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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THERMAL-HYDRAULIC SUBCOMMITTEE

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TUESDAY

APRIL 19, 2016

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear
 Regulatory Commission, Two White Flint North, Room
 T2B1, 11545 Rockville Pike, at 8:30 a.m., Michael
 L. Corradini, Meeting Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL L. CORRADINI, Meeting Chairman

RONALD G. BALLINGER, Member

JOY L. REMPE, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

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ACRS CONSULTANT:

UPENDRA ROHATGI

INVITED EXPERT:

JOSE MARCH-LEUBA

DESIGNATED FEDERAL OFFICIAL:

ZENA ABDULLAHI

ALSO PRESENT:

LIPING CAO, Westinghouse

AARON EVERHARD, Westinghouse

JEFFREY KOBELAK, Westinghouse

MITCH NISSLEY, Westinghouse

KATSUHIRO OHKAWA, Westinghouse

VESSELIN PALAZOV, ISL, Inc.

TOM RODACK, Westinghouse

MICHAEL SHOCKLING, Westinghouse

LEONARD W. WARD, NRR

*Present via telephone

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C-O-N-T-E-N-T-S

OPEN SESSION

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P R O C E E D I N G S

8:31 a.m.

CHAIRMAN CORRADINI: (presiding) The meeting will come to order.

This is a meeting of the Thermal-Hydraulic Subcommittee of the ACRS. My name is Mike Corradini, Chairman of the Subcommittee.

ACRS members in attendance today are Dr. Joy Rempe, Mr. John Stetkar, Mr. Dick Skillman, and Dr. Ron Ballinger.

We also have invited experts in attendance, Dr. Jose March-Leuba, and our consultant, Upendra Rohatgi, also known as Kumar, so I don't mispronounce every part of your name.

(Laughter.)

Zena Abdullahi is the Designated Federal Office for this meeting.

WCAP-16996P Topical Report is a three-volume report, a big three-volume report, which covers WCOBRA/TRAC-TF2, Code Suite Models, Correlations, and Assessment. The Topical Report also provides the FULL SPECTRUM LOCA uncertainty methodology and Demonstration Plan analyses.

The WCAP extends the NRC-approved Westinghouse best-estimate large-break LOCA

1 methodology to all break sizes, including
2 intermediate and small-break LOCAs. The best-
3 estimate large-break LOCA methodology is referred
4 to as Automated Statistical Treatment of
5 Uncertainty Methods, or affectionately, ASTRUM.

6 The proposed Westinghouse best-estimate
7 FULL SPECTRUM LOCA evaluation methodology is
8 intended to analyze any break size in which the
9 break flow is beyond the capacity of normal
10 charging pumps, up to and including a double-ended
11 guillotine break with a break flow equal to two
12 times the pipe area.

13 In the current WCAP submittal,
14 Westinghouse is seeking approval only for the
15 application of the FSLOCA Evaluation Model for
16 Westinghouse three- and four-loop plans with ECS
17 injection of postulated break in the cold leg. In
18 the future, Westinghouse intends to extend the LTR
19 to their two-loop designs with upper plenum
20 injection and CE designs. In addition, the FSLOCA
21 Evaluation Model is limited to PWRs with dry
22 containment building designs.

23 Considering the volume of the
24 information covered in this Topical Report, we held
25 a number of Subcommittee meetings -- in August of

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1 2014, in November of 2014, and then, in June of
2 2015. In the original meeting, the staff briefed
3 us on the content of the best-estimate LOCA Topical
4 Report and the highlights of the staff review. In
5 November, Westinghouse described the technical
6 basis supporting the methodology. And in June,
7 Westinghouse discussed the changes in the
8 methodology as a result of the staff review.

9 So, today's Subcommittee meeting is a
10 culmination of a series of briefings and will go
11 for a long time. That is an added comment.

12 (Laughter.)

13 Most of today's meeting is closed in
14 order to protect the highly-proprietary nature of
15 the LOCA methodology that is under review. The
16 agenda identifies the closed portions of the
17 meeting. During that time, I would request that
18 the Westinghouse staff to survey the attendees in
19 the room and ensure that all the participants are
20 cleared for access for their proprietary
21 information. In addition, no telephone lines
22 should be open during the closed portion of the
23 meeting unless it is a closed bridge number
24 provided to us by Westinghouse.

25 As the meeting is being transcribed, I

1 request that the participants in the meeting use
2 the microphones located throughout the room.
3 Remember, you have the little green light that has
4 to go on. You know where to push it. We always
5 forget and, then, we will remind you. And Mr.
6 Stetkar is designated button-pusher reminder.

7 Participants should first identify
8 themselves and speak with sufficient clarity and
9 volume, so that they can be readily heard.

10 We will now proceed with the meeting,
11 and I will call upon Tom Rodack of Westinghouse to
12 begin the presentation.

13 Tom?

14 MR. RODACK: Thank you.

15 Good morning. I'm Tom Rodack, former
16 Director of Licensing and Engineering Programs at
17 Westinghouse.

18 I am here today with several members of
19 our FSLOCA team. We are here to brief you and to
20 provide an overview of the FULL SPECTRUM LOCA
21 methodology. Presenters will be Mitch Nissley,
22 Aaron Everhard, Jeff Kobelak, and Mike Shockling.

23 We really appreciate this opportunity
24 to provide you with a briefing on this material.
25 This project began in 2005 and, as you noted,

1 generated copious licensing documentation, on the
2 order of 10,000 pages.

3 The FULL SPECTRUM LOCA methodology is
4 an integral part of Westinghouse's strategy to meet
5 current and future regulatory and industry needs.
6 Implementation of the FULL SPECTRUM LOCA methods
7 will enable Westinghouse to consolidate and retire
8 a number of legacy codes and methods.

9 As you indicated in your comments, Mr.
10 Chairman, we have met with you on two prior
11 occasions, once in 2014 and again in 2015. We have
12 drawn from your comments in those meetings and
13 tried to identify areas of interest to you. And
14 today's presentation covers those areas of interest
15 and should provide a good foundation for the
16 presentation this afternoon on the NRC staff review
17 of the methods.

18 The presentations today will begin with
19 a history of Westinghouse's LOCA methods, a brief
20 history, and also an explanation on how the FULL
21 SPECTRUM LOCA methods will fit in with
22 Westinghouse's technology portfolio.

23 We will, then, continue with an
24 overview of the small-break LOCA event, identifying
25 key phenomena to get everybody on the same page

1 with regard to the event, and then, go on and
2 explain how the key phenomena are treated in the
3 FULL SPECTRUM LOCA methodology, provide a
4 discussion of the overall statistical methods, and
5 then, provide a comparison of results with the FULL
6 SPECTRUM LOCA technology against separate and
7 individual effects test data.

8 The last presentation will be a sample
9 application of the methods, and we probably won't
10 get to that until after lunch.

11 We invite you, as always, to question
12 and interrupt as you see fit. We are here to
13 basically inform you. We have the presenters, but,
14 also, a number of experts in the audience. And
15 hopefully, if you have questions, we will be able
16 to answer them expeditiously.

17 Any questions or comments?

18 CHAIRMAN CORRADINI: I think some of us
19 have some clarification questions, but I think we
20 will just get to them as we work on through.

21 MEMBER REMPE: Actually --

22 CHAIRMAN CORRADINI: On the other hand,
23 Dr. Rempe?

24 (Laughter.)

25 MEMBER REMPE: I do have a question. I

1 was looking through this stuff and thinking about
2 it and looking ahead at the staff's presentation.
3 As you mentioned, there have been a lot of RAIs.
4 There have been changes in some of the
5 documentation and modeling and applicability.

6 Do you have any high-level lessons
7 learned? I mean, was it, in perspective, maybe
8 Westinghouse may believe they didn't fully
9 understand the scope of what would be expected from
10 the staff? Or, if you had to go through this
11 again, what are the lessons learned from this?
12 Over a decade in trying to get this through seems
13 like a long time.

14 MR. RODACK: Wow.

15 (Laughter.)

16 MEMBER REMPE: I guess I am curious on
17 the industry perspective. I think we will hear the
18 staff's perspective later today, and I wanted to
19 let you have that opportunity.

20 MR. RODACK: I think my primary lesson
21 learned, and I wouldn't say this is Westinghouse's
22 lesson, but my primary lesson learned is the
23 absolute importance of having a strong project
24 manager and licensing engagement throughout the
25 process. We kind of floundered, I think because

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1 there were times in the review where that was
2 missing. As a result, we kind of spun our wheels,
3 I think.

4 MEMBER REMPE: Thank you.

5 MR. RODACK: Yes.

6 CHAIRMAN CORRADINI: I want to point
7 out that you have to use your microphone and
8 identify yourself with sufficient volume.

9 DR. WARD: Yes, Len Ward, NRC.

10 I would just point out that the review
11 started, you know, their efforts started long
12 before the review, but the review started in
13 November 2010. And you are talking three volumes
14 with over 4,000 pages, and with all of the audit
15 materials and the responses that they so graciously
16 did for us, you have probably got close to 10,000
17 pages of stuff to look at. I will discuss more of
18 what they did. But, anyway, it was a formidable
19 effort, you know.

20 CHAIRMAN CORRADINI: Any other members?

21 (No response.)

22 Okay.

23 MR. RODACK: So, I would like to invite
24 each of the presenters to briefly introduce
25 themselves --

1 CHAIRMAN CORRADINI: Sure.

2 MR. RODACK: -- and explain how they
3 fit into the team.

4 But, before that, we have tried in our
5 presentation to identify all acronyms, spell them
6 out on first use, but we will very clearly quickly
7 lapse into jargon. So, at the end of the
8 presentation there is a list of acronyms, and if
9 you get confused, you can just refer back there or
10 you can just ask us what we are talking about.

11 So, Mitch?

12 CHAIRMAN CORRADINI: We are not in
13 closed session yet. Are we going to go immediately
14 into closed session with this information?

15 Mitch?

16 MR. NISSLEY: This is Mitch Nissley.

17 We will introduce ourselves. I have
18 two introductory slides to lay out the day, and
19 then, we will go into closed.

20 CHAIRMAN CORRADINI: And you are going
21 to make sure we are on track?

22 MR. NISSLEY: Make sure I make a
23 comment at that time.

24 CHAIRMAN CORRADINI: Thank you.

25 MR. NISSLEY: You bet.

1 CHAIRMAN CORRADINI: Okay.

2 MR. NISSLEY: Good morning. My name is
3 Mitch Nissley. I joined Westinghouse in 1981. So,
4 this summer I will hit 35 years with Westinghouse.

5 My involvement in the history of the
6 development of Westinghouse best-estimate LOCA
7 methods is principally in the original code
8 qualification document and, then, the ASTRUM
9 evaluation models. These were both specific to the
10 large-break LOCA applications. My involvement in
11 this program was largely from a historical
12 perspective point of view, as well as some
13 consultation and peer-review-type input.

14 Thank you.

15 MR. EVERHARD: Good morning. I'm Aaron
16 Everhard. I've been with Westinghouse almost 17
17 years, all within the LOCA group. I started out in
18 Appendix K, large- and small-break LOCA analysis
19 and methods, improvements. Then, I transitioned to
20 the best-estimate methods where I joined at the
21 tail-end of the ASTRUM development and licensing,
22 and have been with FULL SPECTRUM LOCA since we
23 started the development.

24 MR. KOBELAK: Good morning. My name is
25 Jeff Kobelak, and I have been Westinghouse since

1 2003. I have spent my entire career there working
2 in the best-estimate LOCA analysis technology. I
3 started actually performing best-estimate analyses
4 with some of our prior evaluation models that Mr.
5 Nissley discussed, and I started working on FULL
6 SPECTRUM LOCA shortly after its inception. I have
7 been working on that, the method development and
8 licensing, since 2006.

9 MR. SHOCKLING: Good morning. My name
10 is Mike Shockling. I have been with Westinghouse
11 since around 2007. I have been involved in ASTRUM
12 analyses and FSLOCA development since then. More
13 recently, since the RAI process and audits, I have
14 been involved in analysis and application part of
15 the method.

16 MR. NISSLEY: Okay. With that, we will
17 begin the presentation material.

18 As I commented before, I have two
19 introductory slides, after which we will really get
20 into the heart of the presentation material. Some
21 of this has already been touched on.

22 Westinghouse submitted, as Dr. Ward
23 indicated, the FULL SPECTRUM LOCAL Evaluation Model
24 Licensing Topical Report in November of 2010. So,
25 this was a methodology that was under development

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1 for almost six years prior to submitting it for NRC
2 review and approval.

3 There were a number of revisions made
4 throughout the course of the licensing process, and
5 I believe it was to everybody's benefit, and
6 probably especially this Subcommittee, that the
7 current documentation does reflect the changes as
8 the methodology evolved during the licensing
9 process. Revision 1 of the Topical Report was
10 submitted throughout 2015 and does reflect the
11 changes resulting from the licensing process.

12 Prior meetings with this Subcommittee
13 were, as was touched on before, in August of 2014,
14 Dr. Ward gave a summary of his review findings, the
15 focus of areas of some contention and how
16 Westinghouse resolved those areas of contention.

17 In November of 2014, Westinghouse
18 provided a full-day overview of the methodology.
19 During that meeting, we had good dialog with the
20 Subcommittee. There were a number of specific
21 topics that the Subcommittee identified that they
22 wanted to hear more about. And in June of 2015, we
23 came back and did, what I will say, more of a deep
24 dive on the areas that the Subcommittee had
25 identified as worthy of further discussion and a

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1 deeper dive in the presentations.

2 This presentation will, again, back up
3 a bit and give an overview up through the early
4 part of the afternoon. In particular, there are
5 some new attendees here. I will try not to be too
6 repetitious of prior presentation material, and we
7 have tried to walk the balance between giving a
8 complete overview, with the goal-setting of a good
9 foundation for the afternoon presentation by the
10 NRC staff, where they will summarize their review
11 findings and also the content of the Draft SER,
12 which has been presented to the Subcommittee.

13 The agenda for today for the
14 Westinghouse portion is I will next go into closed
15 session and start out with an introduction. That
16 will probably take on the order of a half-an-hour
17 or so.

18 I will, then, turn it over to Aaron
19 Everhard, to my right, who will give an overview of
20 the small-break LOCA transient itself and discuss
21 and focus on the key phenomena and physical
22 processes that occur during a postulated small-
23 break LOCA transient.

24 It will probably be about time for the
25 morning break, obviously your call, but as we scope

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1 out the way the day plays, that is probably about
2 the time for the morning break.

3 And after that, we will pick it up with
4 Jeff Kobelak who will probably take us up to
5 lunchtime by giving more details on the analysis
6 method itself. We have broken Jeff's presentation
7 up into three sections. We were asked at the prior
8 meetings to give a summary of the key parameters
9 that we found in terms of modeling LOCA transients
10 and how those important and dominant phenomena and
11 processes are treated within the Evaluation Model.

12 We will, then, give an overview of the
13 FULL SPECTRUM LOCA analysis method. One thing
14 interesting as part of this review process is,
15 before while it has always been very important to
16 do significant code validation for realistic codes,
17 the uncertainty methods have always been applied in
18 the context of PWR or BWR applications.

19 In this case, as part of the licensing
20 process, we actually applied the uncertainty
21 methods to two integral effects tests. One was for
22 the cylindrical core test facility, which is an
23 integral test facility for the reflood portion of a
24 PWR large-break LOCA. That facility is located in
25 Japan.

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1 We also did an application of the
2 uncertainty methods to the rig of safety
3 assessment, one of the key tests from ROSA, which
4 is another facility in Japan. So, we did apply our
5 uncertainty methods to an important integral
6 effects test for both the large-break and the
7 small-break scenario in order to illustrate how it
8 applies when you have measured data versus just
9 applying it to the PWR.

10 MEMBER SKILLMAN: Mitch, let me ask
11 this question about those two test facilities and
12 application of the uncertainties. How large are
13 those test facilities? I ask the question because
14 we have seen the plants grow from 150-160 fuel
15 assemblies to 180, to 190. The new class are 241
16 fuel assemblies. And so, the question that really
17 pops to my mind is, how do those tests and
18 uncertainties applied in those tests apply to these
19 larger and larger diameter cores, reactor vessels,
20 and internals?

21 MR. NISSLEY: Okay. I think there are
22 really two parts to the question there. Let me
23 make sure I have got it right. You are curious of
24 what scale the facilities are and, then, the
25 applicability of that smaller-scale information to

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1 a full-scale PWR, especially recognizing that they
2 continue to grow?

3 MEMBER SKILLMAN: Yes, sir.

4 MR. NISSLEY: Okay. Thank you.

5 And I will ask my colleagues here to
6 correct me if I am off a little bit on the scale.
7 But the CCTF is a 124th or 121st, okay, 1-over-21
8 scale of a four-loop Westinghouse PWR, which for
9 the classes of plants that we are asking for
10 approval here today, and that we plan to apply in
11 the immediate future, is scaled appropriately for
12 the current generation of operational PWRs that we
13 are initially intending to apply this method to.
14 The ROSA facility is 1-over-48, and it was scaled
15 to a Westinghouse four-loop plant also.

16 So, regarding the scaling of these
17 plants, although they are subscale, they are full
18 integral effects tests. We do have a scaling
19 assessment within the documentation. In
20 particular, we did do separate effects testing,
21 test simulations, with the upper plenum test
22 facility from Germany, which is a full-scale
23 simulation of a four-loop German PWR. So, we have
24 done full-scale validation to the extent that it is
25 available from the UPTF facility, but the integral

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1 effects tests were subscale. We did address
2 scaling throughout the methodology.

3 There were some areas where what you
4 will hear throughout the day is at the end of the
5 day the final methodology -- and we are probably
6 getting into some proprietary things, but I am
7 conscious of that, so I will limit my comments to
8 some extent -- is that there are areas where,
9 because of the lack of full-scale data,
10 Westinghouse made concessions with regard to the
11 uncertainty treatment, partly because of the lack
12 of full-scale data. So, we think that we have
13 looked at scaling carefully and in some cases have
14 made concessions in how we will apply the
15 methodology in a PWR because of the lack of full-
16 scale data.

17 CHAIRMAN CORRADINI: So, just to make
18 sure, you will come back to this in the closed
19 session?

20 MR. NISSLEY: Yes.

21 CHAIRMAN CORRADINI: Okay.

22 MR. NISSLEY: I think you will hear
23 pieces of it throughout the day, and maybe we keep
24 that just to make sure that we cover that, but I
25 think we will be very clear that there are areas

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1 where some concessions were made because of scaling
2 and the resulting uncertainty.

3 CHAIRMAN CORRADINI: Okay, Mitch.
4 Thank you.

5 MR. NISSLEY: You bet.

6 CONSULTANT ROHATGI: So, when you guys
7 estimated the uncertainty for radius phenomena and
8 model, you had an addition because of scale
9 distortion or small-scale facilities?

10 CHAIRMAN CORRADINI: I am going to ask
11 that we hold the question, because if you are going
12 to get anything specific, we want to go into closed
13 session anyway.

14 MR. NISSLEY: Yes, we are a few minutes
15 away from closed session.

16 CHAIRMAN CORRADINI: Okay.

17 MR. NISSLEY: But I would ask that you
18 hold that question in the same context that, you
19 know, we will be touching on that throughout the
20 day, and we are mindful of the questions you are
21 giving us as we go. And we will attempt to resolve
22 them as we move through the day, but keep those as
23 perhaps end-of-the-day wrap-up kind of discussion.

24 Jeff's presentation will likely take us
25 up to lunchtime. After lunch, I think we will pick

1 up with Mike Shockling presenting an application of
2 this Evaluation Model to an actual PWR licensing
3 application illustration.

4 At that point, hopefully, we will have
5 given a fairly complete overview of just what this
6 Evaluation Model is all about and how it gets
7 applied. Hopefully, that will set up the NRC's
8 presentation where they will present their review
9 findings and summarize the content of their Draft
10 SER and make other remarks, as appropriate.

11 Okay. With that said, we are going to
12 kick off the main part of the presentation, and I
13 would ask that we go into closed session at this
14 time.

15 CHAIRMAN CORRADINI: Okay. So, I will
16 ask the Westinghouse leads to make sure that
17 everybody in the room is supposed to be in here and
18 anybody you don't know -- you're okay? You're
19 good?

20 And we have closed the phone lines?
21 Okay.

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And so, do you guys have somebody on a closed line or is everybody physically here?

MR. NISSLEY: We have some people on call, nobody that we need to --

CHAIRMAN CORRADINI: So, there should be no lines open, is that correct?

CONSULTANT ROHATGI: There is a Westinghouse line there. So, we should close it completely?

MR. NISSLEY: Yes.

CHAIRMAN CORRADINI: Okay. All right. Let's wait to do that.

MR. NISSLEY: Thank you. I appreciate you appreciating the Westinghouse proprietary information.

(Pause.)

CONSULTANT ROHATGI: Things are closed.

MR. NISSLEY: Okay. All right. Thank you.

(Whereupon, at 8:55 a.m., the meeting went out of open session and into closed session.)

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