Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: ACRS Regulatory Policies and Practices Subcommittee

Docket Number: N/A

Location: Rockville, Maryland

Date: May 15, 2018

Work Order: NRC-3729 Pages 1-126

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

1
2
3
4 DISCLAIMER
5
6
7 UNITED STATES NUCLEAR REGULATORY COMMISSION'S
8 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
9
10
11 The contents of this transcript of the
12 proceeding of the United States Nuclear Regulatory
13 Commission Advisory Committee on Reactor Safeguards,
14 as reported herein, is a record of the discussions
15 recorded at the meeting.
16
17 This transcript has not been reviewed,
18 corrected, and edited, and it may contain
19 inaccuracies.
20
21
22
23

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

REGULATORY POLICIES & PRACTICES SUBCOMMITTEE

+ + + + +

TUESDAY

MAY 15, 2018

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B2, 11545 Rockville Pike, at 8:30 a.m., Walter L. Kirchner, Chairman, presiding.

COMMITTEE MEMBERS:

WALTER L. KIRCHNER, Chairman

PETER RICCARDELLA, Member-at-Large

RONALD G. BALLINGER, Member

HAROLD B. RAY, Member*

ACRS CONSULTANT:

STEPHEN P. SCHULTZ

DESIGNATED FEDERAL OFFICIAL:

QUYNH NGUYEN

ALSO PRESENT:

ANDY CAMPBELL, NRC

ALLEN FETTER, NRC

JENNIE RANKIN, NRC

MARY RICHMOND, Bechtel

RAY SCHIELE, Tennessee Valley Authority

MALLECIA SUTTON, NRC

RAO TAMMARA, NRC

ROBERT TAYLOR, NRC

ALEX YOUNG, Tennessee Valley Authority

*Present via telephone

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

P R O C E E D I N G S

(8:29 a.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'm Walt Kirchner, Chairman of this Subcommittee meeting. ACRS Members in attendance today are Ronald Ballinger and myself. We are expecting Margaret Chu and Harold Ray may join us on the phone.

Quynh Nguyen of the ACRS staff is the designated federal official for this meeting. And I might point out if you're interested in thermal-hydraulics this is the wrong meeting. It's next door where we're doing a hearing for Brunswich MELLLA+, the Thermal-hydraulics Subcommittee.

On November 15, 2017, we heard and were presented a general overview of this application. Today the Subcommittee will hear from representatives of TVA and the staff regarding selected sections of TVA's Clinch River Early Site Permit application and the corresponding safety evaluations as follows.

Geography and Demography, 2.1. Nearby Industrial Transportation and Military Facilities,

2.2. Aircraft Hazards, 3.5.1.6 and Accident Analysis, 15.1. The Committee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full Committee.

And I might point out we're joined by Pete Riccardella. And a slight oversight, I failed to mention that we also have Steve Shultz with us as a consultant to the ACRS.

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 the Commission, 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 ACR section of the US 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. We have a bridge line established for interested members of the public to listen in.

To preclude interruption in the meeting the phone bridge will be placed in the listen-in mode during the presentations and any 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 the meeting attendees and participants silence their cell phones and any other electronic devices that may be 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 that the green light of the microphone is on before speaking and off when not in use. We will now proceed with the meeting. And I call upon Robert Taylor, senior management of NRO to begin, Robert.

MR. TAYLOR: Good morning. Can you hear me?

CHAIRMAN KIRCHNER: Yes.

MR. TAYLOR: Good morning and thank you, Mr. Chairman. It is a pleasure for the staff to come before the ACRS today to present the first chapters in its review of the Clinch River Early Site Permit.

My name is Rob Taylor and I'm the acting director of NRO's Division of New Reactor Licensing. As you indicated, on November 15th last year the NRC staff presented to the ACRS full Committee on the early permit site review process, the plant parameter envelope concept and the review status/schedule for the Clinch River ESP review.

TVA also discussed the Clinch River

nuclear site features and their ESP application. Today's presentation is the next step in our process before the ACRS on the results and the status of this review.

The staff and TVA have made substantial progress on the Clinch River ESP and today's presentation is a reflection of that good work. The chapters being presented today have developed safety evaluations with no open items.

The fact that there are no open items is a reflection on the thoroughness of the staff's review and TVA's responsiveness to the staff inquiries as we have worked through the issues. This is the first ESP for a small modular reactor plant design which has presented unique and novel items for the Applicant and the NRC.

Despite this, we are pleased to report that the review is progressing on schedule. We anticipate that we will back before the Subcommittee for meetings on the other SEs under development in the August and October time frame this year.

Our goal is to have ACRS full Committee meetings in November or December of this year. With that, the staff looks forward to a fruitful dialogue with the ACRS today. So thank you and we look forward

to the discussion.

CHAIRMAN KIRCHNER: Okay, thank you. We'll turn now to the Applicant and Raymond Schiele from TVA. Please proceed.

MR. SCHIELE: Good morning. (Off microphone comments). I'd like to introduce the team supporting us today. We've got Alex Young, TVA Engineer; Rachel Turney-Work, supporting 2.1, Geography & Demography. We have Mary Richmond and Becky Carr and Karene Riley supporting the remaining sections.

I've been in the industry for about four years, submarines, Calvert Cliffs operations for 16, SRO shift manager. And for the last 20 I've been managing large licensing projects and I've had the pleasure since 2016 of supporting the Clinch River SMR ESPA application.

First, a little bit about TVA, TVA's mission. TVA is a partner with 154 local power companies serving over nine million people, 700,000 businesses in parts of seven states directly serving 56 large industries and federal installations.

Just a quick visual of what this looks like. This is a map showing the gray area is the watershed to show you where the current fleet nuclear

sites are right now, Browns Ferry, Watts Bar and Sequoyah and where the Clinch River site is in relation to that.

A brief overview of application development. In 2014, TVA decided to pursue an early site permit application. In 2010 to 2015, they did site characterization.

We submitted the ESPA in May of 2016. NRC accepted review in December of 2016. Last summer at this time we supported lots of audits. The Rev. 1 for the ESPA was submitted in December of 2017 and we've been supporting RAIs from early fall in 2017 to as recently as early this spring in 2018 QA.

This is a high level picture of the status of the original schedule for both the NRC safety review and the NRC environmental review. You can see the original schedule had us possibly dealing in late 2018 with no open items.

We have, as Rob said, the schedule, we're on schedule maybe a little ahead of that. We're having the first ACRS meeting in middle of 2018. So the safety review is going well.

Also the environmental review is going very well too. We're in the middle of the DEIS review. That review is scheduled to conclude the

first week of June.

Chapter 2, Section 2.1, Geography & Demography. Clinch River site, the site is 935 acres. It's adjacent to the Clinch River arm of the Watts Bar Reservoir and on the north it's bordered by the Oak Ridge Laboratory property.

It's in the City of Oak Ridge in Roane County, Tennessee. These geography distances are approximate to the City of Kingston, Harriman, Lenoir City and Knoxville.

The land is owned by the US government and managed by TVA as an agent of the federal government. Here is an illustration of the property where the one mile LPZ is and a five mile radius.

As you can see, it's, you can see the illustration of the river around three sides, east, west and south with the Oak Ridge property to the north. Within that one mile there are no hospitals, prisons, jails in the LPZ and no transient population events or attractions in that area.

This is an illustration of the EAB. The EAB is the site boundary. And this is a radius that shows zero to two miles. That's the big blue circle. The red outline is the Clinch River property line.

The Clinch River site is internal to that.

The property is about 1,200 acres. The site is 935. So this section right here if you sort of cut it off a little bit right here, that would be the difference between the site and the property boundaries.

MR. SCHULTZ: What are the facilities within the five mile radius? Do you have --

MR. SCHIELE: That's a slide coming up.

MR. SCHULTZ: Thank you.

MR. SCHIELE: Sure. Population distribution, this is a slide illustrating the, so the dark blue in the center is ten miles and the lighter blue larger one is ten to 50.

So we did an evaluation of the population projected out to the 50 mile radius. The years for the selection for the census was 2010. The calculation development year was 2013. And the two dates of interest is the 2021 start of construction and 2027 start of operation.

CHAIRMAN KIRCHNER: May I ask how many people are within the darker blue ten mile sector?

MR. SCHIELE: I have that number here somewhere. Rachel, do you have that number quickly inside the ten mile?

CHAIRMAN KIRCHNER: I see it there for the other sectors. I was just curious if it was

comparable number.

MR. SCHIELE: There was another slide like this with ten miles blown up that shows. I don't have those numbers. I can get you that.

CHAIRMAN KIRCHNER: Please proceed.

MR. SCHIELE: This is an illustration of population center boundaries. Population centers, as defined by 10 CFR 100.3, are densely populated clusters with more than 25,000 people.

There are two centers that were of significance, the Knoxville area and the Cleveland area. The Knoxville is about 4.8 miles from the site and the Cleveland area is about 45 miles.

So on this picture you'll see Knoxville right there and Cleveland is right at the corner of the picture down here. And yellow star is the site.

(Off microphone comment)

MR. SCHIELE: This is the urban areas right which is a large vicinity. It's 4.8 miles southeast at the very edge of the urban area, correct. Yes, go ahead, Rao.

MR. TAMMARA: My name is Rao Tammara. The SSAR table --

CHAIRMAN KIRCHNER: And who you are with?

MR. TAMMARA: I am with the NRO. I am

also a technical reviewer for 2.1 on staff. Table 2.1-2 gives the summary of the total population for 2010 within zero to ten miles is 67,203.

CHAIRMAN KIRCHNER: Thank you.

MR. SCHIELE: Thank you, Rao. Population density, per Reg Guide 4.7 site suitability criteria for nuclear power stations densities were calculated for the 50 mile region for these three time periods, the projected start of construction, the projected commencement of operation and at the end of the operation date, 2067.

The total projected population, the total projected transient population were totaled to be able to come up with a population density. The 2021 and 2027 population density, as projected on these numbers, is 247 for 2021, 261 people per square mile for 2027.

To note, this is less than the densities that are recommended to be maintained for Reg Guide 4.7. That threshold is 500 people per square mile.

Go on to Section 2.2, Industrial, Transportation and Military Facilities. The purpose of this section is to establish whether the effects of potential accidents in the vicinity of the site from present and projected industrial, transportation,

military facilities should be used in design basis events for plant design parameters for selected accidents.

Within this area of five miles there is one navigable waterway, one major highway, four major roads, a minor rail line, two natural gas pipelines all within five miles. Additional facilities were evaluated beyond ten miles that were significant enough to be considered for further review.

No identified roads, railways or navigable waterways at distances greater than ten miles posed significant potential hazards. In addition, the products and materials associated with these industrial facilities or transportation routes were evaluated.

Here's an illustration of the industrial facilities that were evaluated. The inner circle here is five miles. Inside that circle is the Oak Ridge Laboratory.

The next circle is ten miles. And you'll see one. That's the Kingston Fossil Plant. Outside of ten miles, between ten and 20 you will see the Oak Ridge Water Treatment Plant, the Bull Run Fossil Plant and the Hallsdale Power Utility District Melton Hill Water Treatment Plant.

Transportation routes and natural gas pipelines. This slide illustrates location and you will see a five mile radius there of the Clinch River arm of the Watts Bar Reservoir.

So the actual waterway, that's a boundary and it's also a transportation route. You'll see two gas pipelines. Here's a six inch pipeline right here. Here's a 22 inch pipeline.

Major transportation routes, Tennessee Interstate 40 on this illustration if you look right here this would be going to Knoxville. And on the other side this would be going to Nashville.

One other point on here is there's two railroads. At the top of the screen you'll see the Norfolk Southern Railroad. There's actually two arms to that.

One is outside this picture, it's at nine miles. This is, the closest is about at 6.5 miles. There's also a minor railroad, the Heritage Railroad right here.

The next slide is airports and airways. On this slide you'll see two federal airways, V16 and J46. That's this green line here and the dark blue line there.

Also as illustrated is, there's five

private airports within ten miles and there's two private airports outside of ten miles. So this list right here Big T, Wolf Creek, Cox, these are all these little blue dots inside of ten miles.

There's two outside of ten miles. You'll see at the bottom of the screen Ferguson Flying Circus and the other one, I apologize, when I put the white box here for the legend it covered up this other private airport.

The name of it is Oliver Springs and they're about 180 degrees from other on the screen. So the two outside of ten are Oliver Springs and Ferguson Flying Circus.

CHAIRMAN KIRCHNER: Does Knoxville have a major airport?

MR. SCHIELE: Knoxville does have a major airport. It supplies, it's called the Metropolitan Knoxville Airport Authority. And I don't know how many --

CHAIRMAN KIRCHNER: It's well outside the ten mile.

MR. SCHIELE: On this map it would be --

CHAIRMAN KIRCHNER: Far to the right.

MR. SCHIELE: Yes, okay. Evaluation of potential accidents. Reg Guide 1.206 discusses

accidents that have a probability of occurrence of, or in the order or magnitude 10^{-7}.

The accident categories that were selected to evaluate this threshold were chemical releases, explosions, flammable vapor clouds, toxic chemicals and fires, collisions with the intake structure, aircraft hazards and liquid spills.

As we saw in the earlier slide, five facilities were selected as storage facilities for this evaluation. And, oops, the transportation routes that were evaluated were both pipelines, Interstate 40 and the two federal airways.

The effects of the design basis events were as follows. The evaluations that were performed for hazards nearby the Clinch River site, it included accidents involving explosions, flammable vapor clouds, collisions with the intake and liquid spills do not pose a threat to the Clinch River site.

However, evaluation of the potential effect of toxic chemical releases from both industrial facilities and transportation routes concluded that with the exception of anhydrous ammonia and chlorine the distance to the toxic in points are less than the distance to the power block area. So we're okay.

Main control room habitability analysis

will be reperformed at the time of COLA for anhydrous ammonia and chlorine. Because this was a PPE and no specific design was picked there is no specific location on site for the control room. So the control room had the ability to be reevaluated during the COLA.

As far as chemical releases on site, once again because it was a PPE there is not a specific design. So the effects of a release on site will be reevaluated with the COLA, okay.

Chapter 3, Section 3.5.1.6, Aircraft Hazards. NUREG-0800 standard review plan --

MR. SCHULTZ: Just a question, Ray.

MR. SCHIELE: Go ahead.

MR. SCHULTZ: On the highway transportation routes and potential chemical releases, TVA has done other evaluations for other sites I presume.

MR. SCHIELE: Correct.

MR. SCHULTZ: Of a similar nature. Is there any particular reason why the situation at this site would be different from what you've analyzed before for control room habitability?

MR. SCHIELE: I imagine there would be some precedence. But the fact that this is such a

remote location. I'll ask Mary Richmond if she wants to add to this.

MR. SCHULTZ: That's one reason I'm asking.

MR. SCHIELE: Yes. And the I-40 is the major route for evaluation where we are. I don't know if there's any precedent for like what was evaluated for Sequoyah or Watts Bar. Mary, can you add anything to that?

MS. RICHMOND: One of the issues was that I-40 is the closest and it's a major route. So we were being --

CHAIRMAN KIRCHNER: May, sorry to interrupt. Would you fully identify yourself?

MS. RICHMOND: I'm sorry, Mary Richmond, Bechtel. Interstate 40 is the major route between. So we were very careful and we did it very methodically taking the chemicals.

As you saw, there are some water treatment plants in the area that store chlorine. And there's also fossil fuel plants that use anhydrous ammonia for part of their selective catalytic reduction system to remove the NOX.

So that was identified and we analyzed it. And it's, for explosions and for flammable vapor

clouds it's canceled out except for the toxicity analysis because both of those chemicals are very highly volatile toxic chemicals.

So they were removed for, at COLA stage because the distance ideology is greater so we can look at the control room habitability in greater detail. That's not unusual.

There are some other plants that control room habitability analysis was done for those chemicals.

CHAIRMAN KIRCHNER: Thank you.

MR. SCHIELE: Thank you, Mary. Aircraft Hazards, NUREG-0800 standard review plan establishes the criteria for evaluating hazards, 10^{-7} is the threshold that needs to be considered.

Using proximity criteria TVA performed a screening analysis to establish whether the probability of aircraft hazards, accidents rather, for the proposed site would be less than the order of magnitude of 10^{-7} by inspection.

Criterion 1, this was basically plant to airport distance and number of operations. Based on the five small privately owned airports between five and ten miles and the two privately owned airports between ten and 15 miles, the evaluation was

performed.

The projected number of operations is less than the threshold for Criterion 1. Therefore, Criterion 1 was determined to have been met for aircraft operations and no further evaluation was required.

Criterion 2, this criterion is based on the five statute mile distance to the nearest edge of military training routes including low level routes and the location of military operating areas. The site is about 19 miles from the center line of training route IR2 and about 36 miles from the Snowbird military operating area.

Based on this separation it was determined that Criterion 2 was met and no further evaluation was required. Criterion 3, Criterion 3 is based on at least two statute miles beyond the edge of the nearest federal airway.

I will go back to the airway slide real quick because we're going to talk about this. So you can see the two federal airways within, that's the five mile radius, that's the smaller radius.

The criterion is two statute miles. The federal airway is from center line, four on either side of center line. That's an eight mile path.

So based on the location of the site and these two airways we did not meet Criterion 3. So further evaluation was required. I'll get back to that.

So a detailed aircraft hazard analysis was performed. The results of the analysis showed that based on the probabilities of a hazard and the probabilities of the dose consequences associated with that hazard that it was 10^{-6} with a realistic probability that it was actually lower based on qualitative arguments.

Therefore, the effect of aircraft hazards for this section is met.

CHAIRMAN KIRCHNER: Would you elaborate, Ray, for the record on what you mean by qualitative arguments? Normally the criterion is 10^{-7}. Isn't that correct?

MR. SCHIELE: It's 10^{-7} for the hazard.

CHAIRMAN KIRCHNER: And you had a number, I won't recite the number. But it was, I'm glad to see you rounded it off.

MR. SCHIELE: 10^{-7} was for the hazard. For the dose consequences associated with the hazard it was 10^{-6}. So the full evaluation, and I'll let Mary Richmond from Bechtel elaborate on this, the full

evaluation showed that based on the qualitative argument and meeting 10^{-6} on the order of 10^{-6} was met. Mary, do you want to add to that?

MS. RICHMOND: I'm Mary Richmond, Bechtel. Basically the 10^{-7} order of magnitude is for the probability of occurrence with those consequences exceeded.

However, in the guide in NUREG-0800 and also in the design specific standard review for the SMRs there is an allowance because when you're talking about probabilities that low and the data available, and I'll talk a little bit more about the data availability for aircraft crashes, 10^{-6} per year is acceptable if combined with reasonable qualitative arguments you can show that the realistic probability is lower.

So the 10^{-7} number a little bit over the order of magnitude that was calculated, was a very conservative number. So for example, some of the qualitative arguments that we've presented in the SSAR include we were doing a bounding building for a PPE because at this time a design isn't selected.

So we chose a PP height, for example, of 160 feet and that was red, like we put a box around the plan. So that's a very high height for a reactor.

So if you were to like lower the height the "R" probability would be lower to that order of magnitude.

Another example of making the probabilistic value a little more realistic is we conservatively included the rad waste building because at the time we're not, we don't know. But that was included.

If the rad waste building was not included in the boxed area we would also be down to the 10^{-7} order of magnitude. Probably one of the most conservatisms when Rao talks this afternoon is the FAA data for the air traffic on the airway is not available.

So we looked at the major airports serving those airways and we put 50 percent of that, those operations on the airway because that's what was available. If you lower that, those numbers you're going to see a much reduced result of the probability of an aircraft crash.

Also at the time again because we just have a box, there was no credit taken for skid distances because that's one of the effective areas about the skid. And the design, so there's probably going to be at least an obstruction to one side that's protected in the safety related structures.

I'm not giving credit for it. None of those were credited. So those were the qualitative arguments that were included. We were just over that 10^{-7} and we think with these qualitative arguments we can show that it's below.

CHAIRMAN KIRCHNER: Does the Knoxville airport feed into this set of airways?

MR. SCHIELE: By distance, no, because this is --

CHAIRMAN KIRCHNER: No, I didn't express that well. Do, with their landing and take off patterns, do they then feed into these air routes or are these the 30,000 and above air routes?

MR. SCHIELE: You're talking about the two, V16 and J46?

CHAIRMAN KIRCHNER: Yes.

MR. SCHIELE: Yes. I would have to look that up. I'm not sure. Mary, do you know that?

MS. RICHMOND: Right. The number of operations that we used, we did use the Knoxville-McGhee Tyson Airport because they do feed into that. So that's one reason why our numbers are high is because those number of operations are very high.

MEMBER BALLINGER: On this map do you show the holding patterns?

MR. SCHIELE: No.

MEMBER BALLINGER: So if you superimpose the holding patterns on this, where are they?

MR. SCHIELE: So this --

MEMBER BALLINGER: I've sat in the Knoxville Airport with a tornado coming through in a holding pattern and I can tell you that the probability of an incident in that set of circumstances has got to be higher than just landing and taking off.

MR. SCHIELE: This is a fairly small circle here because this is five and ten miles. And Knoxville is way off the map here.

MEMBER BALLINGER: Okay, because these holding patterns are generally like a 20 mile race track, right. I'm just wondering if they overlap.

MR. SCHIELE: I'm not sure, but I can find out. Okay.

MEMBER BALLINGER: Harold has sent me a couple of emails. He's been trying to talk and not being able to get through. He says that Ron is working on it but apparently it's not working.

CHAIRMAN KIRCHNER: Has he sent you questions?

MEMBER BALLINGER: He hasn't sent me any

questions.

MEMBER RAY: Can you hear me okay now?

CHAIRMAN KIRCHNER: Yes, Harold. Would you like to ask any questions at this point?

MEMBER RAY: That's all right. We're well down the road. It's fine. I just want to make sure if I tried to speak that you could hear me, but we're good.

CHAIRMAN KIRCHNER: We're working. Ray, please proceed.

MR. SCHIELE: Thank you. Moving on to Chapter 15, Transient and Accident Analysis. NEI 10-01 provides industry guidance for developing the plant parameter envelope in support of an early site permit.

It gives guidance on the analysis model for the time-dependent transport of radionuclides out of the core through several pathways each with a different time-dependent removal mechanism for nuclides.

For the purpose of evaluating off site, post-accident doses the vendor analysis with the highest dose was selected for use in the site-specific dose analysis. Each of the four SMR designs under consideration was expected to provide advanced design features that would further minimize accident

consequences.

TVA anticipates by calculation that these consequences of a LOCA would be less than those for the large PWR designs and that no events of greater consequences will be identified. The COLA will verify that the accident doses provided in the ESPA are bounding or will provide an evaluation of accident radiological consequences.

Source term, the LOCA source term selected for the inclusion for the PPE was based upon vendor input and represents the design with the highest resulting doses. To assess the reasonableness of this evaluation a comparison of the PPE LOCA source term to that of the AP1000 was performed.

The result was the activity release associated with the worst two hour time period of a scaled down AP1000 is approximately 25 percent greater than that of the surrogate plant. The activity release for the 30 day duration of the LOCA for the AP1000 is approximately equivalent to that of the surrogate plant and is also considered reasonable.

CHAIRMAN KIRCHNER: So at this point, Ray, then you're using of the four potential designs that you're considering the largest single unit which is 800 megawatts but your site envelope is 2,000 plus

megawatts thermal, right?

CHAIRMAN KIRCHNER: So the assumed value was the worst case dose, not necessarily the source term. But the worst case dose from that source term from all four designs.

So if a design had one reactor or two or 12, whether it would be released was using that language. I can have Alex elaborate on that a little more. Alex Young from TVA.

MR. YOUNG: So I think for a questions that's revolving around the site is being licensed in, excuse me, Alex Young, TVA. So I think your question is revolving around the site as being licensed to 2420 megawatts but we're talking about the 800 megawatts thermal gear.

So when we looked at the accident scenarios we just looked at the vendor with the highest dose and we just considered one unit for that vendor as an accident.

We did not consider that multiple units for that vendor are in a simultaneous accident. So that's why it's looking at 800 opposed to a total of 2420.

CHAIRMAN KIRCHNER: I understand that fully. I'm making a point that the assumption here is

that you don't have common cause, common mode failure. You're looking at the larger single, one single module being the source of the accident.

MR. SCHIELE: That's correct.

CHAIRMAN KIRCHNER: So we'll take that up with the staff.

MR. SCHIELE: Evaluation methodology and conclusion. SMR doses for a LOCA are evaluated at both the EAB and LPZ boundary. Doses are calculated using a ratio of X/Q methodology which includes the following parameters.

Short term 95th percentile accident atmospheric dispersion factors for the Clinch River site. Bounding vendor provided LOCA doses and X/Q values associated with bounding vendor provided LOCA doses.

The resulting accident doses are expressed as a total effective dose equivalent, TEDE, consistent with 10 CFR 52.17. All site LOCA doses meet the 25 room TEDE limit specified in 10 CFR 52.17.

CHAIRMAN KIRCHNER: So, Ray, again for the record, what was the highest dose that you estimated versus the 25 rem limit because I understand the NRC policy on this is that they are not looking for 25 rem.

MR. SCHIELE: Correct.

CHAIRMAN KIRCHNER: They're looking for a considerable margin below that.

MR. SCHIELE: Alex, do you want to take that?

MR. YOUNG: Sure. So out of Chapter 15 with the EAB the zero to two hour dose for the site was estimated at or was calculated at 21.6 rem. And then the 30 day dose for the LPZ was at a total of 2.97 rem.

CHAIRMAN KIRCHNER: Thank you.

MR. SCHIELE: That concludes TVA's presentation on Sections 2.1, 2.2, 3.5.1.6 and Chapter 15. Are there any additional questions?

MR. SCHULTZ: Ray, let me back up a bit on the source term. The 800 megawatt thermal that's larger than some of the units that you're considering. So that was just an evaluation metric that was used to determine a generic source term associated with the SMR, a generic SMR concept?

MR. SCHIELE: I'll go to Alex.

MR. YOUNG: Sure. So the 800 megawatts is the thermal power dose associated with the largest vendor that we considered out of four SMR vendors. So basing on the principal core power resulting in core

inventory and amount of radioactive material that provided the most conservative source term for us. So that was the basis for the 800.

MR. SCHULTZ: And the evaluation of release was done in what way? The evaluation of the release of that source term.

MR. YOUNG: So the releases are based off or are mostly based off of standard Reg Guide 1183 methodology which is then, some of the vendors they take into account some advanced SMR features that reduce some of those source terms to a certain extent.

Vendors provided that information to us that is supposed to be their atmospheric release source term and if by the associated doses when we do the ratio the X/Q's methodology to take that dose and convert to a site dose.

MR. SCHULTZ: Okay, thank you. So you went through a process that provided some element of maximization to determine a, what you would consider a maximum dose for a particular power level to determine some level of a bounding source term?

MR. YOUNG: Yes. All the vendors provided information to us. They all provided source terms and doses to us and we picked the vendor that had the highest doses.

MR. SCHULTZ: But did, if a unit was less than 800 megawatts thermal, did you scale that up in some fashion or did you go kind of on a design by design basis?

MR. YOUNG: No. We went on design by design basis. We did not do any type of composite or scaling of the other values to look at a dose per megawatt ratio kind of thing.

We just looked at the largest vendor and their largest dose because if we, the designs aren't scaling in that manner right now.

MR. SCHULTZ: So what you found was that the limiting values were for the 800 megawatt thermal?

MR. YOUNG: That is correct.

MR. SCHULTZ: Thank you.

CHAIRMAN KIRCHNER: Any additional questions? Ron, any further questions at this point? Okay. Thank you, Ray.

MR. SCHIELE: Thank you.

CHAIRMAN KIRCHNER: We're ahead of schedule. So I think rather than take a break at this point let's proceed to the staff and your team, Bob. Take a moment here to change out.

MR. FETTER: Is this on?

CHAIRMAN KIRCHNER: Yes. Just push the

button and you should see a green light.

MR. FETTER: Yes, it's much greener now. Good morning. I'm Allen Fetter, one of the two safety projects for the Clinch River nuclear site, early site permit review.

Ms. Mallecia Sutton is one of the other safety project managers who is seated at the table with Rob Taylor and our current branch chief, Ms. Jennie Rankin who will be with us through the end of the fiscal year through the other ACRS meetings and possibly longer.

Ms. Sutton will be at the table for the next ACRS Subcommittee meeting on emergency planning scheduled for the latter half of August right now on emergency planning and exemption requests. And you will hear about her credentials and experience at that time.

My qualifications include having a doctoral degree in Geology which focused on isotope geochemistry and tectonics. And I worked for, prior to joining the NRC I worked for a number of years for an environmental and geotechnical engineering firm.

I started working at NRC in 2004 and since 2009 I have been a project manager in the Office of New Reactors. Prior to taking over as safety project

manager for the Clinch River early site permit review, I was the environmental project manager for the Bellefonte COL and the PSEG early site permit reviews.

Today's ACRS meeting, Subcommittee meeting is the first of four Subcommittee meetings that are planned for the Clinch River ESP review. Today Mr. Rao Tammara, the NRC reviewer for safety evaluations for 2.1, 2.2, 3.5.1.6 and 15.03 will present three separate slide presentations on his evaluations.

Between each presentation we will offer ACRS Members the opportunity to ask questions or provide comments to each presentation. For the sections discussed today in addition to the staff's review of TVA's application, staff set up one public meeting with the Applicant and issued one RAI to the Applicant and the details are in the SE, in order to obtain additional information to support NRC's findings.

Before I turn it over to Mr. Tammara, I want to clarify some statements regarding our schedule that TVA said the DEIS, the draft environmental impact statement was scheduled for June 1st. It was issued on April 27th and we were able to leverage some administrative resources to do that.

We did not accelerate this. We followed

our normal process for a review. The public meeting is on June 5th of this year and the final EIS is next June 2019. And that's all. With that I'll turn it over to Mr. Tamarra.

MR. TAMMARA: I'm Rao. Good morning, I am Rao Tammara. I'm with the NRO. I have three Master's degrees, two in Chemical Engineering, one in Environmental Engineering. I have 40 years of experience, 32 working for a consulting company, NUS Corporation and Tetra Tech NUS.

I joined the NRC in 2006. Since them I am with the NRC working on all COLs and ESPs so far. I reviewed Chapter 2 Sections 2.1.1, 2.1.2, 2.1.3; Aircraft Hazards, 3.5.1.6 and basically I acquired to start the accident analysis Chapter 15.

For Clinch River these are the five subsections I have reviewed and I will present these three subsections one after the other. The first one is 2.1 and 2.2 which addresses the demography and geography.

Next slide please. This main section has three subsections which include 2.1.1, consisting of site location and description; 2.1.2 which is exclusion area control, authority and control. The third subsection is 2.1.3, population distribution.

The site location and description addresses the description of the site which includes coordinates, site boundaries, orientation of principal plant, location of highways, railroads, waterways in the vicinity of the site and exclusion area.

The unique feature of this site is the exclusion area. The exclusion area is delineated by the site boundary, site boundary.

However, for the Applicant has designated an analytical EAB where they have conservatively considered the dose evaluations very close to the plant taking conservatively 1,100 feet and evaluating the dispersion parameters, accident dispersion parameters.

And corresponding using the dose evaluations using the analytical EAB the dispersion parameters are being addressed or evaluated in the subsection of SSAR 2.3. But those are being utilized in Chapter 15 for the dose evaluations.

MR. SCHULTZ: Rao, could you provide some background as to why that approach was taken in determining an analytical EAB?

MR. TAMMARA: Because that really, the actual EAB is much farther away and the EAB is in different directions. If you analyze the X/Q it is

much less, potentially much less than what they have taken conservative.

They have taken uniformly throughout all 16 directions, same small distance so that they can consider if we meet this dose criteria we will meet at the site boundary. That was the conservatism the object.

And staff has no objection from that point because they have used that one. The dose they have being much, you know, would be lower than whatever they use.

Therefore, they have conservatively taken a more limiting dose conformance therefore we have no objections to what they have chosen. We have no reason. That's the reason we have accepted that.

MR. SCHULTZ: Are there any site characterization X/Q evaluations that have been done? Is there a tower site evaluations for X/Q at this point?

MR. TAMMARA: That probably I am not the right person to answer that question because --

MR. SCHULTZ: I might have asked the Applicant but --

MR. TAMMARA: Not Applicant on the meteorological section which they evaluated in more

detail in Chapter Section 2.3. They looked at the on site data. They have the assumptions. They have evaluated --

MR. SCHULTZ: So that's been done separately?

MR. TAMMARA: Right. This is, we are the users but they are the reviewers. Therefore, I cannot probably answer very freely.

MR. SCHULTZ: I understand. Thank you.

MR. TAMMARA: Whoever is presenting that section will be glad to really given insight how they evaluate it.

MR. SCHULTZ: But this analytical approach was to basically allow an evaluation to be done --

MR. TAMMARA: Right.

MR. SCHULTZ: -- without all of the detailed information assembled which will happen later on.

MR. TAMMARA: That's correct. The value of X/Q is more conservative compared to the other ones. That's what we have taken into account.

MR. SCHULTZ: Certainly.

MR. TAMMARA: That is all.

MR. SCHULTZ: Thank you.

MR. TAMMARA: The second is exclusion area

control. And that's addresses the legal authority, control of the activities and, that are unrelated to the plant operation and whatever the arrangements they have made with respect to the state local governments in case of emergency.

The third subsection deals with the current population and the population projections in future for the life of the plant within the 50 miles of the plant. Characteristics of the low population zone, whether there are any residences in the description of the low population zone area and population center distance and population density.

One more unique situation for this site is the 10 CFR 100.3 defines that the population center having a population greater than 25,000 people should be one and one third times the distance between the plant reactor to the outer boundary of LPZ.

But in this case the plant is located in the city limits of Oak Ridge itself. So it is an interesting point to, because if you literally look at the city it is very difficult to meet that one.

But however, if you take a look at the second paragraph of the same regulation the regulation says political boundaries are not limiting. You have to look at the population where the majority

population is residing, how far away from the boundary, political limits.

So if you, based upon that one by observing where the population of Oak Ridge is located if you take a look at the north to east northeast sectors even though the boundary is within the city limit, meaning within the reactor but the population starts beyond five miles.

Up to five miles it is zero. Therefore, interpreting that requirement to have considers they are meeting the one and one third distance from the reactor to the LPZ because LPZ is only one mile.

CHAIRMAN KIRCHNER: And that doesn't include the transient population on the Oak Ridge Reservation, right?

MR. TAMMARA: No, but still it is, yes, right. So that, but however the Applicant analysis used Census Bureau for different designation when you're in the urban area designation.

But ultimately the conclusion is similar. But we insisted, staff looked at that they should adhere to the regulative requirement and the Applicant should both conclusions have said they meet the requirement.

Just I wanted to present the uniqueness of

the site so that how it has been accepted if they have any questions I want to clarify that.

CHAIRMAN KIRCHNER: So I'm looking at Reg Guide 4.7, yes, and I see that the boundary for the LPZ should be based on population distribution not political boundaries that you said. Have you, has the Commission, have we ever licensed a plant with only one mile LPZ?

MR. TAMMARA: Not really. But two miles we have. But one mile we haven't. And also we haven't seen this situation for the last. That's why I brought up it's a unique situation in this application.

CHAIRMAN KIRCHNER: Okay. And we are going to hear about emergency planning later in the summary, okay. Thank you.

MR. TAMMARA: Next slide please. Staff reviewed the information provided by the Applicant pertaining to the site location and description and also checked independently the information available from the public domain.

Staff found it acceptable and they satisfied the guidance provided in NUREG-0800, Section 2.1.1. Staff also reviewed the information provided by the Applicant pertaining the exclusion area

authority and control.

Based on the information provided staff finds it acceptable as it satisfies the guidance provided in NUREG-0800 Section 2.1.2. Next slide please.

Staff also reviewed the information provided by the Applicant pertaining to population distribution including population projections during the life of the plant, operation center distance as I described before and also population density.

Based on the information provided by the Applicant and staff's independent confirmatory analysis, the staff found the information to be acceptable as it meets the requirements of 10 CFR 100.20.

Next slide please. The second subsection is 2.2, which pertains to nearby industrial, transportation and military facilities. This section has first portion identification of all of these facilities.

Those are sources within the five miles of the site. And the second portion is the description of the materials, products and other materials or chemicals which are processed, stored by these sources.

So they include maps of the site, nearby facilities and transportation routes, description of the facilities products and materials and the number of people they employ, description of pipelines, highways, waterways, airways and airports.

And they also include the projections for the future industrial growth. Next slide please. Staff reviewed the Applicant provided specific, I'm sorry.

Information provided by the Applicant pertaining to the location and description of nearby industrial, transportation and military facilities for the evaluation of potential hazards for their safe operation of the proposed plant.

Based on the review of the information provided by the Applicant and also staff's independent checking of the information from the available data from public domain, staff found it to be acceptable as the information used the guidance provided in NUREG-0800, Section 2.2.1-2.2.2.

Another important thing for this site is that there is a proposed airport which is planned to be built in the year 2022. If this airport comes into being at the COLA stage the impact evaluation of the hazards of this airport has to be evaluated and

included in the application.

Yes, 2022. It should be included in this COLA application. Therefore, a permit condition 2.2-1 is included in this SE to evaluate at that time.

Next slide please. The third section, subsection of this main 2.2 is the evaluation of potential accidents. In this evaluation the basic evaluation is to determine whether there is any accident which is designated to be a design basis accident.

A design basis accident is defined as an accident that has a probability of occurrence in the order of magnitude of 10^{-7} or greater and resulting in a potential consequence exceeding 10 CFR 100 dose guidelines.

So the design basis accident has to occur in connection with those exceeding the 10 CFR Part 100 guideline and that's probably the total probability should be greater than 10^{-7}. So in order to find out whether there is any design basis accident the evaluations are determined to, evaluated to determine whether any accident is design basis accident.

In doing so the impacts considered explosions, flammable vapor cloud explosions from industrial facilities, truck traffic, pipelines,

waterways, release of hazardous chemicals from transportation accidents, major depots, storage areas, on site storage tanks.

And potential from transportation accidents, industrial storage facilities, on site storage and potentially forest fires. Next one.

Staff reviewed the Applicant provided site specific evaluations of potential accidents. The Applicant performed evaluations of potential hazards due to nearby facilities in the CRN site vicinity.

The effects of chemical releases from on site chemical storage will be evaluated at the COLA referencing this ESP because the locations of the on site storage, control room and other safety related structures designs and the locations will be determined at the COLA stage, they are not available at the ESP stage.

Next slide please. Based on the review the Applicant provided information, analysis and staff's independent confirmatory calculations, the staff found Applicant's conclusions to be acceptable, as the evaluations are in accordance with the guidance provided in NUREG-0800, Section 2.2.3 with an exception of potential impacts from toxic chemical release of anhydrous ammonia, chlorine and nitric acid

from a truck transport on the roadway.

Since the Applicant determined the minimum safe distance due to the potential toxic chemical concentration of anhydrous ammonia, chlorine and nitric acid, from the potential release from the truck transport is greater than the actual distance the Applicant is, communicate and shall reanalyze the impacts of the delivery tank using the guidance provided in Reg Guide 1.78 and NUREG-0800 to demonstrate the compliance with 10 CFR Part 100.

Therefore, a permit condition to 2.2 that two is included in the SE.

CHAIRMAN KIRCHNER: Okay. Just for qualitative comparison purposes, since I-40 is approximate to this site versus for example TVA's other sites, I think it's I-75 that goes down --

MR. TAMMARA: Yes.

CHAIRMAN KIRCHNER: -- to Chattanooga. But that's a considerable distance from Sequoyah and Watts Bar. Is this unusual? Would this require a COLA to provide a, what do I want to say, an HVAC system for the control room that's different, superior, more difficult to implement than is typically done for most power plants?

MR. TAMMARA: Not necessarily. The

problem here is this is a ESP. So the roadway is about 5,800 feet away from the closest boundary. So presently we do not know exactly where the control room is.

So what is the intake structure is whether it is a limited or, we don't know the design. And we don't know the evaluation factors of the control room because it is a, first of all it is a new design.

And it is not a light water, to make some assumptions. So first we don't know the location. Second, we don't know the design parameters of the intakes.

And we don't know the design parameters of the evaluation grades. Therefore, it is difficult to calculate what would be the concentration in the control room.

So the present analysis what has been done is if there is an accident we calculated the concentration very closest to the boundary and see whether the limited concentration would be higher or lower.

If our analysis has shown, our data analysis had shown the concentration is lower than alleged potentially control room would not have any problem because the site won't, concentration is lower

and it is meeting the limiting concentration.

There is no way to exceed in the control room. But however, it is not the case. The concentration is much higher at the site boundary, therefore it is ambiguous to assume the control room has a potential to increase.

I mean, it may exceed the limiting concentration. Therefore, that has to demonstrated. That is the intent over here. They have to evaluate it at the COL stage.

CHAIRMAN KIRCHNER: My point here was that compared to, for example, TVA's other sites their location is sufficiently distant from major arteries like an interstate highway such that they will fall below the toxicity limit just by dispersion and distance.

MR. TAMMARA: Yes, I do not --

CHAIRMAN KIRCHNER: But here we have a relatively small site, relatively approximate to I-40. And I would submit that the, and if you look at the exclusion area boundary in particular the bulk of the areas to the north away from the lower site boundary that's closest to I-40.

So the location of the intakes is not going to be an issue. So first order in doing that

analysis is, it appears that they're going to have a higher toxic protection.

They're going to have, I'm trying to think of the right way to say this. That the toxicity that the HVAC system for the control room is going to deal with is going to be higher than they would see at their other sites.

MR. TAMMARA: Possibly. I cannot answer.

MR. FETTER: So it sounds like you're saying the amount of recirculation that a control versus fresh air intake and that's something that's not a specialty that Rao has.

MR. TAMMARA: And also it is like, that's why we are putting a condition they have to demonstrate the actual data that it is not going to impact the operators. That is the intent.

CHAIRMAN KIRCHNER: So noted, okay. Thank you.

MR. TAMMARA: Any other questions?

CHAIRMAN KIRCHNER: Why don't we proceed on, Allen?

MR. FETTER: That's fine. Are you guys okay continuing on?

MR. TAMMARA: Yes, sure. I have no problem.

MR. FETTER: We just need a little technical assistance for this slide show.

MR. TAMMARA: The next section is Aircraft Hazards, Section 3.5.1.6. Next slide please. For the site suitability the plant design should consider that any of the aircraft accidents is not a design basis event.

I have already explained what the design basis accident is, that an event having a probability of 10^{-7} or greater having the consequences greater than dose limits exceeding the dose limits 10 CFR Part 100 that includes 10 CFR 50.34(a)(1) with a probability of occurrence greater than 10^{-7} per year.

Doing the aircraft analysis there are, some of the screening criteria are applied and they have to be considered and also screened out based upon the guidance. Federal airways, holding patterns and approach patterns should be at least two statute miles away.

Military installations or any air space usage should be at least 20 miles from the site. All airports should be at least five miles from the site.

Next slide please. The airports which are within the five to ten miles the flights that are having, can be screened out if they are 500 d^2. D, is

the distance from the plant to the airport.

If you calculate that number of flights and if it is within the, the actual number of flights are within the limit that no further evaluation of that airport is required. So also if it is, airport is beyond ten miles the limiting value of the number of flights is 1,000 d^2.

The airports identified by the Applicant and checked by the staff do not meet, meet this criterion therefore no additional evaluation has been performed or required to be performed for the area of the airports.

Staff reviewed the Applicants information pertaining to the site specific aircraft analysis. The Applicant identified only two airways that are within two miles of the site that include V16 and J46 which they have evaluated the probability of accident.

The Applicant determined the aircraft crash probability of 7.53 to the -7 per year using non airport operations referenced in DOE guidance accident analysis for aircraft crash and hazardous facilities.

Next slide. Staff performed an independent confirmatory analysis using the actual FAA data. Staff collected and looked in five year recent data from the FAA that covers 2011 to 2015 all flights

flying within the five miles or in the ten miles of this sight irrespective of where the, type of the aircraft is.

And we used that data to calculate conservatively applying all the flights within the ten miles following those two airways. And we calculated what would be the probability conservatively.

The potential aircraft crash probability we calculated, staff calculated is 1.5 times 10^{-8} based upon all the flights within ten miles following those two airways. So that is a most conservative calculation using the real FAA data.

And based upon that one staff accepts the Applicant's value as reasonable. Therefore, staff agrees with the Applicant's conclusion that the aircraft crash probabilities is in the order or magnitude 10^{-7} per year or less and meets the provided NRC guidance.

CHAIRMAN KIRCHNER: Rao, just for clarification purposes, the preceding slide shows an estimate of 7.53 times 10^{-7} using the DOE standard. So that feels a lot like one times 10^{-6} to me, right. As an engineer when I round this up.

MR. TAMMARA: That's correct.

CHAIRMAN KIRCHNER: So I guess the only

thing I would say is that the Applicant provided us with some qualifying arguments that would reduce their number. It just, since we're dealing with numbers here at least in the material that's been presented, it just doesn't follow ipso facto that you agree with their estimate.

You calculate a number with real data or "real" data from FAA that's significantly lower than their number and therefore you can feel confident that your determination is fine. I'm just having a problem that you agree with the Applicant.

MR. TAMMARA: The way the guidance is written if you take a look at the guidance, first thing is if you make the assumptions and show that comfortably the probability calculated is 10^{-7} or less, okay, generalize options than it is easy to accent.

But if you read the second sentence of the guidance it says if you, if the assumptions are realistic and more appropriate are any statistical evidence if you can use, you can go and you can accept as high as 10^{-6} per year. So the language written is you can make a general, if you don't have anything you mix general reasonable engineering and scientific assumptions and prove your less than 10^{-7} it is

acceptable because everything would be less than that.

But if you haven't really statistics available or you have a real data which is measured or documented then you can take and show you can go as far as 10^{-6} still it is acceptable. So if you read in those things the staff is using the second portion.

I'm using the FAA realistic data and when taking really conservative and not taking military only, light plane only, only commercial and using total number of flights and I'm assuming they're all going in that and still am using and calculating.

So what else could we? It is most conservatively showing a distance. But they might have it, the Applicant might have used some because they are not available with this data. But they have made some assumptions to use more realistically what they have.

So therefore, when staff's judgment is used and it is acceptable. That is the situation here.

CHAIRMAN KIRCHNER: Thank you. Our former member, John, no, John is still a member, Stetkar would appreciate your more realistic calculation. I'll let it go at that. Thank you.

MR. TAMMARA: Thank you.

MR. SCHULTZ: Rao, a related question. The permit condition 2.2-1 references or relates to that potential new airport that you mentioned earlier might be constructed.

MR. TAMMARA: No, it is under construction.

MR. SCHULTZ: It is and it's nearby the site. Does that, is there enough information for you to have included that here?

MR. TAMMARA: No, we haven't. It is, not enough information is available.

MR. SCHULTZ: But it's under construction?

MR. TAMMARA: I think so. It will be, the notion is it comes into being in 2022. So at what stage it is in I'm not sure.

MR. SCHULTZ: Is there any expectation that the results of the evaluation would change because of the location and the size of that airport? Do you think it would change the evaluation that you're doing now?

You've done quite a detailed evaluation as has the Applicant related to this airport. To have something sitting out there that's going to be evaluated later.

MR. TAMMARA: No, that will, usually that

kind of facility they have to go to the federal and state permitting procedures because there is another nuclear plant is there. They have to evaluate what would be the impact of the airport to nearby facilities just like we are doing here.

Just to give an example when we are doing the Calvert Cliffs COL there was next door the natural gas staging facility storage and also the, they would bring store and distribution facility, Cove Point. So when the State of Maryland gave a permit they had to evaluate what would be the accident safety point of, evaluation of the Calvert Cliffs.

They helped evaluate. And also as an operating plant Calvert Cliff has to evaluate what would be the potential impact of the proposed facility.

MR. SCHULTZ: Understood.

MR. TAMMARA: So therefore, we haven't done for the ESP therefore we have put it but a condition that at the COL stage they have to evaluate that.

MR. SCHULTZ: All right. Is there not enough information to determine that --

MR. TAMMARA: That's correct.

MR. SCHULTZ: Wait, let me ask my

question. Is there not enough information to determine that it won't be a difficult situation where something has got to give between the airport construction and design or the plant design before 2022?

MR. TAMMARA: That's correct.

MR. SCHULTZ: It seems like enough information might be available to at least determine that the construction project can continue and this site evaluation can continue.

MR. TAMMARA: But we need to know --

MR. SCHULTZ: Or in reverse, this is going to be a problem in 2022 and something will have to be worked out. That doesn't seem to be a proper way to proceed.

If it's going to be a problem if we can determine that now obviously it would be a better time than six years from now or so after the construction is more complete. I mean that's how facilities get into difficulty is when you get things close to done and then find out, we didn't consider it properly and there might be a problem here.

MR. TAMMARA: That's why we are identifying the Applicant, hey, you need to realize, be aware of it.

CHAIRMAN KIRCHNER: But I think where Steve is going is just to do a little projected calculation. You've got a general aviation airport, x, I forget the exact distance.

If you put a nominal general aviation airport load into the mix along with the distance that the airport is, would it substantially change your conclusions or would you still have adequate margin in terms of this crash probability or conversely if you don't have adequate margin and you fall below then that's something that would factor into the plant design and layout obviously or any mitigating measures, right, by the Applicant, right?

MR. SCHULTZ: That's what I was looking for. Clearly the evaluation needs to be done in detail once the parameters are known. But is there a determination at this time that this is not going to create an issue for the airport or for the site application by 2022?

MEMBER BALLINGER: In the justification for the airport itself an analysis had to be done. Why put the airport there? It must be some assumption of the number of flights in and out and all that to justify constructing the airport in the first place. And so you would think that justification would be

easy to get access to.

It might be a little artificial. But at least you have a number.

MR. CAMPBELL: Is this on? Okay, I'm Andy Campbell. I'm the deputy director of DSEA. The part of the problem with doing just that is it's very speculative.

Without knowing the specifics of what the airport is going to be and whether or not it's even going to be for the ESP stage that would be highly speculative. On the other hand, you could do some sort of screening.

But it would be again, very speculative. There's not a lot of data and it's certainly not required at the ESP stage. It would be required at the COL stage.

So in terms of the analysis I'm not sure what the regulatory basis for said analysis would be without definitive plans and definitive information for an airport.

CHAIRMAN KIRCHNER: Well I would, because there's, I know our charter is restricted to safety. But obviously the Applicant has financial interests at risk as well.

And it would seem to me prudent rather

than speculative to make such an estimate of the potential impact of that proposed airport and I'll let it go at that.

MR. CAMPBELL: Certainly the Applicant could do that if they so desired.

CHAIRMAN KIRCHNER: Okay. Does that conclude this section?

MR. TAMMARA: Yes.

CHAIRMAN KIRCHNER: At this point, let's see we have one more section to go. And why don't we take a short break and come back at 10:15 on the clock there on that wall. And so we are recessed.

(Whereupon, the above-entitled matter went off the record at 10:02 a.m. and resumed at 10:14 a.m.)

CHAIRMAN KIRCHNER: Let's begin the meeting and proceed to Chapter 15 please.

MR. TAMMARA: Yes. The next section is Chapter 15, Accident Analysis. Evaluation of radiological consequences, consequences of postulated designed basis accidents for the proposed CRN site.

Dose analysis include plant parameter envelope accident source terms consisting of assumed DBA, isotopic releases to the environment in lieu of specific plant design information. Site

characteristic short term accident atmospheric dispersion factors that they have developed site specific information in Chapter 2, Section 2.3.

So those dispersion parameters have been used for the, this Chapter 15. 10 CFR 52.17 and also citing 10 CFR 50.34(a)(1) postulated accident dose analysis requirements have the same dose criteria.

The evaluation must determine that an individual located at any point on the boundary of the exclusion area for any two hour period following the onset of postulated fission product, release would not receive a radiation dose in excess of 25 rem total effective dose equivalent, TEDE.

An individual located at any point on the outer boundary of low population zone who is exposed to the radioactive cloud resulting from postulated fission product release during the entire period of its passage would not receive a radiation dose in excess of 35 rem TEDE.

SRP 15.03 provides a new guidance including evaluation of PPE accident releases. Next slide please. The fission product released to the environment is reviewed based on industry accepted approaches, assumptions and methodologies.

The Applicant considered the loss of

coolant accident LOCA is expected to be more closely approached. 10 CFR 52.17 limits then other design basis accidents that may have greater probability of occurrence but lesser magnitude of activity release.

The selected PPE LOCA accident source term is based on standard, light water reactor fuel which is representative of SMR design assuming core power level of a single unit at 800 megawatt thermal. For reasonableness the PPE source term is compared with the AP1000 design with a scaling factor by ratio of .235 that is the ratio of 800 megawatt thermal to 2,400 megawatt thermal and assessed to be not unreasonable.

The radionuclide released to the environment for the loss of accident LOCA is documented and is considered by the Applicant in the ESP application as a part of plant parameter envelope in the SSAR Table 2.0.3.

Staff found the PPE LOCA release source term to be not unreasonable for the purpose of site analysis postulated for the consequences of a possible accident event. So it is, the reasonableness is based upon that ratio.

Next slide please. The dose to the individual located at the EAB or on the outer boundary

of LPZ is calculated based on the amount of activity released to the environment at dispersion using the transport from the release point to the dose point, breathing rate of an individual at the dose point location and the activity to the dose conversion factor.

So these are the parameters which will determine the dose. Since the dose and the vendor dose is determined based upon the vendor X/Q that is more representative of many of the sites the only change for the site is the site specific X/Q.

So dose can be determined by the ratio of when the X/Q, site specific characteristic evaluation. So the dose can be ratioed off. That is the way the dose is evaluated for the ESP site.

The actual doses of the exclusion area boundary and the outer boundary of the LOCA operation zone at the CRN site are obtained by multiplying the vendor supplied dose associated bounding PPE LOCA source term with the ratio of the site specific, site characteristic and the vendor supplied site parameter X/Q's by the equation. Dose at the site is equal to dose specified by the vendor by the ratio of site characteristic X/Q versus vendor supplied X/Q.

Analysis meets the dose criteria specified

in 10 CFR 50.34(a)(1) and also 10 CFR 52.17 and the PPE includes the bounding accident releases for the determination. Next slide please.

MR. SCHULTZ: Just on that slide a question. What are the boundary distances that are being used here?

The exclusionary boundary you mentioned, it was mentioned earlier that there was an analytical boundary that was associated with that. Is that what this is or --

MR. TAMMARA: Yes, that's correct, 1,100.

MR. SCHULTZ: 1,100 and the LPZ --

MR. TAMMARA: Is one mile.

MR. SCHULTZ: -- boundary is?

MR. TAMMARA: One mile.

MR. SCHULTZ: One mile, okay. Thank you.

MR. TAMMARA: 1,100 feet.

CHAIRMAN KIRCHNER: I have a slightly different question but related. It is an irregular, the actual exclusionary boundary is irregular. Is 1,100 the smallest distance to, of the exclusion area this doesn't go on the transcript very well. Is it irregular for --

MR. TAMMARA: The site boundary and also --

CHAIRMAN KIRCHNER: The 1,000 or 1,100 is the minimum distance from the center point of the site --

MR. TAMMARA: That's correct.

CHAIRMAN KIRCHNER: -- to the smallest lineal distance.

MR. TAMMARA: The closest point.

CHAIRMAN KIRCHNER: Okay, fine.

MR. TAMMARA: That's correct.

CHAIRMAN KIRCHNER: Thank you. Second, have you audited the site characteristics, the X/Q numbers that are used? I would note that in your table you point out that the vendor designs for that ratio or that parameter more correctly are engineering numbers like 1 times $10^{-3,5}$, 5 times 10^{-4}, et cetera.

And then we have some rather precise site characteristic numbers for the same parameter. Have you audited that? Does that allow for, does it allow for thermal inversions?

I've been through that area before when the fog sets in and the cloud cover is very low and the coal doesn't go anywhere, the coal dust and such That's an area of the country that's subject to morning fog and such.

So how confident are you in that site

characteristic parameter, particularly for the EAB given that when you use that multiplier you get fairly close to 25 rem, 21.6 as was pointed out.

MR. TAMMARA: That's correct. The site characteristic X/Q are evaluated based upon the site meteorology and other parameters using the code that has been evaluated by our meteorology subsection under 2.3.

It has documented what are the models they have used, what criteria they have audited in the parameters how they came up with. A detailed analysis have been used and analyzed and addressed in Section 2.3.

So when they present that section probably they will give you more insight and more thorough explanation of how they determined, how they accepted the numbers.

We are, they actually reviewed, accepted the X/Q and they independently generated and compared the Applicant's and theirs and concluded and based upon their evaluation we used the numbers because we are the end users to get the ratio. But I do not know specifically to answer.

CHAIRMAN KIRCHNER: Well I understand that. You've got three significant figures in that

parameter. I put my glasses on and I can't even read this.

MR. TAMMARA: 4.96.

CHAIRMAN KIRCHNER: 4.96, so you know what occurs to me is that what you have from the vendors are, as I mentioned, engineering like numbers, 1.0 times 10^{-3}, et cetera. Then we have rather precise numbers for the site characteristic.

And I understand they probably were generated using the guidance and the Reg Guide. But it begs the question what uncertainty that number might have with bounds and how comfortable then one is that estimating a dose of 21.6, which is getting close in engineering terms to 25, and the expectation is to, right, that is not a limit that is to be attained.

It's, if I remember, 10 CFR 50.34 there is some wording there that suggests that there should be a comfortable margin. So how comfortable are you with this analysis?

MR. TAMMARA: You find this out. The case for COL they have to make sure the actual source terms they have selected end up on. They have to compare against the source term and make sure the PPE is bounding.

It is so strong they have selected in the

PPE source term is bounding then it is okay. Otherwise they have to take a variance. This ESP stage it is showing taking the boundary PPE value you are meeting the 25.

CHAIRMAN KIRCHNER: Well we, of course there is uncertainty in several assumptions that result in that final number in terms of dose. There's the uncertainty as to whether scaling AP1000 is an accurate assumption.

It's, in a gross sense I would expect that's a good assumption. From what we know from some of the designs they probably wouldn't see the burn up that AP1000 will attain at this point, et cetera.

But it does, I just want to put a marker down that when we here from the meteorology people we would like to test those numbers.

MR. TAMMARA: Right.

CHAIRMAN KIRCHNER: And then we'll come back and look at how close this is to 25 rem.

MR. TAMMARA: That's true. But in our judgment at the COL stage if there is a variation in the source term, so in the actual design probably that answer will be much closer to 25 they might have to do some mitigating measure.

But variance such as that they are

deviating from the source term. So but because the X/Q is already evaluated for the site specific there is nothing they can do probably.

So the only thing they can do is they might have to have additional controls to lower the release and mitigate it. I do not know.

CHAIRMAN KIRCHNER: Or they could do what you did with aircraft. They could go back and reevaluate the meteorology.

MR. TAMMARA: Right, that's true. They have to. That's what I'm saying. They have to reevaluate taking the variance and show, demonstrate that their dose calculation, recalculated dose calculation with the actual source term is within the 25 margin, whatever they have demonstrated that.

MS. SUTTON: This is Mallecia Sutton. So the staff is currently writing the SE and will present the findings on the X/Q which I know they currently have an article on now related to X/Q with the Applicant and will be happy to present your, the findings on October, November.

So I know that some of that the staff is analyzing and is reviewing at this time.

CHAIRMAN KIRCHNER: Now the other thing again for the record that I should note is you are

assuming the limit is based on a single module failure.

MR. TAMMARA: That's correct.

CHAIRMAN KIRCHNER: Not the bounding plant parameter element that would obtain if it were looking at a larger --

MR. TAMMARA: That's correct because the limits are based upon the unit.

CHAIRMAN KIRCHNER: Yes. Okay, Ron, any nuclear questions?

MEMBER BALLINGER: No.

CHAIRMAN KIRCHNER: Pete?

MEMBER RICCARDELLA: No.

CHAIRMAN KIRCHNER: Steve.

MR. SCHULTZ: (Off microphone comments.) No, I think my comments will just pick up where you that is the, we understand what is being done at this stage is the evaluation. There are also going to be some near term discussions related to dose evaluations that are going to be performed related to the EAB, LPZ and for emergency planning purposes.

In order to have good discussion related to those parameters the determination of boundaries is going to be important to understand the uncertainties associated with these assumptions for the variety of

different designs that might be considered and also the sensitivities that one might determine.

As was stated, we do have limits that have been established in the regulation. At this stage in terms of new reactor licensing we are looking for margin and when one considers its evaluation which might pertain to a different approach to emergency planning.

One would expect that margins and limits would be very important. Just a general comment at this time to consider at the next stage, near term stage and licensing proceedings. Thank you for your presentation.

MR. TAMMARA: Thank you.

CHAIRMAN KIRCHNER: Okay. Let me turn and see if anyone from the public is in audience and wishes to make a comment. Seeing none, we'll open up the bridge line and see if we have any members of the public who have been listening in and wish to make a comment.

MEMBER RAY: Walt, before you do that, did you take member comments? I couldn't hear.

CHAIRMAN KIRCHNER: I was going to take final comments, Harold, in just a moment.

MEMBER RAY: That's fine. It was,

whatever was going on the last minute or so I couldn't hear so please go ahead.

CHAIRMAN KIRCHNER: Okay. We have two meetings going on simultaneously and while we are waiting for some technical assistance, Harold, if you have any comments this would be a good opportunity while we have the staff in front of us.

MEMBER RAY: Yes, I would be glad to. I'm sorry I'm not there. I will try and provide equivalent input.

But in any event, on the discussion of the perspective possibility of an airport and its implications for the site I think that will warrant some more discussion as to whether in an ESP proceeding if it's gotten to some point and whether it's an airport or any other thing, it's not specific to airports, but whether proposed additions to the environment should be considered and if so on what basis.

The discussion that I could hear which was we don't know the details about it yet and therefore it hasn't been considered but might have to be in the future. I think in an ESP proceeding, it's my opinion anyway that perhaps we ought to consider things when they've gotten at least to some point of specificity.

I certainly did that on a liquefied natural gas facility on one occasion. So that's the only comment that I have.

CHAIRMAN KIRCHNER: Okay, thank you. So if any member of the public is out there and wishes to make a comment please state your name and provide your comment.

Not hearing anyone I think we can close the bridge line and proceed around the table. Any final comments, Ron?

MEMBER BALLINGER: No further comments.

CHAIRMAN KIRCHNER: Pete?

MEMBER RICCARDELLA: No comments.

CHAIRMAN KIRCHNER: Steve?

MR. SCHULTZ: No further comments. I thank the staff. I think the presentations by both the staff and the Applicant have been well done this morning and I appreciate the current status information and look forward to the future meetings. Thank you.

CHAIRMAN KIRCHNER: So let me echo Steve's thanks and to both the staff and the Applicant. And with that we are adjourned.

(Whereupon, the above-entitled matter went off the record at 10:37 a.m.)

Clinch River
Early Site Permit
SSAR Sections 2.1, 2.2, 3.5.1.6, & Ch.15

Advisory Committee on Reactor Safeguards
Subcommittee Meeting

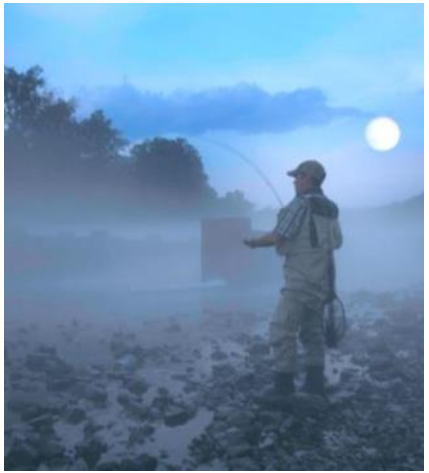
Presented by
Ray Schiele, Licensing Manager

May 15, 2018

TVA's Mission

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

Energy



Environment

Economic Development

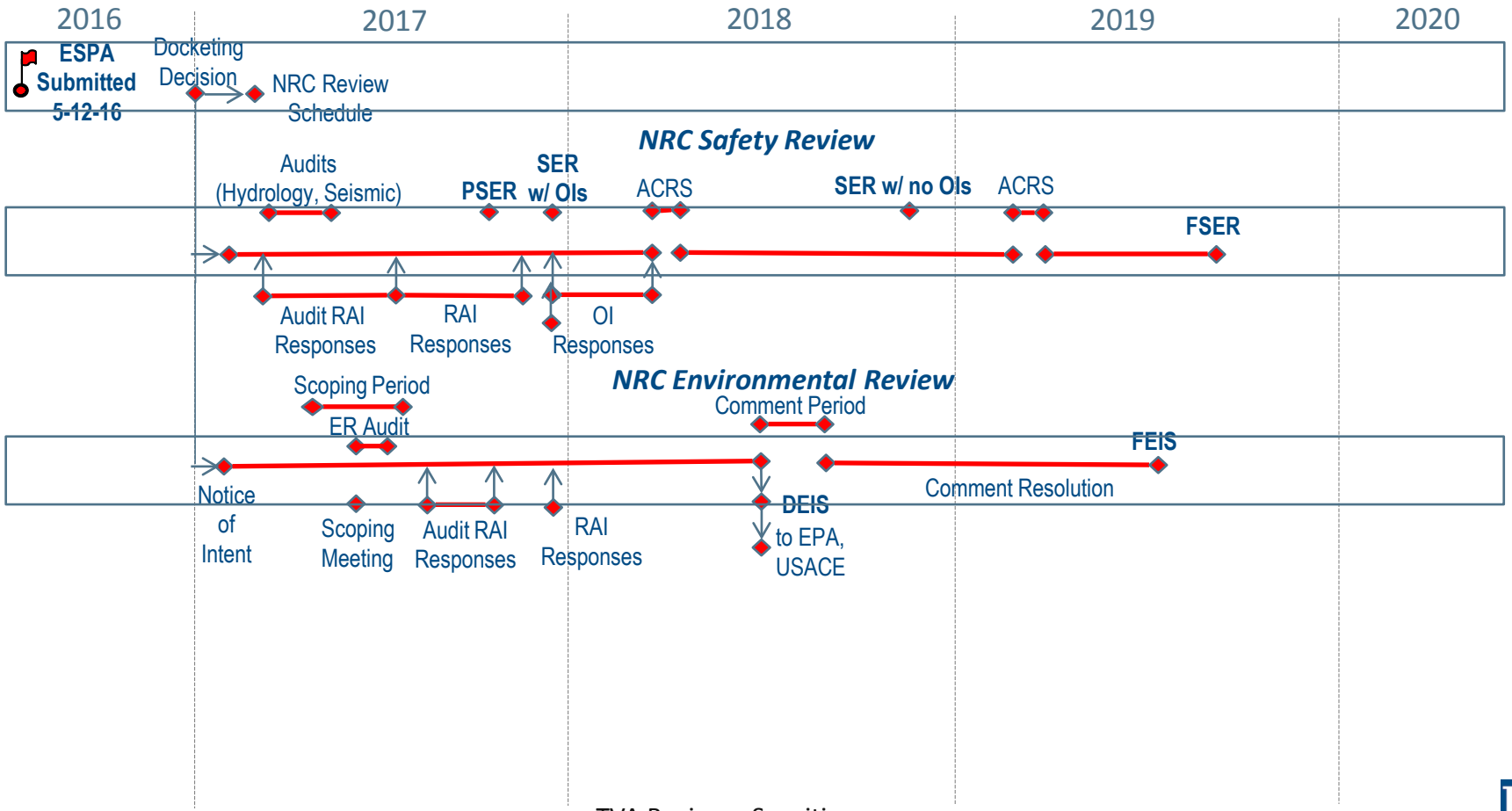
Partner with **154** local power companies, to serve **9 million people** and **700,000 businesses** in parts of **seven states.** Directly serve **56** large industries and federal installations.

TVA's Nuclear Fleet

Early Site Permit Application Development

▪ TVA decides to pursue ESPA	2014
▪ Site Characterization	2010 - 2015
▪ ESPA Submitted to NRC	May 2016
▪ NRC accepts ESPA for review	December 2016
▪ NRC performs Audits	March-May 2017
▪ ESPA Rev. 1 Submitted	December 2017
▪ RAIs	2017-2018

ESPA Project Update – Licensing Process



Chapter 2 – Section 2.1

Geography & Demography

Section 2.1 – Geography & Demography

The proposed CRN site location encompasses 935 acres of land adjacent to the Clinch River arm of the Watts Bar Reservoir, within the City of Oak Ridge, Roane County, Tennessee.

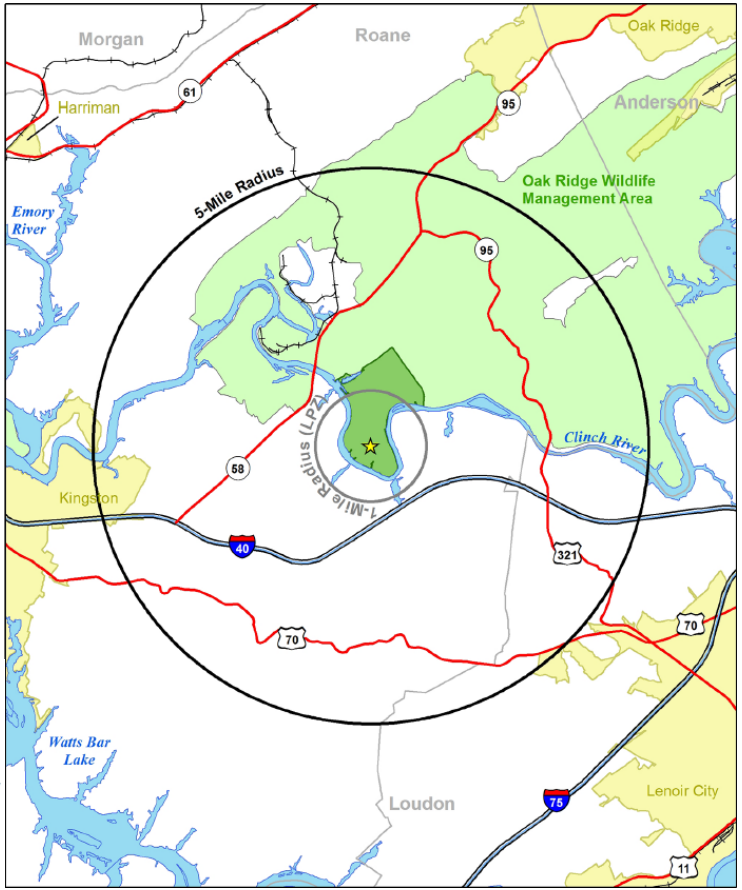
- Borders DOE Oak Ridge Reservation
- 6.8 miles East of Kingston, TN
- 9.2 miles East-Southeast of Harriman, TN
- 8.8 miles Northwest of Lenoir City, TN
- 25.6 miles West-Southwest of Knoxville, TN

The land is owned by the United States of America and managed by TVA as the agent of the federal government.

Section 2.1 – Geography & Demography

Population Distribution

- The low-population zone (LPZ) is defined as a 1 mi radius from the site center point.
- There are no hospitals, prisons, or jails within the LPZ
- There are no transient population events or attractions within this area.



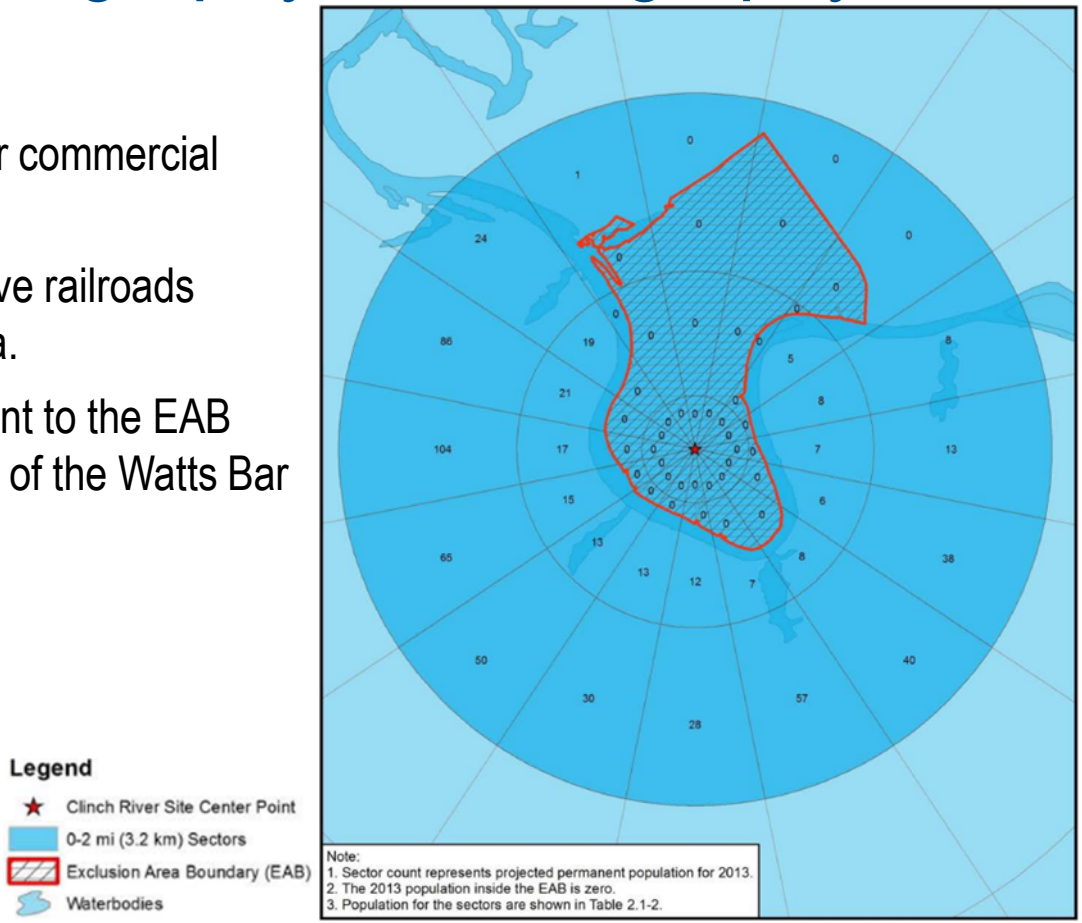
Legend

- Center Point
- Low Population Zone (LPZ)
- 5-Mile Radius
- Highway
- Interstate
- Railroad
- Counties
- Rivers and Lakes
- Clinch River Property Boundary
- City and Town Boundary
- State and Local Parks

Section 2.1 – Geography & Demography

Exclusion Area Boundary

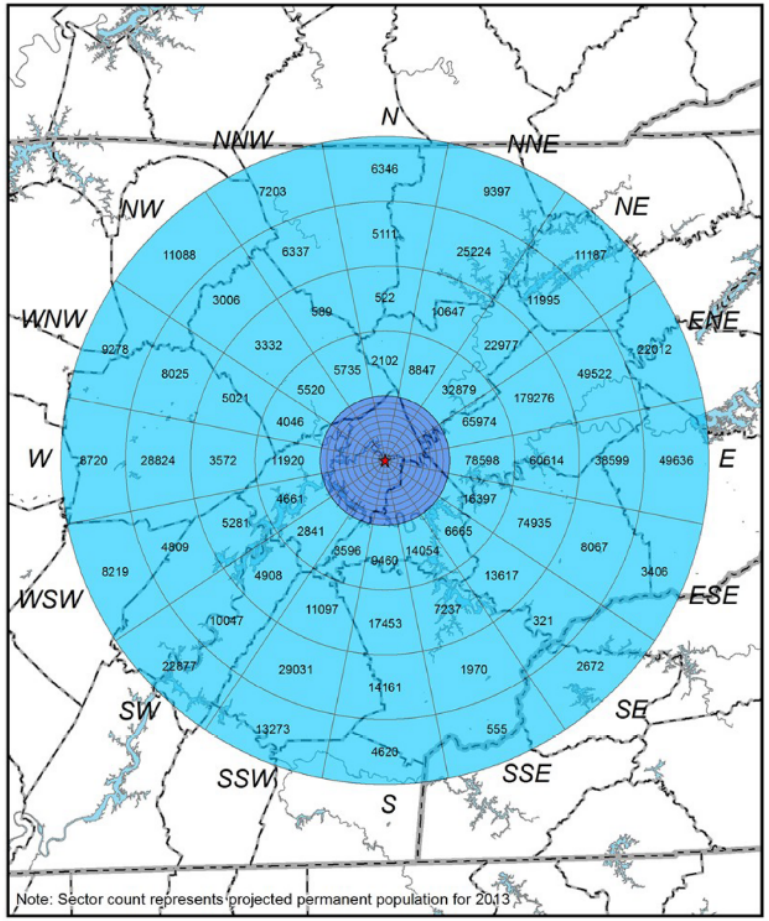
- There are no residences or commercial activities within the EAB.
- No public highways or active railroads traverse the exclusion area.
- Barge traffic occurs adjacent to the EAB along the Clinch River arm of the Watts Bar Reservoir.



Section 2.1 – Geography & Demography

Population Distribution

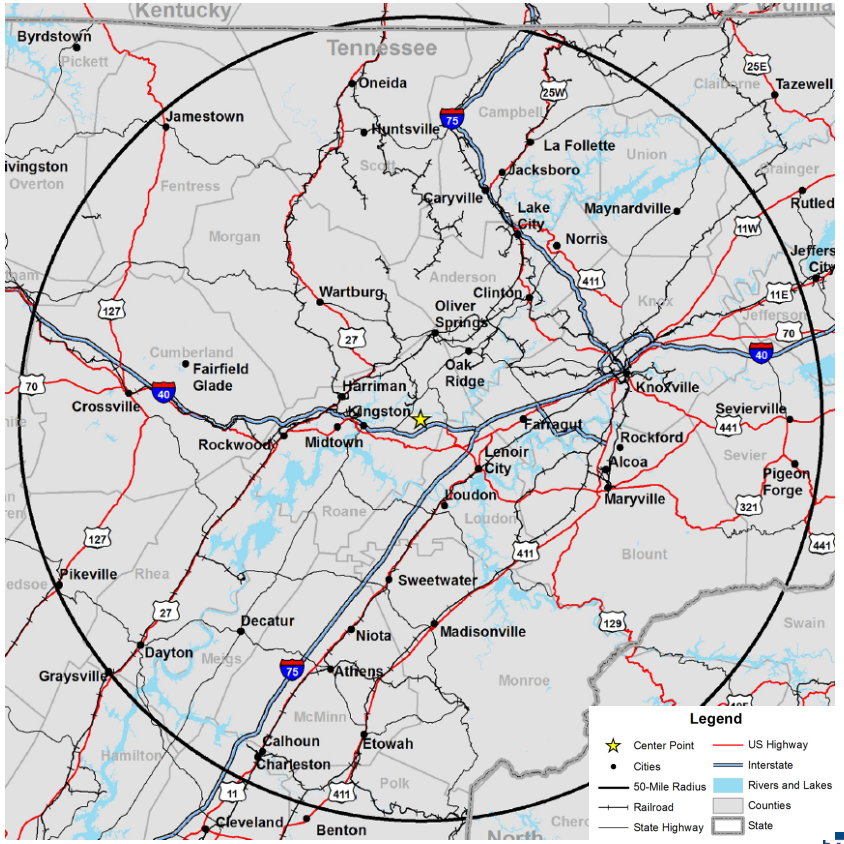
- The population distribution surrounding the site, up to a 50-mi radius, estimated based upon the most recent 2010 USCB decennial census data.
- Transient population is projected to 40 years beyond the 2027 commencement of operation date for the last unit.



Section 2.1 – Geography & Demography

Population Center

- Distance to population center boundary (greater than 25,000 people) complies with 10 CFR 100.3 guidance.
- USCB census-delineated urban areas are used to identify population centers and are based largely on population density.



Section 2.1 – Geography & Demography

Population Density

Population densities, per Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, were calculated for the 50-mi region for the projected start of construction date (2021), the projected commencement of operation date for the last unit (2027), and the end of operation date (2067).

- The total projected permanent population for 2021 and 2027 is approximately 1,305,000 and 1,377,000, respectively.
- The total projected transient population for 2021 and 2027 is approximately 638,000 and 674,000, respectively.
- The 2021 and 2027 total projected population for the 50-mi region is approximately 1.94 million and 2.05 million, respectively.
- The 2021and 2027 total population density is 247 people per mi^2 and 261 people per mi^2, respectively. These projected population densities are less than the 500 people per mi^2 recommended by Regulatory Guide 4.7.

Chapter 2 – Section 2.2

Nearby Industrial, Transportation, and Military Facilities

Section 2.2 – Nearby Industrial, Transportation, and Military Facilities

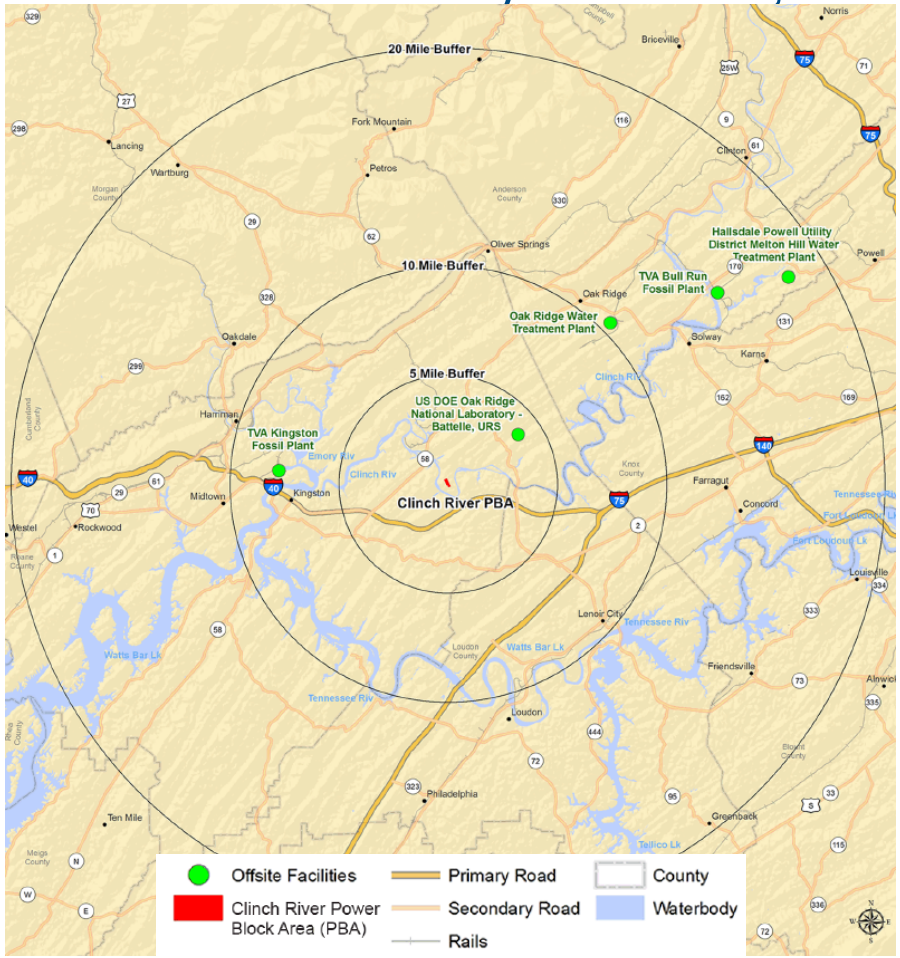
Locations and Routes

- Potential hazard facilities and routes within the 5-mile vicinity of the CRN Site identified in accordance with RG 1.206, RG 1.91, RG 4.7, and RG 1.78.
  - Identified all facilities and activities within 5 miles
  - Identified potentially significant facilities and activities beyond 5 miles.
- 1 navigable waterway, 1 major highway, 4 major roads, 1 minor rail line, and 2 natural gas pipelines identified within 5 miles.
- Additional industrial facilities were identified beyond 10 miles that were significant enough to be considered for further review.
- No identified roads, railways or navigable waterways at distances greater than 10 miles that are significant potential hazards.

Description of Products and Materials

- Identified chemicals used, produced, or transported by each facility/activity.

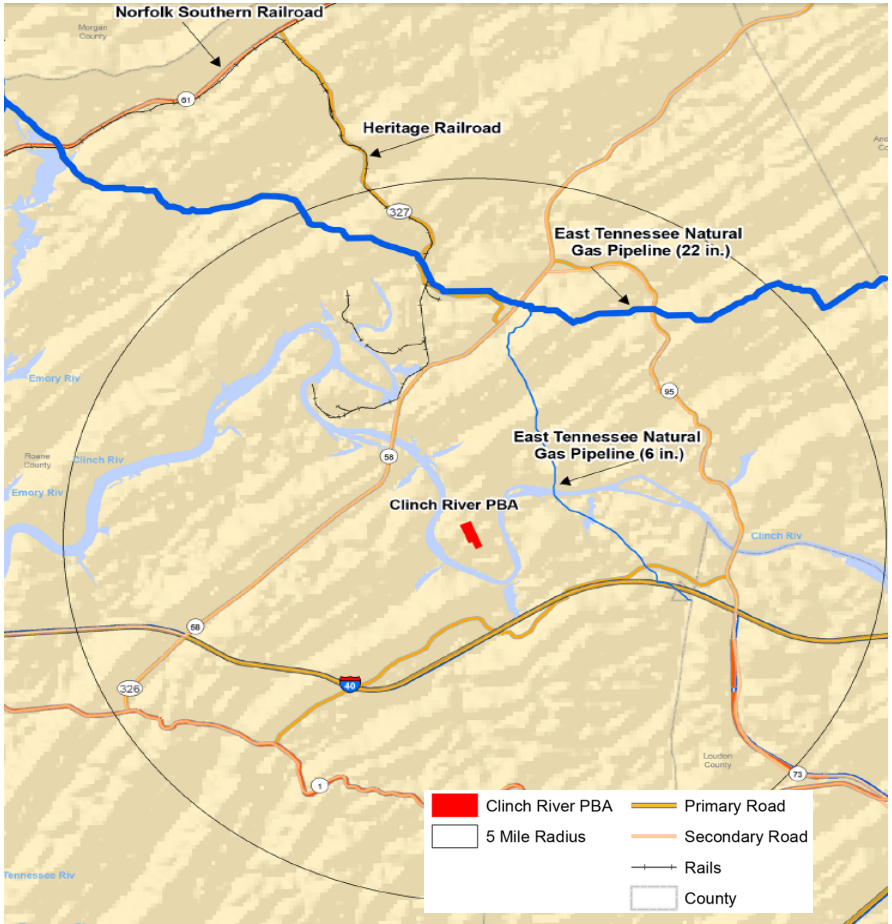
Section 2.2 – Nearby Industrial, Transportation, and Military Facilities



Industrial Facilities

- ORNL (Battelle and URS)
- TVA Kingston Fossil Plant
- Oak Ridge WTP
- TVA Bull Run Fossil Plant
- Hallsdale Powell Utility District Melton Hill WTP

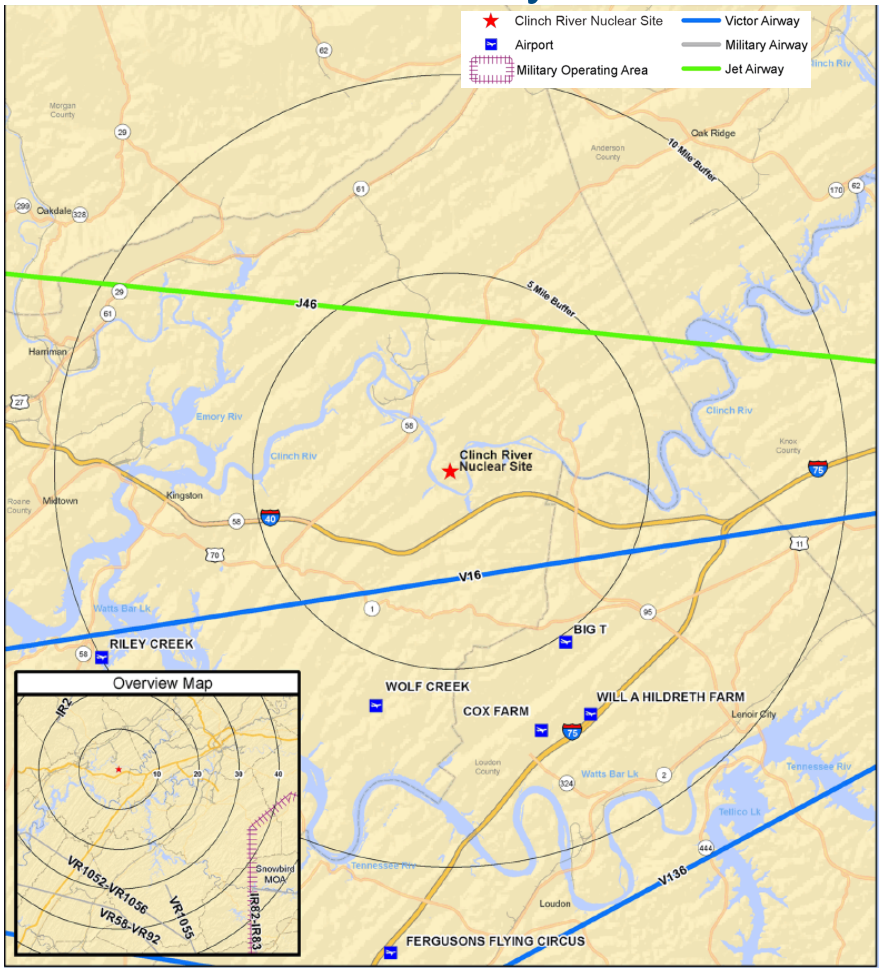
Section 2.2 – Nearby Industrial, Transportation, and Military Facilities



Transport Routes/Natural Gas Pipelines

- Clinch River arm of Watts Bar Reservoir
- I-40
- TN 1/US11-70, and TN 58, TN 95, and TN 327
- Heritage Railroad Corporation Railway
- East Tennessee Natural Gas Pipeline 1 (6 inch) and Pipeline 2 (22 inch)

Section 2.2 – Nearby Industrial, Transportation, and Military Facilities



Airports and Airways

- Big T
- Wolf Creek
- Cox Farm
- Will A Hildreth Farm
- Riley Creek
- Federal Airways V16 and J46

Section 2.2 – Evaluation of Potential Accidents

Determination of Potential Accidents

- RG 1.206 states that design-basis events, internal and external to the CRN Site, are defined as those accidents that have a probability of occurrence on the order of magnitude of 10-7 per year or greater with potential consequences serious enough to affect the safety of the plant to the extent that the guidelines in 10 CFR 100 could be exceeded.

- The following accident categories are considered in selecting design-basis events:
  - Chemical Releases: Explosions, flammable vapor clouds (delayed ignition), toxic chemicals, or fires.
  - Collisions with the intake structure.
  - Aircraft hazards.
  - Liquid spills.

Section 2.2 – Evaluation of Potential Accidents

The following locations were analyzed for postulated accidents within the accident categories considered in selecting design-basis events:

Nearby Storage Facilities

- ORNL (Batelle and URS) (located 3.8 mi from the CRN Site power block area)
- TVA Kingston Fossil Plant (located 7.6 mi from the CRN Site power block area)
- Oak Ridge WTP (located 10.3 mi from the CRN Site power block area)
- TVA Bull Run Fossil Plant (located 15 mi from the CRN Site power block area)
- Hallsdale Powell Utility District Melton Hill WTP (located 18.2 mi from the CRN Site power block area)

Nearby Transportation Routes

- East Tennessee Natural Gas Pipelines 1 and 2
- I-40
- Federal Airways V16 and J46

Section 2.2 – Evaluation of Potential Accidents

Effects of Design Basis Events

- Evaluations were performed of the potential hazards nearby to the CRN Site. These evaluations concluded that potential accidents involving explosions, flammable vapor clouds, collisions with intake structures, and liquid spills do not pose a threat to the CRN Site.
- Evaluation of the potential effect of toxic chemical releases from nearby industrial and transportation routes concluded that, except for anhydrous ammonia and chlorine potentially transported along I-40, the distance to the toxic endpoints are less than the distance to the CRN Site power block area. A main control room habitability analysis will be performed at the time of COLA for the transport of anhydrous ammonia and chlorine on I-40.
- The effects of chemical releases from onsite chemical storage will be evaluated in the COLA because plant features such as the control room habitability system design and location of safety-related structures must be considered to determine there is no adverse effect from these hazards.

Chapter 3 – Section 3.5.1.6
Aircraft Hazards

Section 3.5.1.6 – Aircraft Hazards

- NUREG-0800 establishes that the risks as the result of aircraft hazards should be sufficiently low, in that each requires that aircraft accidents that could lead to radiological consequences in excess of the exposure guidelines of 10 CFR 50.34(a)(1) with a probability of occurrence greater than an order of magnitude of 10-7 per year should be considered in the design of the plant.

- Utilizing proximity criteria, TVA performed a screening analysis to establish whether the probability of aircraft accidents for the proposed CRN Site is considered to be less than an order of magnitude of 10-7 per year by inspection.

Section 3.5.1.6 – Aircraft Hazards

Criterion 1:
The plant-to-airport distance, D, is between 5 and 10 statute miles, and the projected annual number of operations is less than 500 D2, or the plant-to-airport distance, D, is greater than 10 statute miles, and the projected annual number of operations is less than 1000 D2.

- Five small privately-owned airports are located between 5 and 10 statute mi of the CRN Site and two small privately-owned airports are within 10 to15 statute mi of the CRN Site.
- The airport projected number of operations, based on available data, is less than the significance factor (i.e., the allowable annual number of operations) called for by criterion 1.
- The results of this evaluation, summarized in SSAR Table 2.2-7 of the ESPA, indicate that the proximity screening criterion 1 is met for each evaluated airport; therefore, no nearby airports need further evaluation.

Section 3.5.1.6 – Aircraft Hazards

Criterion 2:
The plant is at least 5 statute miles from the nearest edge of military training routes, including low-level training routes, except for those associated with usage greater than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation.

- The CRN Site is located about 19.2 statute mi from the centerline of military training route IR2 this training route or approximately 13.4 statute mi from the edge of the training route.
- The closest military operation area (MOA) is the Snowbird MOA located approximately 36 mi from the CRN Site
- Given this separation distance between the CRN Site and the nearest military training route (greater than 5 mi from the nearest edge of a military training route), along with the distance to the nearest MOA, criterion 2 is met.

Section 3.5.1.6 – Aircraft Hazards

Criterion 3:
The plant is at least 2 statute miles beyond the nearest edge of a Federal airway, holding pattern, or approach pattern.

- There are two Federal airways, one victor (V) and one jet (J) route (V16 and J46, respectively) whose nearest edge lies within 2 statute mi of the CRN Site.
- Thus, due to the proximity of Federal airways V16 and J46, the proposed CRN Site does not meet proximity screening criterion 3.
- A detailed aircraft hazards analysis was performed and the expected rate of occurrence of potential exposures resulting in radiological dose has been shown to be on the order of magnitude of 10-6 per year and the realistic probability has been shown to be lower, based on qualitative arguments.

Chapter 15
Transient and Accident Analysis

Chapter 15 – Transient and Accident Analysis

Accident Selection

- NEI 10-01, *Industry Guidance for Developing a Plant Parameter Envelope in Support of an Early Site Permit* recommends that accident analyses model the time-dependent transport of radionuclides out of the reactor core through several pathways, each with different time-dependent removal mechanisms for radionuclides.
  - For the purposes of evaluating offsite post-accident doses, the vendor analysis with the highest resultant post-accident dose was selected for use in the CRN Site-specific dose analysis.
- Each of the four small modular PWR designs under consideration for the CRN Site is expected to include advanced design features that would further minimize accident consequences.
- TVA anticipates that the consequences of a LOCA will be less than those for large PWR designs and that no events of greater consequence will be identified.
- The COLA will verify that the accident doses provided in this ESPA are bounding or provides an evaluation of accident radiological consequences.

Chapter 15 – Transient and Accident Analysis

Source Terms

- The PPE LOCA source term is based on a design that uses standard light-water reactor fuel, which is representative of the SMR designs under consideration, and assumes a core power level for a single unit at 800 MW thermal.
- To assess reasonableness, a comparison of the PPE LOCA source term to that of the AP1000 design was performed.
  - The activity release associated with the worst 2-hour time period of the scaled-down AP1000 is approximately 25 percent greater than that for the surrogate plant (as provided in the PPE).
  - The activity release for the 30-day duration of the LOCA is approximately equivalent to that of the surrogate plant and is also considered reasonable.

Chapter 15 – Transient and Accident Analysis

Evaluation Methodology and Conclusions

- SMR Doses for a LOCA are evaluated at the EAB and LPZ boundary.
- Doses are calculated using the ratio of the X/Q methodology.

  The evaluation uses the following parameters:

  - Short-term 95th percentile accident atmospheric dispersion factors (X/Qs) for the CRN Site.
  - Bounding vendor-provided LOCA doses.
  - X/Q values associated with the bounding vendor-provided LOCA doses.
- The resulting accident doses are expressed as total effective dose equivalent (TEDE), consistent with 10 CFR 52.17. All site LOCA doses meet the 25 rem TEDE limit specified in 10 CFR 52.17

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

Safety Review of the Clinch River Nuclear Site, Early Site Permit Application

Demography/Geography/Site Hazards: (SSAR Sections 2.1 and 2.2)

Presented by
Seshagiri Rao Tammara, Technical Reviewer
NRO/DSEA/RPAC
May 15, 2018

Key Review Areas

2.1 Geography and Demography

Site Location and Description

- Coordinates, site boundaries, orientation of principal plant structures, location of highways, railroads, and waterways that traverse in the vicinity of the site and exclusion area

Exclusion Area Authority and Control

- Legal authority, control of activities unrelated to plant operation, and arrangements for traffic control

Population Distribution

- Current population and future projections, characteristics of the low population zone (LPZ), population center distance, and population density

Key Review Areas

2.1 Geography and Demography

- Staff reviewed the information provided by the applicant pertaining to Site Location and Description, and also checked independently the information available from the public domain. Staff found it to be acceptable as they satisfy the guidance provided in NUREG-0800 Section 2.1.1.

- Staff reviewed the information provided by the applicant pertaining to Exclusion Area Authority and Control. Based on the information provided, the staff finds it to be acceptable as it satisfies the guidance provided in NUREG -0800 Section 2.1.2.

Key Review Areas

2.1 Geography and Demography (cont'd)

- Staff reviewed the information provided by the applicant pertaining to Population Distribution including population projections covering the life of the plant, Population Center Distance and Population Density.
  - Based on the information provided by the applicant and staff's independent confirmatory evaluation, the staff found the information to be acceptable as it meets the requirements of 10 CFR 100.20.

Key Review Areas

2.2 Nearby Industrial, Transportation, and Military Facilities

Identification of Potential Hazards in Site Vicinity

- Maps of site, nearby significant facilities and transportation routes
- Description of facilities, products, materials, and number of people employed
- Description of pipelines, highways, waterways, airways and airports
- Projections of industrial growth

Key Review Areas

2.2 Nearby Industrial, Transportation, and Military Facilities (Cont'd)

- Staff reviewed the information provided by the applicant pertaining to the location and description of Nearby industrial, Transportation and Military Facilities for the evaluation of potential hazards for the safe operation of the proposed plant.
  - Based on the review of information provided by the applicant and the staff's independent checking of information from the available data from the public domain, the staff found it to be acceptable as the information meets the guidance provided in NUREG-0800 Section 2.2.1-2.2.2.
- The current site plans indicate future construction of an airport nearby the site by 2022. If this is in operation by COLA stage, its impact evaluation is required to be addressed in COLA. Permit condition 2.2-1 concerns this requirement.

Key Review Areas

Evaluation of Potential Accidents:

- Design-Basis Events: Accidents having a probability of occurrence on the order of magnitude of 10^{-7} per year or greater and resulting in a potential consequences exceeding 10 CFR 100 dose guidelines
- Explosions and Flammable Vapor Clouds – Industrial Facilities, Truck Traffic, Pipelines, Waterway Traffic
- Release of Hazardous Chemicals - Transportation Accidents, Major Depots, Storage Areas, Onsite Storage Tanks
- Fires – Transportation Accidents, Industrial Storage Facilities, Onsite Storage, Forest

Key Review Areas

Evaluation of Potential Accidents (Cont'd):

Staff reviewed the applicant-provided site specific evaluations of potential accidents. The applicant performed evaluations of potential hazards due to nearby facilities in the CRN Site vicinity.

- The effects of chemical releases from onsite chemical storage will be evaluated in the COLA referencing this ESP, because the locations of storage, control room and other safety-related structures designs and locations will be determined at COLA stage.

Key Review Areas

Evaluation of Potential Accidents (Cont'd):

- Based on the review of the applicant-provided information, analyses and the staff's independent confirmatory calculations, the staff found the applicant's conclusions to be acceptable, as the evaluations are in accordance with the guidance provided in NUREG-0800 Section 2.2.3, with the exception of potential impacts from toxic chemical release of anhydrous ammonia, chlorine and nitric acid from a truck transport on nearby roadway.

- Since the applicant determined the minimum safe distance due to potential toxic chemical concentration of anhydrous ammonia, chlorine and nitric acid from the potential release from a truck transport is greater than the actual distance, the applicant is committed and shall reanalyze the impacts of the delivery tanker truck using guidance provided in RG 1.78 and NUREG-0800, to demonstrate the compliance with 10 CFR100.20. Therefore, Permit Condition 2.2-2 is included.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

Safety Review of the Clinch River Nuclear Site, Early Site Permit Application Aircraft Hazards: (SSAR Section 3.5.1.6)

Presented by
Seshagiri Rao Tammara, Technical Reviewer
NRO/DSEA/RPAC
May 15, 2018

Key Review Areas

3.5.1.6 Aircraft Hazards

- For the site suitability, the plant design should consider that any of the aircraft accidents is not a design basis event (where the aircraft accident could lead to radiological consequences in excess of the exposure guidelines of 10 CFR 50.34(a)(1) with a probability of occurrence greater than an order of magnitude of 10^{-7} per year)
- Federal airways, holding patterns, or approach patterns should be at least 2 statute miles away
- Military installation or any airspace usage (e.g., bombing ranges) should be at least 20 miles from site
- All airports should be at least 5 miles from site

Key Review Areas

3.5.1.6 Aircraft Hazards (Cont'd)

- All airports should have projected operations less than:
  1. $500d^2$ for airports within a distance (d) of 5 to 10 miles
  2. $1000d^2$ for airports outside of 10 miles distance (d)
- Staff reviewed the applicant's information pertaining to site-specific aircraft analysis (aircraft hazards).
- The applicant calculated the aircraft crash probability for the identified two airways (V16 and J46) which are within 3.2 km (2 mi) of the CRN Site.
- The applicant determined the aircraft crash probability of 7.53×10^{-7} per year using non-airport operations referenced in DOE-STD-3014-96, "Accident Analysis for Aircraft Crash into Hazardous Facilities."

Key Review Areas

3.5.1.6 Aircraft Hazards (Cont'd)

- The staff performed independent confirmatory aircraft crash probability calculations using the highest recent 5-year (2011-2015) Federal Aviation Administration (FAA) supplied flight operations data within 8 km and 16.1 km (5 mi and 10 mi) of site.
- The potential aircraft crash probability of 1.5×10^{-8} per year is conservatively estimated by the staff, assuming that all the flights within 16.1 km (10mi) of CRN Site from FAA data follow these two airways.
- Therefore, staff agrees with applicant's conclusion that the aircraft crash probability is about an order of magnitude of 10^{-7} per year or less and meets the provided NRC guidelines.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

Safety Review of the Clinch River Nuclear Site, Early Site Permit Application Accident Analysis, (SSAR Chapter 15)

Presented by
Seshagiri Rao Tammara, Technical Reviewer
NRO/DSEA/RPAC
May 15, 2018

Accident Analysis

SSAR Chapter 15 "Accident Analysis"

- Evaluation of the radiological consequences of postulated Design Basis Accidents (DBAs) for the proposed CRN Site
- Dose analysis used:
  1. PPE accident source term consisting of assumed DBA isotopic releases to environment in lieu of specific plant design information
  2. Site characteristic short term (accident) atmospheric dispersion factors (See review of SSAR Chapter 2)

Regulations and Guidance

- SSAR (10 CFR 52.17(a)(1)) and siting (§50.34(a)(1)) postulated accident dose analysis requirements have the same dose criteria:

  The evaluation must determine that:

  1. An individual located at any point on the boundary of the exclusion area for any 2 hour period following the onset of the postulated fission product release would not receive a radiation dose in excess of 25 rem total effective dose equivalent (TEDE).
  2. An individual located at any point on the outer boundary of the low population zone, who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a radiation dose in excess of 25 rem TEDE.
- SRP 15.0.3 provides review guidance, including evaluation of PPE accident releases.

PPE Accident Source Term

Chapter 15 "Accident Analysis" (cont'd)

- The radionuclide release to the environment for a loss of coolant accident (LOCA) is documented and is considered by the applicant in the ESP application as a part of the PPE in SSAR Table 2.0-3.

- Staff found the PPE LOCA release source term to be not unreasonable for the purposes of site analysis or postulated from considerations of possible accident event.
  - The PPE source term is compared with that of AP1000 design (provided in Vogtle 3 and 4 ESPA) with scaling ratio of 0.235 (800 MWt/3,400 MWt) and ascertained to be not unreasonable.

DBA Dose Analysis

Chapter 15 "Accident Analysis" (cont'd)

- The accident doses at the exclusion area boundary (EAB) and the outer boundary of the low population zone (LPZ) at the CRN Site are obtained by multiplying the vendor supplied dose associated with bounding PPE LOCA source term, by the ratio of the site-specific(site-characteristic) and vendor supplied site-parameter X/Qs.
  - $Dose_{site} = Dose_{vendor} [(X/Q)_{site} / (X/Q)_{vendor}]$
- Analysis meets the dose criteria specified in 10 CFR 50.34(a)(1) and 10 CFR 52.17(a)(1) and the PPE includes the bounding accident releases for the determination.

DBA Dose Analysis

Chapter 15 "Accident Analysis" (cont'd)

- The calculated radiological consequences at CRN Site are within regulatory dose criteria of 25 rem TEDE for the maximum 2-hour period at the EAB and 25 rem TEDE at the outer boundary of the LPZ for the duration of the accident release. The analyses used and PPE source term are not unreasonable. Therefore, staff considers the applicant approach adequate and acceptable in meeting the regulatory requirements of 10 CFR 50.34(a)(1) and 10 CFR 52.17(a)(1).