they may proposed a new emergency plan.

In other words, if they come in and they show that one of the technologies they've chosen does not -- using the methodology that we've approved in the ESP does not meet either the site boundary or two-

mile plume exposure pathway EPZ, then they would lose the benefit of the finality associated with the approved two major features emergency plan. And they would have to come in at the COL time with a complete and integrated emergency plan, a completely new complete and integrated emergency plan with no benefit from the preapproval and finality for the site boundary or two-mile plan that we've reviewed.

If the two-mile plume exposure pathway EPZ is selected and justified, the NRC will request that FEMA review the off-site emergency plans -- and I think that addresses your earlier question -- because at that time, there would be a requirement for a complete and integrated emergency plan to have to submit off-site emergency plans. And that's where FEMA would come in, where they would review and approve, as part of our consultation, the off-site emergency plans.

If, however, the site boundary plume exposure pathway EPZ is selected and justified using the methodology, no formal FEMA approval of the off-site radiological plans are required because there would not be any off-site radiological emergency plans submitted in the COLA.

The COL applicant will still need,

however, to address requirements to communicate and coordinate with off-site support organizations and agencies.

Yes?

CHAIRMAN KIRCHNER: Let me throw a hypothetical case out there. So invariably, we've seen this with the existing fleet. They always want to uprate the power, get more out of their investment.

So what happens now if TVA -- you grant these exemptions, et cetera, and with these limitations, permit conditions, et cetera -- but they think this over for a bit and they say well, you know, we really ought to get a few more hundred megawatts electric out of this and they'll push up the thermal rating? Are you still then in a position, notwithstanding what we heard this morning -- I don't know if you were there on the rulemaking --

MR. MUSICO: I was there.

CHAIRMAN KIRCHNER: -- and the future of that rulemaking, if they came in and said well, gee, I think we can't quite shoehorn it into our current site boundary and maybe we need a little cushion, so we want to do it at three miles, what would happen then? Would you -- notwithstanding the rulemaking that should allow that flexibility, would you then

just reopen the case for that contingency?

MR. MUSICO: Well, yes. Yes, we would.

CHAIRMAN KIRCHNER: And I guess exemption would be the means to handle it.

MR. MUSICO: They would -- pardon?

CHAIRMAN KIRCHNER: An exemption, then, would be the means to handle it.

MR. MUSICO: No, not necessarily. If they came in and they determined, through whatever means -- the power itself, the power levels are really not particularly relevant to the analysis that we did, except to the extent that using the methodology, subsequently they can meet the dose -- using the methodology they've defined and we've approved, they can meet the site boundary of two miles.

If they decide to come in with the reactor technology that has a higher power level then that could not meet either the site boundary or two-mile plume exposure pathway EPZ, they would lose the finality, the benefit associated with the two major features emergency plan that we approved. They would be required to come in with a totally new complete and integrated emergency plan which reflected that.

With respect to the methodology, they have the benefit of the methodology and if they could show

that, using that methodology, they don't meet the two-mile or the site boundary but they meet three miles, conceivably, they could come in and use the methodology with a new complete and integrated emergency plan --

CHAIRMAN KIRCHNER: That's what I was testing.

MR. MUSICO: -- and we would review that.

CHAIRMAN KIRCHNER: And you would review that.

MR. MUSICO: Well, we wouldn't be reviewing the methodology again.

CHAIRMAN KIRCHNER: Right, no.

MR. MUSICO: We would be reviewing the complete and integrated emergency plan.

CHAIRMAN KIRCHNER: Right but you wouldn't throw them out and say no, that's ten miles, folks.

MR. MUSICO: No. No --

CHAIRMAN KIRCHNER: Okay. That's what I'm testing.

MR. MUSICO: -- because the methodology --

CHAIRMAN KIRCHNER: I'm testing how flexible your approach is.

MR. MUSICO: -- is not site boundary, two miles, or ten miles. The methodology is the dose at

whatever distance it turns out to be.

CHAIRMAN KIRCHNER: Exactly.

MR. MUSICO: So we did think about that.

CHAIRMAN KIRCHNER: Okay, good.

MR. MUSICO: So yes, that's an interesting approach that they could possibly take.

MS. BRADFORD: This is Anna Bradford from NRO. Just one nuance is we wouldn't necessarily have to -- I mean the methodology would be approved. So someone said we wouldn't review the methodology. We would review the application of that methodology --

CHAIRMAN KIRCHNER: Of course. Yes, of course.

MS. BRADFORD: -- to make sure we agree with where they came out.

CHAIRMAN KIRCHNER: Yes, all right.

MEMBER MARCH-LEUBA: Yes, but make sure when you write the SP that you box yourself with the two-mile because you call it two-mile everywhere. I'm looking at a map and I would love to have a one and a half mile.

MR. MUSICO: Well, I wouldn't say they boxed themselves. I would say they provide themselves with a high amount of flexibility.

CHAIRMAN KIRCHNER: Yes.

MEMBER MARCH-LEUBA: Well tell me again, if it was only one and a half mile, you could make the lower, the south boundary I-40 and don't have to have any migration plans.

MR. MUSICO: They would have to choose the two-mile emergency planning zone if they wanted to use that major feature as a risk plan.

MEMBER MARCH-LEUBA: They cannot take one and a half?

MR. MUSICO: They can take one and a half but they still have to use the two-mile emergency planning major features plan.

MEMBER MARCH-LEUBA: Why?

MR. MUSICO: If the methodology determined that the desired dose was at one and a half miles, they couldn't have the benefit of the site boundary major features emergency plan. They would have to utilize the two-mile major features emergency plan.

Now, if they didn't want to utilize that and let's say they wanted to have a new one and a half mile emergency planning zone, they would also lose the benefit of the evacuation time estimate and they would still have to off-site emergency plans. So, it would be -- it wouldn't be advantageous to them to do that because they've already gotten a lot of finality for

that two-mile emergency planning zone. They've got the finality associated with the evacuation time estimate, as far as our review of the major features emergency plan. And they just have to supplement that, provide the delta for the complete and integrated emergency at the COL application --

MEMBER MARCH-LEUBA: Most of the plan is on I-40 and the Oak Ridge Turnpike because everything else is a desert. There is nothing there.

MR. MUSICO: Well you know they could move the road. Who knows.

MEMBER MARCH-LEUBA: Okay.

MR. MUSICO: All right, slide 23. Thank you.

All right, slide 23 -- let's see -- this summarizes the five key findings that the staff made in the safety evaluation report and these reflect the findings that are required by our regulation.

First of all, the staff found that there are no significant impediments to the development of emergency plans. Secondly, there was an adequate -- TVA provided an adequate description of contacts and arrangements with federal, state, and local support agencies. The staff found that the proposed exemptions are acceptable. The staff found that the

proposed major features emergency plans are acceptable. And finally, that the proposed dose-based consequence-oriented EPZ sizing methodology is reasonable.

Next slide, please, and I'll turn it back over to Michelle or to Mallecia. Sorry.

MS. SUTTON: The staff's conclusion. The staff presented its review and findings on emergency planning for the TVA Clinch River early site permit application. The staff concludes that the plume exposure pathway emergency planning zone size and methodology is acceptable for determining the appropriate size of the plume exposure pathway emergency planning zone for the Clinch River Nuclear Site because it is consistent with the analyses that form the technical basis for the current ten-mile plume exposure pathway emergency planning zone.

The two major features emergency plans are acceptable because they meet the applicable standards of 10 CFR 50.47 and requirements of Appendix E to 10 CFR Part 50.

The exemption requests are acceptable because they are authorized by law, will not present an undue risk to the public health and safety, are consistent with the common defense and security, and

special circumstances are present.

Therefore, the staff finds the TVA early site permit application acceptable with respect to emergency planning and related exemption requests.

Because we are discussing an early site permit, the staff wanted to clarify the relationship of the early site permit exemptions to a future combined license application that references the permit. The staff's presentation provided details on the evaluation of TVA's methodology, exemption requests, and emergency plans. This table provides the breakdown of TVA's request for approval in these three topic areas in their early site permit application and the final products of the staff's evaluation.

In addition, it provides how the early site permit and exemptions can be implemented in a combined license application if the early site permit conditions are met.

The last is an action that will not be completed until the Commission makes a decision whether to grant an early site permit and the exemptions. The appropriate plume exposure pathway emergency planning zone size for this site will not be determined until a combined license application that

references a specific small modular reactor design is submitted for the Clinch River Nuclear Site.

If there are no additional questions on this table or for the staff, this will conclude the staff's presentation.

Any questions?

CHAIRMAN KIRCHNER: Thank you. Let me go around first -- or take public comments first. Excuse me.

So let me look around and see if anyone is in the room. Is there anyone in the room from the public who wishes to make a comment?

Seeing no one stepping forward, can we open -- it is open.

To those on our bridge line, is there anyone from the public who would wish to make a comment?

Hearing none, we can close the bridge line -- or mute the bridge line. Thank you.

And I will go around the table, starting with Ron.

MEMBER BALLINGER: No comments.

CHAIRMAN KIRCHNER: Dennis.

MEMBER BLEY: No comments.

CHAIRMAN KIRCHNER: Matt.

MEMBER SUNSERI: I appreciate the presentations. I have no comments.

CHAIRMAN KIRCHNER: Joy.

MEMBER REMPE: I also appreciate the presentations but have no comment.

CHAIRMAN KIRCHNER: Jose.

MEMBER MARCH-LEUBA: Why break a perfect record? No comment.

CHAIRMAN KIRCHNER: Well, again, with the caveat that this is just one member's opinion and not that speaking for the ACRS, I think what we've heard from the applicant and what the staff has presented -- thank you for your presentations -- sounds reasonable and prudent. And I expect that the devil will be in the details when we actually see an actual technology selection and the COLA.

So if there are no further comments, thank you again, and we are adjourned.

(Whereupon, the above-entitled matter went off the record at 3:42 p.m.)

Clinch River
Early Site Permit
Part 2,SSAR Section 13.3, Part 5, & Part 6

Advisory Committee on Reactor Safeguards
Committee Meeting

Presented by
Archie Manoharan, Licensing
Alex Young, Engineering

August 22, 2018

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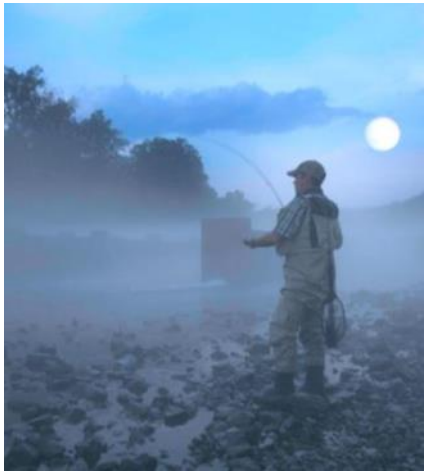
TVA's Mission

Serving the people of the Tennessee Valley to make life better.

Energy

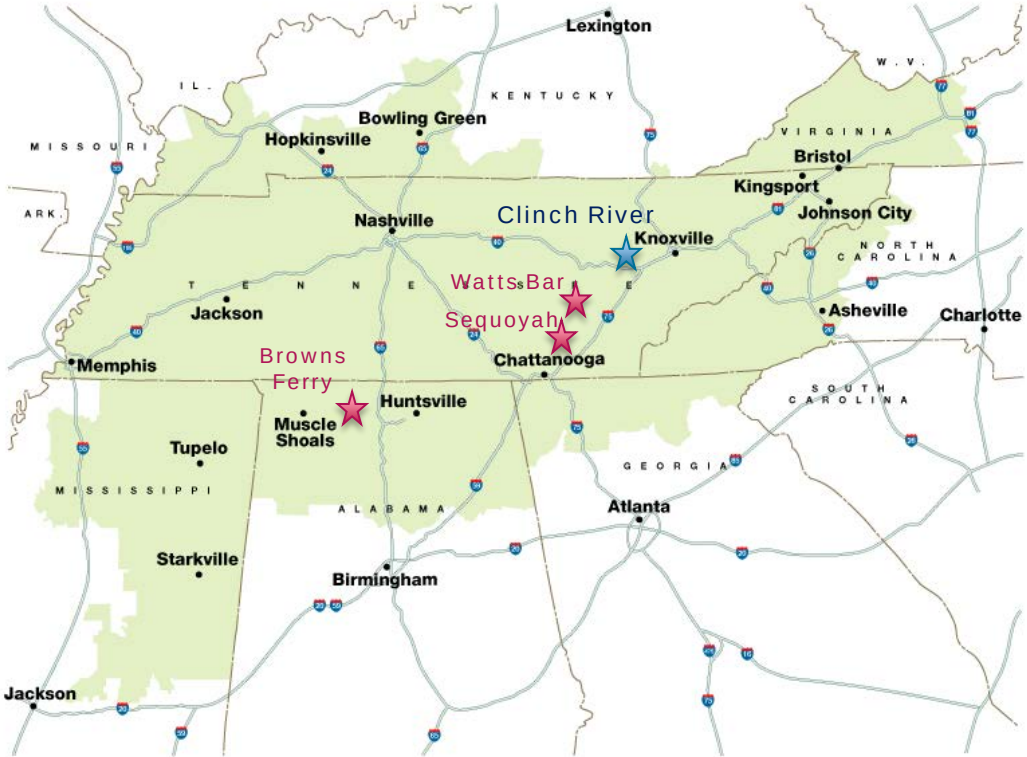


Environment

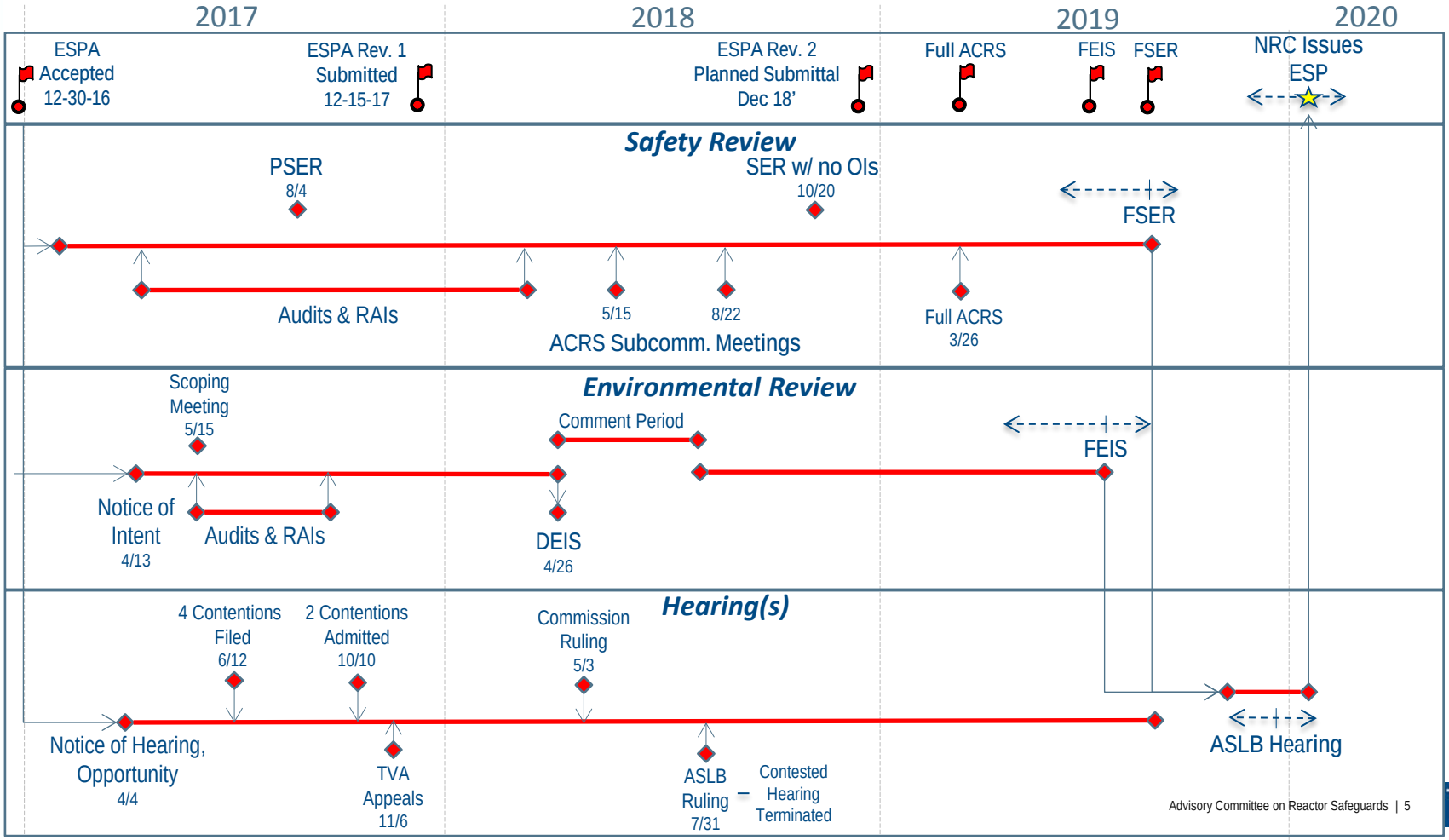
Economic Development

Partner with 154 local power companies, to serve more than 9 million customers in parts of seven states. Directly serve 54 large industries and federal installations.

TVA's Nuclear Fleet



NRC Review of ESPA



ESPA – Emergency Preparedness Development

The ESPA considered information from four light water small modular reactor (SMR) designs:

- NuScale (160 megawatts thermal (MWt), 50 megawatts electrical (MWe))
- SMR-160 Holtec (525 MWt, 160 MWe)
- mPower (530 MWt, 180 MWe)
- Westinghouse (800 MWt, 225 MWe)

Combined nuclear generating capacity for the Clinch River Site not to exceed 2420 MWt (800 MWe)

Need for Scalable Emergency Planning Zone (EPZ):

- NUREG-0396 introduced the concept of a 10-mile EPZ 40 years ago
- NUREG-0396 considered large light water reactors (LWRs)

Based on SMR design information:

- TVA developed a dose-based, consequence-oriented approach to determine an appropriate EPZ size for a SMR
  - approach has the same dose criteria as NUREG-0396
  - takes into consideration SMR design and safety advancements
- Two emergency plans were proposed and developed
  - all four designs are expected to be able to meet the dose criteria for 2-mile EPZ
  - at least one design is expected to be able to meet the does criteria for Site Boundary EPZ
- Exemption requests that allow for review of major features of emergency plans other than 10-mile EPZ

Presentation Outline

Part 2, Site Safety Analysis Report (SSAR), Section 13.3, Emergency Preparedness:

- 13.3.1 Physical Characteristics
- 13.3.2 Emergency Plan (Refers to Part 5 of the ESPA)
- 13.3.3 Emergency Planning Zones
- 13.3.4 Evacuation Time Estimates (Supports Part 5B)
- 13.3.5 Contacts and Agreements

Part 5, Emergency Plan:

- Part 5A Emergency Plan Site Boundary EPZ
- Part 5B Emergency Plan 2-Mile EPZ

Part 6, Exemptions and Departures

- Exemption Requests for a Plume Exposure Pathway (PEP) EPZ at Site Boundary
- Exemption Requests for an approximate 2-mile PEP EPZ

Key NRC Interactions Related to Emergency Preparedness

Two audits were conducted to review the emergency preparedness information in the ESPA

- First audit – November 2017 through February 2018
  - Example analysis completed by TVA to demonstrate feasibility that dose criteria can be met at Clinch River Site Boundary (RAI-8885)
- Second audit – April 2018
  - EPZ Plant Parameter Approach (RAI-9206)

Requests for Additional Information (RAIs)

- RAI-8885 – demonstrate that dose criteria can be met at Site Boundary EPZ
- RAI-9206 – discuss how EPZ methodology was implemented in the example analysis and the EPZ plant parameter approach developed

Part 2, SSAR,
Chapter 13 – Section 13.3
Emergency Preparedness

Section 13.3.1 – Physical Characteristics

Site Description

DOE Oak Ridge Reservation borders the North-East sides

6.8 miles East of Kingston, TN

8.8 miles Northwest of Lenoir City, TN

9.2 miles East-Southeast of Harriman, TN (not shown)

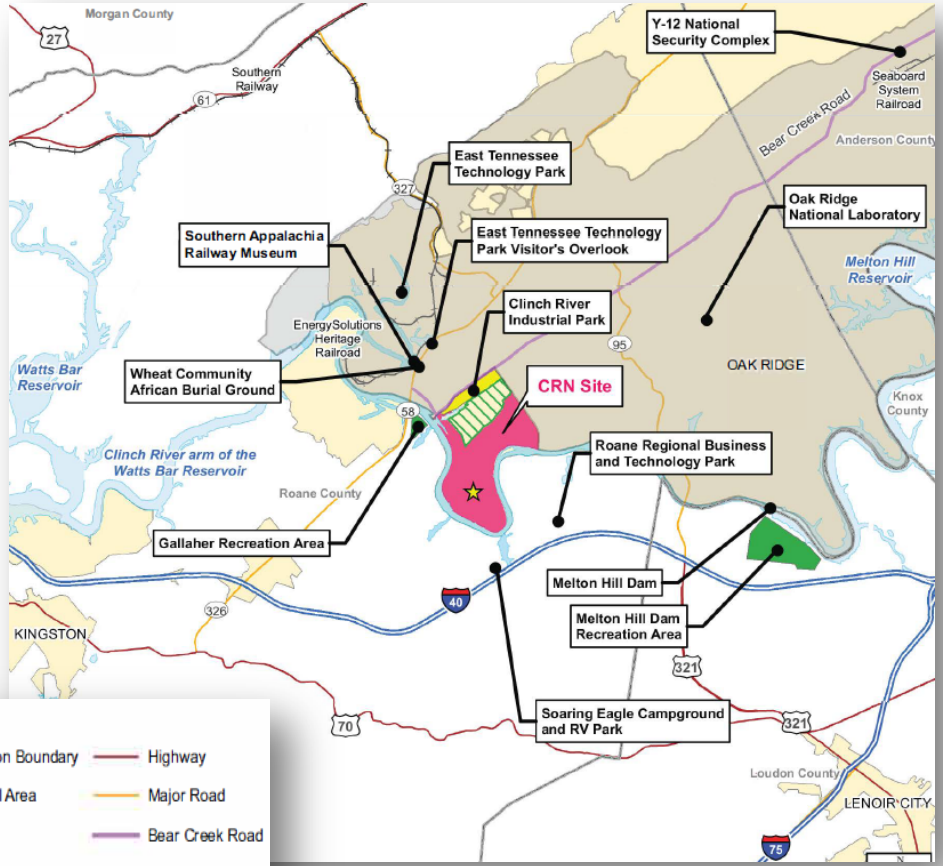
25.6 miles West-Southwest of Knoxville, TN (not shown)

Area Population

U.S. Census 2010 data projected to 2015

856 permanent residents within 2-mile PEP EPZ

186,500 permanent residents within 15 miles



Section 13.3.3 – Emergency Planning Zones

The methodology uses a dose-based, consequence-oriented approach for determining the appropriate size of the PEP EPZ consistent with the NUREG-0396 approach with a dose criteria of the Environmental Protection Agency (EPA) early phase Protective Action Guides (PAGs).

The methodology is consistent with the NUREG-0396 approach:

- a spectrum of accidents are addressed
- Dose criteria is the same
- PEP EPZ boundary ensures protection from dose levels above 1 rem total effective dose equivalent (TEDE) limit established in the EPA PAG

Four light water SMR designs were considered which significantly differ from the large LWRs:

- smaller cores
- lower source terms
- reduced accident consequences
- reduced likelihood of accidents
- slower accident progression allows more time for mitigating actions

Section 13.3.3 – Emergency Planning Zones

Technical criteria for determining the PEP EPZ size uses the existing emergency preparedness regulatory framework and dose saving criteria established in NUREG-0396

- Consistent with the NUREG-0396 sizing rationale, the technical criteria for determining the PEP EPZ size:
  - A. Encompass those areas in which projected dose from design basis accidents (DBAs) could exceed the EPA early phase PAGs.
  - B. Encompass those areas in which consequences of less severe core melt accidents could exceed the EPA early phase PAGs.
  - C. Be of sufficient size to provide for substantial reduction in early severe health effects in the event of more severe core melt accidents.

Section 13.3.3 – Emergency Planning Zones

Criteria A and B: PEP EPZ encompasses those areas in which the plume exposure doses from DBAs and less severe core melt accidents could exceed the EPA early phase PAG

- Areas outside the PEP EPZ would meet the EPA early phase PAG dose limit of less than 1 rem TEDE.
- The methodology for verifying dose consequences beyond the PEP EPZ do not exceed the EPA early phase PAG levels includes:
  - Step 1 - Selecting appropriate accident scenarios *(accident scenarios with mean core damage frequency (CDF) greater than 1E-6 per reactor-year (rx-yr))*
  - Step 2 - Determining source terms for selected accident scenarios
  - Step 3 - Calculating the dose consequences for selected accident scenarios
  - Step 4 - Comparing the dose consequences for selected accident scenarios with the EPA early phase PAG

Section 13.3.3 – Emergency Planning Zones

Criteria C: PEP EPZ be of sufficient size to provide for substantial reduction in early severe health effects in the event of more severe core melt accidents

Methodology for verifying that areas outside the PEP EPZ meet the limits for substantial reduction in early health effects:

- Step 1 - Selecting appropriate accident scenarios *(accident scenarios with mean CDF greater than 1E-7 per rx-yr)*
- Step 2 - Determine source terms for selected accident scenarios
- Step 3 - Calculate the dose consequences for selected accident scenarios at the PEP EPZ boundary
- Step 4 - Calculate the distance at which the conditional probability to exceed 200 rem (whole body) exceeds 1E-3 per rx-yr
- Step 5 - Compare that distance with the PEP EPZ

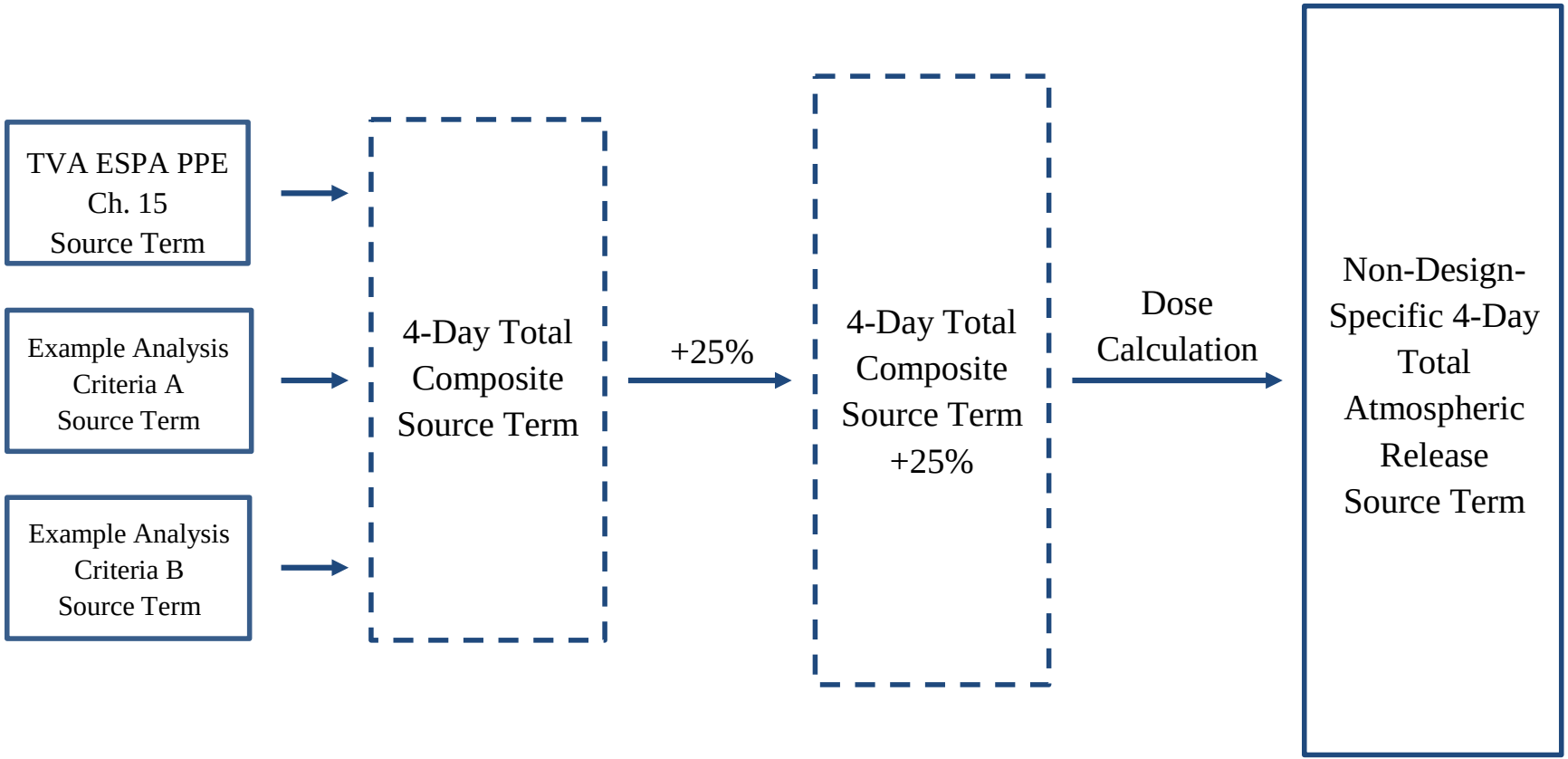
Design Specific Example Analysis – Site Boundary PEP EPZ

- Evaluates NuScale Power Plant at the Clinch River Site
- Implements the dose-based methodology described in SSAR Section 13.3
- Demonstrates that Site Boundary EPZ is possible
- Doses at Site Boundary are much less than the EPA early phase PAG

Criteria	Site Boundary Dose TEDE (rem)	EPA Early Phase PAG Limit TEDE (rem)
A: Design Basis Accidents	0.104	1
B: Less Severe Core Melt Accidents	0.158	1

C: Reduction in Early Severe Health Effects	No accident scenarios with mean CDF greater than 1E-7 per rx-yr.

EPZ Plant Parameter Approach



Section 13.3.5 – Contacts and Agreements

Letters of Support

- Letters of support from the State of Tennessee, Anderson County, Roane County, and the City of Oak Ridge were submitted in support of the ESPA.
- 10 CFR 52.17(b)(4) requires that the applicant make good-faith efforts to obtain certifications from local, State, and Federal governmental agencies with EP responsibilities.

Letters of Agreements and Certification Letters

- Certification letters and letters of agreements will be pursued during the combined license application (COLA) process.
- TVA will maintain agreements with surrounding emergency response organizations.
- TVA would continue to work with State and local support organizations to establish an emergency preparedness at Clinch River commensurate with the potential consequences to public health and safety

Part 5 – Emergency Plan

Part 5 – Emergency Plan

Part 5 of the ESPA contains the major features of two distinct Emergency Plans for Clinch River Site in accordance with 10 CFR 52.17(b)(2)(i).

Part 5A

- Describes major features of an Emergency Plan for a PEP EPZ consisting of the area encompassed by the Site Boundary.

Part 5B

- Describes major features of an Emergency Plan for a PEP EPZ consisting of an area approximately two miles in radius surrounding the Clinch River Site.

Both plans address the 16 planning standards in NUREG–0654, Section II, which reflects the requirements in 10 CFR 50.47(b)(1) through 10 CFR 50.47(b)(16) and Appendix E to 10 CFR Part 50 considering the requested exemptions described in Part 6 of the ESPA

Part 5A – Emergency Plan (Site Boundary EPZ)

- TVA Generic Emergency Plan as modified for Clinch River Site and an appendix with Site-Specific information
- Actions necessary to safeguard onsite personnel (within the site boundary) and minimize damage to property
- Information to ensure the compatibility of the proposed emergency plans (**for onsite areas**) with facility design features, site layout, and site location

Part 5B – Emergency Plan (2-Mile EPZ)

- TVA Generic Emergency Plan as modified for Clinch River Site and a Site-specific appendix
- Information to ensure the compatibility of the proposed emergency plans (**for both onsite areas and the PEP EPZ**) with facility design features, site layout, and site location.
- Site Evacuation Time Estimate Report

Part 5B – Evacuation Time Estimate

- Analysis of evacuation times is one method to identify any significant impediments to the development of emergency plans at the Site
- Provides TVA, State and local governments with site-specific information needed for protective action decision making
- Evacuation Time Estimates (ETE) analyses for Clinch River Site were completed in accordance with the guidance provided in NUREG/CR-7002, Criteria for Development of Evacuation Time Estimate Studies
- These analyses did not identify any physical characteristics unique to the Clinch River Site that could pose a significant impediment to the development of emergency plans

Part 6 – Exemptions and Departures

Part 6 – Exemptions and Departures

Pursuant to 10 CFR 52.7, Specific Exemptions, which is governed by 10 CFR 50.12, Specific Exemptions, TVA requested exemptions from the following emergency preparedness requirements for the Clinch River Site:

- Certain standards in 10 CFR 50.47(b) regarding onsite and offsite emergency response plans for nuclear power reactors
- Certain requirements of 10 CFR 50.33(g) and 10 CFR 50.47(c)(2) to establish PEP EPZ for nuclear power plants
- Certain requirements of 10 CFR Part 50, Appendix E, which establish the elements that make up the content of emergency plans

Two Sets of Exemptions

Based on the dose-based EPZ methodology described in Section 13.3 and taking light water SMR designs into consideration, two sets of exemptions were developed:

- Exemptions for a PEP EPZ established at the Site Boundary (Part 5A)
- Exemptions for an approximate 2-mile PEP EPZ (Part 5B)

Part 6 – Exemptions and Departures

Requested exemptions – Table 1-1 Exemptions Requested from 10 CFR 50.33(g), 50.47(b), and 50.47 (c)(2) for the **Site Boundary PEP EPZ Emergency Plan**

Regulation	Requirement	Exemption Request
10 CFR 50.33(g) 10 CFR 50.47(c)(2)	10 mile PEP EPZ distance	Deviate from 10 mile PEP EPZ
10 CFR 50.47(b), b(4), b(5), b(6), b(9), b(10)	Various elements of a formal offsite emergency plan	Deviate from formal offsite radiological emergency plan requirements on the basis that there are no offsite radiological consequences from any credible event in excess of the criteria described in Section 13.3. Note: TVA's emergency plan will describe the capabilities to determine if a radiological release is occurring and promptly communicate that information to the offsite response organizations for their consideration.

Part 6 – Exemptions and Departures

Requested Exemptions – Table 1-2 Exemptions Requested from 10 CFR 50, Appendix E for the Site Boundary PEP EPZ Emergency Plan

Regulation	Requirement	Exemption Request
10 CFR 50, Appendix E, Section IV.2 – IV.7	Evacuation time estimates (ETEs)	Deviate from ETE requirements as no offsite consequences from any credible event in excess of the criteria provided in Section 13.3, formal offsite radiological emergency response plans with preplanned evacuation details are not necessary. Therefore, there is no need for ETEs.
10 CFR 50, Appendix E, Section IV.D.1, D.3, D. 4	Certain elements of offsite notifications	Deviate from certain offsite notification requirements as members of public would not be within the Site Boundary PEP EPZ. (Note: TVA is not seeking an exemption from the requirement to notify responsible State and local government agencies within 15 minutes after declaring an emergency.)
10 CFR 50, Appendix E, Section IV.F.2, F.2.a, F. 2.a.(i) – 2.a.(iii), F.2.b, F.2.c, F.2.d	Certain elements of offsite exercises	Deviate from certain offsite exercise requirements as no formal offsite radiological emergency response plans would be needed as no offsite consequences from any credible event in excess of the criteria provided in Section 13.3. (Note: TVA would continue to invite State and local support organizations to participate in the periodic drills and exercises conducted.)

Part 6 – Exemptions and Departures

Requested Exemptions – Table 1-3 Exemptions Requested from 10 CFR 50.33(g) and 50.47(c)(2) for the 2-Mile PEP EPZ Emergency Plan

Regulation	Requirement	Exemption Request
10 CFR 50.33(g) 10 CFR 50.47(c)(2)	10 mile PEP EPZ distance	Deviate from 10 mile PEP EPZ

Part 6 – Exemptions and Departures

Technical Justification

- The criteria established in the methodology described in Section 13.3, provides for adequate protection of public health and safety by providing a EPZ that encompasses the areas in which the plume exposure doses could exceed the EPA early phase PAG, and for where there is a substantial reduction in risk of significant early health effects.

Special Circumstances Exist – Underlying Purpose of the Regulations Being Met

- Exemptions are Authorized by Law
- Exemptions Will not Present Undue Risk to Public Health And Safety
- Exemptions Are Consistent with the Common Defense and Security

Summary

	ESPA	COLA
PEP EPZ Methodology (Part 2, SSAR, Section 13.3)	Approval of the dose-based, consequence oriented methodology for determining the PEP EPZ size	Approval of design specific implementation of the methodology approved in the ESPA
EPZ Size (Part 6)	Approval to deviate from the current 10-mile PEP EPZ requirements based on the methodology to determine PEP EPZ size	Approval of design specific PEP EPZ size based on design specific implementation of the methodology
Emergency Plan (Part 5)	Approval of the major features of the Site Boundary and 2-mile emergency plans presented in Part 5	Approval of the remaining elements of either the Site Boundary or 2-mile emergency plans OR a new plan based on design specific PEP EPZ size using methodology

ACRS Subcommittee
August 22, 2018

Tennessee Valley Authority (TVA)

Early Site Permit Application (ESPA)

ESPA Site Safety Analysis Report (SSAR) Section 13.3

Emergency Planning

Advanced Safety Evaluation Report (SER) with no Open Items

Project Managers

Mallecia Sutton (NRO)

Allen Fetter (NRO)

Technical Reviewers

Bruce Musico (NSIR)

Michelle Hart (NRO)

13.3 Emergency Planning – TVA Early Site Permit Application

The ESPA requested review of 3 key areas, which consist of:

- Plume exposure pathway (PEP) emergency planning zone (EPZ) sizing methodology (ESPA SSAR, Sec. 13.3)
- 2 Major Features (onsite) Emergency Plans (ESPA Part 5)
  - ESPA Part 5A reflects a Site Boundary PEP EPZ
  - ESPA Part 5B reflects a 2-Mile PEP EPZ (includes an evacuation time estimate)
- 25 Exemption Requests (ESPA Part 6)
  - ESPA proposes 2 sets of exemptions (for the site boundary/2-mile PEP EPZs)
  - ESPA proposes an exemption from the current 10-mile PEP EPZ
  - Exemptions address portions of 10 CFR 50.33(g), 50.47(b) & (c)(2), and Appendix E to 10 CFR Part 50, for onsite and offsite emergency planning (EP)

Part 52 Licensing Process

- Upon issuance of the early site permit (ESP), the applicant acquires approval, with conditions, on:
  - The PEP EPZ sizing methodology
  - The 25 requested exemptions
  - The 2 major features E-plans (site boundary & 2-mi PEP EPZ)
- In the future, a combined license application (COLA) that incorporates by reference the ESP will:
  - Identify a chosen small modular reactor (SMR) technology for the Clinch River Nuclear Site
    - The applicant must demonstrate that the EPZ sizing methodology supports either the site boundary or 2-mile PEP EPZ
  - Provide a complete & integrated emergency plan
    - For the 2-mile PEP EPZ, must provide onsite & offsite emergency plans
    - For the site boundary PEP EPZ, must provide onsite emergency plan (assumes that site boundary, as defined for EP purposes in the COLA, will be within the applicant's owner controlled area)
  - Address identified COL action items and permit conditions

Review of Exemptions (Special Circumstances)

- The NRC reviewed the requested exemptions pursuant to 10 CFR 50.12 (Specific Exemptions)
  - 50.12(a)(2) – The Commission will not consider granting an exemption unless special circumstances are present.
  - Special circumstances are present whenever –
    - (ii) – Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule, or is not necessary to achieve the underlying purpose of the rule.

Special Circumstances (Underlying Purpose of Rule)

- The underlying purpose of 10 CFR 50.33, 50.47, and Appendix E to 10 CFR Part 50, is to:
  - Ensure that licensees maintain effective onsite and offsite radiological emergency response plans,
  - Ensure that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency, and
  - Establish plume exposure and ingestion pathway EPZs.
- The ESPA serves to provide a basis for the establishment (in the COLA) of either a Site Boundary or 2-mi PEP EPZ, which maintains the same level of protection (i.e., dose savings in the event of a radiological emergency) in the environs of the Clinch River Nuclear Site, as that which exists in the basis for a 10-mi PEP EPZ.

TVA PEP EPZ Size Methodology
Technical Criteria

- PEP EPZ should encompass those areas in which projected dose from design basis accidents (DBAs) could exceed the U.S. Environmental Protection Agency (EPA) early phase protective action guide (PAG)
- PEP EPZ should encompass those areas in which consequences of less severe core melt accidents could exceed the EPA early phase PAG
- PEP EPZ should be of sufficient size to provide for substantial reduction in early health effects in the event of more severe core melt accidents

TVA PEP EPZ Size Methodology
SSAR Section 13.3.3.1

- Accident scenario selection
  - Use bounding DBA from COLA Final Safety Analysis Report Chapter 15
  - Use COLA site- and design-specific probabilistic risk assessment (PRA) to categorize severe accident scenarios
    - All modes, internal and external events, applicable fuel handling and spent fuel pool accidents, multi-module considerations
    - Assess all sequences with mean core damage frequency (CDF) > 10^{-8} per rx-yr
    - More probable, less severe core melt scenarios
      - Mean CDF > 10^{-6} per rx-yr, intact containment
    - Less probable, more severe core melt scenarios
      - Mean CDF > 10^{-7} per rx-yr, containment bypass or failure
- Determine source term releases to atmosphere
- Calculate dose consequences at distance from plant
- Determine PEP EPZ size that meets the dose-based criteria

TVA Dose-Based PEP EPZ Size Criteria

- Dose to individual from exposure to the airborne plume during its passage and to groundshine, using average atmospheric dispersion characteristics for site
- DBA and more probable, less severe accidents
  - 1 rem total effective dose equivalent (TEDE) from 96-hr exposure
  - Lower end of dose range EPA PAG for early phase protective actions (e.g., evacuation and sheltering)
  - Verify that dose consequences do not exceed the EPA PAG beyond the site boundary (within owner controlled area) and 2-mile PEP EPZs
- Less probable, more severe accidents
  - Calculate the distance at which the conditional probability to exceed 200 rem whole body from 24-hr exposure exceeds 10^{-3} per rx-yr
  - Acute dose at which radiation-induced early health effects may begin to be noted (e.g., nausea)
  - Verify that the PEP EPZ supports substantial reduction in early health effects

Review of PEP EPZ Size Methodology

- Staff compared TVA's methodology and dose criteria to the study used as technical basis for current 10-mile PEP EPZ requirement (NUREG-0396)
  - The features of TVA's methodology are consistent with NUREG-0396
    - Considered a range of accidents
    - Performed accident consequence analyses
    - Determined an area outside of which early protective actions are not likely to be necessary to protect the public from radiological releases
- The staff concludes that the applicant's proposed methodology is reasonable, and consistent with the analyses that form the technical basis for the current regulatory requirement of a PEP EPZ of about 10 miles in radius.

SMR Features that Support the Exemption Requests

- TVA stated that special circumstances exist at the Clinch River Nuclear Site due to the anticipated enhanced safety features of the SMR designs under consideration
  - Smaller radionuclide inventory and source terms
  - Projected accident progression rate is anticipated to be slower
  - Various design features are expected to eliminate several historically considered design basis events
  - Severe accidents are projected to be less likely to occur
  - Advanced design features that would minimize accident consequences

Request for Additional Information Question 1

- Specific technical support related to the statements on SMR features and comparison to large light water reactors (LLWRs)
- TVA provided tables with several parameters comparing the smallest and largest SMRs (based on unit rated thermal power) in the Clinch River Nuclear ESPA plant parameter envelope (PPE) to large and medium currently operating pressurized water reactors and the AP1000

  For example:

  - Internal events CDF and large release frequency
  - Source term total activity
  - Primary coolant liquid mass to power ratio
  - Severe accident progression information

Request for Additional Information Question 2

- Demonstration that the proposed PEP EPZ size criteria could be met at a given EPZ boundary distance for potential reactor facilities that would be represented by the surrogate design in the PPE
- TVA provided an example analysis using design information for a specific SMR design as input to the SSAR 13.3 PEP EPZ size methodology
  - Example analysis showed that design could support a site boundary PEP EPZ
  - Not intended to prove case for ESPA to justify a specific PEP EPZ size
    - Based on preliminary design information for an SMR at the lower end of the rated power (160 MWt) that is part of the basis for the Clinch River Nuclear ESPA PPE
    - Used internal events design PRA only
    - Did not do detailed uncertainty analysis

EP Exemption Plant Parameters

- TVA developed a non-design-specific accident release source term that would meet the PEP EPZ size criteria to be used as plant parameters (SER Table 13.3-1)
  - Same idea as PPE DBA source term to envelope an unknown design
  - Referenced in Permit Condition 1 for adoption of EP exemptions
- Isotopic total release activity over 96 hrs results in TEDE of about 0.9 rem at site boundary
  - 3 core melt, intact containment accidents (2 DBAs and 1 severe accident)
  - From 2 SMRs (160 MWt and 800 MWt)
  - Maximum activity release for a specific radionuclide from any of the 3 accidents over a specific dose averaging period was assumed to be the release activity of that radionuclide for that period
    - 0-8 hrs, 8-24 hrs, 24-96 hrs
  - Added 25% margin
  - Additional adjustment to values for backcalculation

Permit Condition 1

- COL applicant referencing the ESP (if approved) would perform an analysis using the SSAR 13.3 PEP EPZ size methodology, with site- and design-specific input, to justify the PEP EPZ size for the COLA
- The COLA PEP EPZ size analysis output includes the source term releases to the atmosphere
  - Isotopic activity release over time
- If the COLA PEP EPZ size analysis source term releases to the atmosphere are bounded by the non-design-specific plant parameter source term information in SER Table 13.3-1, then the COL applicant can adopt the EP exemptions
  - 4-day total activity release to the atmosphere for 71 isotopes
  - COLA values should be shown to be less than ESP (Table 13.3-1) values to adopt the EP exemptions

Plant Parameter Envelope

- TVA identified 4 SMR designs to develop the PPE
  - BWXT mPower (Generation mPower)
  - NuScale (NuScale Power)
  - SMR-160 (Holtec SMR)
  - Westinghouse SMR (Westinghouse Electric Co.)
- A different reactor design that falls within the following PPE information range may be selected in the COLA
  - 2 or more SMRs with a maximum 800 MWt for a single unit
  - Combined site capacity not to exceed 2420 MWt (800 MWe)

Review Standards/Guidance

- 10 CFR Part 52, Subpart A, Early Site Permits
- 10 CFR 50.47 & Appendix E to Part 50
- 10 CFR 50.12 & 52.7, Specific Exemptions
- NUREG-0800, Standard Review Plan, Sec. 13.3, Emergency Planning
- NUREG-0654/FEMA-REP-1 (Rev. 1), Suppl. 2, NSIR/DPR-ISG-01
- NUREG-0696, Functional Criteria for Emergency Response Facilities
- NUREG/CR-7002, Criteria for Development of ETE Studies
- NUREG-0396, Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants
- EPA PAG Manual: Protective Action Guides and Planning Guidance for Radiological Incidents

Federal Emergency Management Agency (FEMA) Consultation

- NRC performed its review in consultation with FEMA, pursuant to the FEMA-NRC Memorandum of Understanding (MOU) (12/7/15, ML15344A371)
- FEMA review was limited because:
  - The ESPA did not include offsite emergency plans, and
  - The major features plans only addressed limited onsite EP features.
- FEMA's January 24, 2018, letter (ML18031B055) stated that:
  - Working with TEMA, FEMA did not identify physical characteristic of the proposed site that could pose a significant impediment to the development of emergency plans, including evacuation from the 2-mi EPZ.
  - The boundary established for the proposed 2-mi PEP EPZ was established relative to local emergency response needs and capabilities, as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries.
  - At this time, FEMA's finding does not endorse or determine the adequacy of a proposed 2-mi PEP EPZ for the site if proposed during the licensing process.
- In its June 12, 2017, letter (ML17164A206) FEMA further stated that it did not review or analyze the feasibility and assumptions for the site boundary EPZ, but if requested in the future, would provide comments and recommendations.

COL Action Items vs. Permit Conditions

- The 16 COL Action Items:
  - Track information that is needed before granting a COL, but is not required in the ESPA
  - Reflect the SMR design that may be identified in the COLA
  - Require NRC evaluation as part of the COLA review
- The 4 Permit Conditions:
  - An ESP is granted subject to permit conditions, which address required detailed information that is not yet known, but will be available in the COLA and subject to NRC confirmation

16 COL Action Items

- 13.3-1, Select SMR (EPA PAGs)/PEP EPZ/E-plan
- 13.3-2, Update Letters of Agreement/MOUs
- 13.3-3, SMR facilities & staffing
- 13.3-4, Emergency action level scheme
- 13.3-5, Alert and notification system
- 13.3-6, SMR communications/data links
- 13.3-7, Joint Information Center location/capabilities
- 13.3-8, Onsite monitoring systems/equipment

COL Action Items (cont.)

- 13.3-9, Technical Support Center
- 13.3-10, Operations Support Center
- 13.3-11, Local Recovery Center
- 13.3-12, Central Emergency Control Center
- 13.3-13, Radiation monitoring systems
- 13.3-14, Meteorological tower & monitoring program
- 13.3-15, On-site personnel decontamination facility
- 13.3-16, Communications testing & hostile action exercises

4 Permit Conditions, 1 Confirmatory Item

- Permit Conditions (PC)
  - SMR PPE Accident Consequence Analyses
    - PC 1, Calculation of EPZ Size
  - Fukushima Dai-ichi (near term task force 9.3, Tier 1)
    - PC 2, Multi-Unit Staffing Assessment
    - PC 3, Communications Assessment
  - 2011 Emergency Preparedness Rulemaking
    - PC 4, On-Shift Staffing Analysis
- Confirmatory Item 13.3-1
  - Withdrawal of exemption request Item No. 19 (re: the requirement for remedial exercises)
    - Section IV.F.2.f of App. E to 10 CFR Part 50
  - Can be closed out when ESPA Rev. 2 is submitted

Combined License Application (COLA)

- In the COL Application:
  - The COL applicant will identify an SMR technology, which must meet the PEP EPZ sizing methodology approved in the ESP for either the site boundary or 2-mile PEP EPZ, or may propose a new emergency plan.
  - If the 2-mile PEP EPZ is selected and justified, the NRC will request that FEMA review the offsite emergency plans.
  - If the site boundary PEP EPZ is selected and justified, no formal FEMA-approved offsite radiological plans are required.
    - The COL applicant will still need to address requirements to communicate and coordinate with offsite support organizations and agencies

Staff Review Findings

- No significant impediments to the development of emergency plans (10 CFR 52.17(b)(1))
- Adequate description of contacts and arrangements with Federal/State/local support agencies (10 CFR 52.17(b)(4))
- Proposed exemptions are acceptable (10 CFR 50.12, 52.7)
- Proposed major features emergency plans are acceptable (10 CFR 52.17(b)(2)(i))
- Proposed dose-based, consequence-oriented EPZ sizing methodology is reasonable

Conclusions

- The staff concludes that:
  - The PEP EPZ sizing methodology is acceptable for determining the appropriate size of the PEP EPZ for the Clinch River Nuclear Site because it is consistent with the analyses that form the technical basis for the current 10-mile PEP EPZ.
  - The 2 major features emergency plans are acceptable because they meet the applicable standards of 10 CFR 50.47 and requirements of Appendix E to 10 CFR Part 50.
  - The exemption requests are acceptable because they are authorized by law, will not present an undue risk to the public health and safety, are consistent with the common defense and security, and special circumstances are present.
- Therefore, the staff finds the TVA ESPA acceptable with respect to emergency planning and related exemption requests.

TVA's Request in ESP Application and Method of Implementation (if ESP Application Approved) in COLA			Final Products and Approval Mechanism	
	ESP	**COLA**	**ESP**	**COLA**
Methodology (SSAR 13.3)	Approval of a dose-based methodology for determining the EPZ size, as described in SSAR Section 13.3.	Approval of site-specific implementation of the previously approved methodology in ESP SSAR Section 13.3 to justify EPZ size. EPZ size calculation provided using site- and design-specific information. Approval of final EPZ size.	Final Product: SER and permit Staff relies on NUREG-0396 and EPA PAG Manual. SECY-15-0077: Staff initiated rulemaking for SMRs and ONTs. Prior to establishment of rule, staff should be prepared to adapt approach to EPZs for SMRs under existing exemption processes, in parallel with its rulemaking efforts (case-by-case).	Final Product: SER, license with EPZ size Using the methodology in ESP SSAR Section 13.3, the COL applicant must demonstrate that the selected SMR design meets EPA PAGs for the selected EPZ size.
Exemption Request (Part 6)	Approval for exemptions from the current 10-mile EPZ requirement if certain conditions are met. Approval to use the methodology in ESP SSAR Section 13.3 to determine EPZ size in the COLA. The ESPA requests 2 sets of exemptions, one for a site boundary EPZ and one for a 2 mile EPZ, and proposed major features of emergency plans for each.	The COLA can rely on EP exemptions granted in the ESP, provided site- and design-specific information justify use of one of the sets of exemptions evaluated in the ESPA.	Final Product: SER and permit with exemptions (if approved) and related conditions Staff relies on exemption guidance, NUREG-0396 and EPA PAG Manual	Final Product: SER, license to reflect EPZ size supported in the COLA.
Emergency Plans (Part 5A and Part 5B)	Approval of the major features of the site boundary and 2-mile emergency plans in Part 5.	Approval of complete and integrated emergency plans, including offsite emergency plans if a PEP EPZ other than site boundary is selected. Includes the remaining features of the emergency plan (either site boundary or 2-mile) from the ESP or new emergency plan based on the final dose-based EPZ size.	Final Product: SER and permit Staff relies on existing rules and guidance, except to the extent that they are not applicable because of the requested exemptions.	Final Product: SER, license to reflect EPZ size supported in the COLA.

Abbreviations

- CDF – core damage frequency
- CFR – Code of Federal Regulations
- COL – combined license
- COLA – combined license application
- DBA – design basis accident
- EP – emergency planning
- EPA – U.S. Environmental Protection Agency
- EPZ – emergency planning zone
- ESP – early site permit
- ESPA – early site permit application
- ETE – evacuation time estimate
- FEMA – Federal Emergency Management Agency
- FSAR – Final Safety Analysis Report
- LLWR – large light water reactor
- MOU – memorandum of understanding
- MWe – megawatts electric
- MWt – megawatts thermal
- NTTF – Near-Term Task Force

Abbreviations (cont.)

- PAG – (EPA) protective action guide
- PC – permit condition
- PEP – plume exposure pathway
- PPE – plant parameter envelope
- PRA – probabilistic risk assessment
- RG – Regulatory Guide
- rem – roentgen equivalent man (1 rem = 0.01 Sv)
- rx-yr – reactor-year
- SER – safety evaluation report
- SMR – small modular reactor
- SSAR – site safety analysis report
- TEDE – total effective dose equivalent
- TEMA – Tennessee Emergency Management Agency
- TVA – Tennessee Valley Authority