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2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 (ACRS)

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7 SUBCOMMITTEE ON GLOBAL NUCLEAR FUEL (GNF) LICENSING

8 TOPICAL REPORT (LTR), NEDE-33885P REVISION 0,

9 "CONTROL ROD DROP ACCIDENT (CRDA) APPLICATION

10 METHODOLOGY" - OPEN SESSION

11 + + + + +

12 TUESDAY

13 DECEMBER 3, 2019

14 + + + + +

15 ROCKVILLE, MARYLAND

16 + + + + +

17 The Subcommittee met at the Nuclear
18 Regulatory Commission, Two White Flint North, Room
19 T2D30, 11545 Rockville Pike, at 8:30 a.m., Jose
20 March-Leuba, Chair, presiding.
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1 COMMITTEE MEMBERS:

2 JOSE MARCH-LEUBA, Chair

3 RONALD G. BALLINGER, Member

4 JOY L. REMPE, Member

5
6 DESIGNATED FEDERAL OFFICIAL:

7 WEIDONG WANG

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

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P-R-O-C-E-E-D-I-N-G-S

8:51 a.m.

CHAIR MARCH-LEUBA: This is a meeting of the Thermal-Hydraulics Phenomena Subcommittee of the Advisory Committee on Reactor Safeguards. I am Jose March-Leuba, Chairman of today's Subcommittee meeting.

ACRS members in attendance are Joy Rempe and Ron Ballinger. Weidong Wang of the ACRs staff is the federal official for this meeting.

During this meeting the Subcommittee will review a draft safety evaluation report for Global Nuclear Fuel Americas, also know as GNFA, Licensing Topical Report NEDE-33885P Revision O, and GNF-CRDA Application Methodology. The Subcommittee will hear presentations by and hold discussions with NRC staff, GNF-A representatives, and other interested persons regarding this matter.

The rules for participation in all ACRS meetings, including today, were announced in the Federal Register on June 13, 2019. The ACRS section of the U.S. NRC public website provides our charter, by-laws, agendas, reports, and full transcripts of all full Subcommittee meetings including the slides presented there. A meeting notice and agenda for this meeting will be posted there.

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1 We have received no written statements or
2 requests to make an oral statement from the public.

3 The first part of today's meeting is
4 opened to public attendance. The second part of the
5 meeting will be closed in order to discuss information
6 that is proprietary to the licensee and its
7 contractors pursuant to 5 USC 552(b)(c)(4).

8 Attendance at this portion of the meeting
9 that deals with such information will be limited to
10 the NRC staff and those individuals and organizations
11 who have entered into an appropriate confidentiality
12 agreement with them.

13 Consequently, we need to confirm that we
14 have only eligible participants in the room for the
15 closed portions when we get there.

16 The Subcommittee will gather information,
17 analyze relevant issues and facts, and formulate
18 proposed positions and actions, as appropriate, for
19 deliberation by the Full Committee.

20 The rules for participation in today's
21 meeting have been announced as part of the notice of
22 this meeting previously published in the Federal
23 Register. A transcript of the meeting is being kept
24 and will be made available as stated in the Federal
25 Register notice. Therefore, we are requesting the

1 participants in the meeting use the microphones
2 located throughout the room when addressing the
3 Subcommittee.

4 The participants should first identify
5 themselves and speak with sufficient clarity and
6 volume so they may be readily heard. Just a reminder,
7 if your name is in front of you, you don't need to say
8 your name every time you talk. If your name is not in
9 front of you, you tell your name so the court reporter
10 knows who you are.

11 We will now proceed with the meeting.
12 Another reminder. Please place your phones on mute
13 because somebody always forgets and it's annoying when
14 it sounds.

15 Now I'll call on the NRC staff to provide
16 some introductory remarks.

17 MS. ROSS-LEE: Good morning and thank you
18 for your patience with shifting rooms and trying to
19 get all the technology aligned appropriately. My name
20 is MJ Ross-Lee. I'm the Deputy Division Director for
21 the Division of Safety Systems. I want to thank you
22 for coming this morning and for your patience as we've
23 shifted rooms.

24 GNF submitted this topical report in 2008
25 with the intent of implementing the proposed

1 methodology into GESTAR II in 2020 as an option for
2 licensees to analyze the control rod drop accident
3 event. GNF's legacy CDRA analysis methodology is
4 based on generic analysis performed to show compliance
5 with old NRC regulatory guidance.

6 The proposed methodology is an updated
7 approach to explicitly verify that the more recent NRC
8 acceptance criteria are met as well as provide
9 flexibility to licensees for analysis on a case-by-
10 case basis. New regulatory guidance on reactivity-
11 initiated events, accidents in the form of a Draft
12 Guide 1327, will be reviewed by ACRS within the next
13 few months prior to being finalized.

14 In the interim, the proposed GNF
15 methodology was reviewed with the criteria from the
16 current guidance in Appendix B to the SRP Section 4.2,
17 as well as the Draft Guide. As a result, the staff
18 expects that licensees will be able to utilize the
19 methodology with the most recent regulatory guidance,
20 whether it be the current SRP guidance or the Draft
21 Guide.

22 The interaction between GNF and NRC staff
23 was very productive in effectively identifying and
24 addressing several potential issues with the finding
25 of applicability of the methodology implementation for

1 specific licensees and to clarify potential uses of
2 the methodology not explicitly identified in the
3 topical report.

4 MEMBER REMPE: So I have a question. If
5 I look at your SE, there's a statement in there, and
6 I'm pretty sure it's not proprietary so I can quote
7 it, saying that the time this SE was written, "The
8 Draft Guide is not expected to be finalized." Are you
9 planning to fix that statement?

10 MR. KREPEL: This is Scott Krepel. The
11 Draft Guide was recently finalized. We finished the
12 public comments just a couple of months ago and it's
13 going to go to the ACRS sometime in the next couple
14 months. The safety evaluation is expected to be
15 completed before the Draft Guide becomes finalized as
16 regulatory guidance so the statement will stay as is.

17 MEMBER REMPE: It's a word thing, but if
18 I read this verbatim, at the time this SE was written,
19 Draft Guide 1327 is not expected to be finalized as a
20 regulatory guide. That sounds like ain't never going
21 to happen to me. Probably it should be revised a bit.

22 MR. KREPEL: Sure, I can go ahead and
23 revise that.

24 MEMBER REMPE: Thank you.

25 MS. ROSS-LEE: Yeah, that makes sense now

1 as you read it, the wording. It will still be draft
2 but it will be finalized at some point in time.

3 MEMBER REMPE: Sounds like it's never
4 going to happen. Thank you.

5 MS. ROSS-LEE: I understand the question
6 now.

7 CHAIR MARCH-LEUBA: With this discussion
8 we'll pass the gavel to -- for the record, I will call
9 you GE, GEH, GNF, and GNF-A. You let me know what I
10 mean by that. Please tell us what the name of your
11 company is and introduce yourselves.

12 MR. HALAC: Hello. My name is Kent Halac.
13 I work for Global Nuclear Fuels and GE Hitachi. I am
14 here today -- I am the lead licensing engineer for
15 fuel licensing at Global Nuclear Fuels. With me is
16 Scott Pfeffer from Global Nuclear Fuels, GE Hitachi
17 also. He is our technical lead in the area of
18 stability and control rod drop.

19 We appreciate you hearing this topic
20 today. We've come a long ways with this particular
21 methodology and we are looking forward to final
22 closure. We submitted the topical in February of 2018
23 and we had a detailed audit which was scheduled for
24 September 2018 but Hurricane Florence had something to
25 say about that and got delayed to October of 2018 and

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1 was executed successfully subsequent to the hurricane
2 in Wilmington.

3 Scott Krepel has done an amazing job
4 digesting our technology and providing excellent
5 feedback on the content and narrowing it to be
6 appropriate and consistent with the draft guidance.

7 We have read and have digested the draft
8 SE associated with this and some of the feedback I've
9 received from our consulting engineers is it's
10 arguably the best SE he's every seen. We want to give
11 complements to Scott for his thorough detailed
12 approach toward this particular technology.

13 With that, I will yield to NRC.

14 CHAIR MARCH-LEUBA: I believe you're up.

15 MR. HALAC: Okay, that's right. Sorry.

16 MR. PFEFFER: I'm Scott Pfeffer. I'm the
17 technical lead for the radiological side of the
18 stability and radiological team at GNF GEH. Prior to
19 that I spent eight years on the stability and
20 radiological team mostly doing stability work previous
21 to that.

22 We'll get into the open items on the
23 control rod drop accident methodology. We'll start
24 off with a brief overview of the drivers and the
25 approach that we took in developing the LTR, and then

1 a brief discussion on the documentation status, so the
2 REIs, limitations and conditions, and the draft safety
3 evaluation.

4 Drivers, as has been previously mentioned,
5 were to align with the latest guidance from the staff
6 related to reactivity-initiated accident fuel damage
7 guidelines, specifically for CRDA for BWRs. The idea
8 was to more thoroughly evaluate possible CRDA
9 scenarios.

10 We also want to improve plant operations
11 to allow a person more flexibility than is currently
12 available under the old methodology which is a banked
13 position withdrawal sequence methodology. As part of
14 that, we've had some fuel changes and things, some
15 difficulties in start-up at plants, and one of those
16 is an inadvertent subcriticality event that can occur
17 so we wanted to allow some flexibility for that.

18 CHAIR MARCH-LEUBA: Subcriticality?

19 MR. PFEFFER: Subcriticality. The old
20 methodology has some generic requirements on banked
21 positions that must be met during the start-up and
22 mostly developed as part of older fuel designs. The
23 banked at four, which is right at the top of the fuel,
24 especially at BOC conditions, can have very little
25 worth.

1 During the start-up if they are too slow
2 in pulling those rods, if they can't pull them fast
3 enough with zero worth as the reactor is heating up,
4 they can actually drop and become subcritical. That
5 happened at LaSalle, I believe it was. We wanted to
6 start to allow for flexibility in those banked
7 positions and that's part of the new methodology.

8 As part of that, also looking for
9 potential dose improvements, the goal for our LTR was
10 to demonstrate no fuel failures and that would allow
11 for some benefit in terms of the dose consequence for
12 control rod drop accident.

13 CHAIR MARCH-LEUBA: And this single rod
14 failure, is that the goal, or is it a requirement, or
15 99.9?

16 MR. PFEFFER: It is a requirement of the
17 methodology that we demonstrate as part of our
18 analysis that there are no failures.

19 The approach we used was to use previously
20 approved methods so that includes PANACEA or PANAC
21 which is our core simulator of PRIME or
22 thermal/mechanical methodology, and TRACG BWR systems
23 code to do our analysis.

24 We wanted to implement the newest
25 guidance. We discussed specifically items that were

1 implemented were hydrogen efficient gas release models
2 and then the pellet-cladding mechanical interaction,
3 and high temperature cladding failure thresholds as
4 far as the acceptance criteria for rod failures.

5 Sources for that guidance were the
6 memoranda on the RAs and hydrogen pickup, as well as
7 SRP 4.2 Appendix B, as well as then supplemented by
8 Draft Guide 1327 as was mentioned previously.

9 Documentation. The LTR that was mentioned
10 was submitted in February 2018. We conducted the
11 audit in October 2018 and had good discussions there.
12 We resolved all RAIs in March 2019, again after some
13 back and forth and good resolution there.

14 LNC notification along with the draft SE
15 was issued in October with a final SE anticipated in
16 January 2020. At that point we would then issue the
17 approved version of the LTR in 2020 after receiving
18 the final SE.

19 As part of the LTR we also included the
20 required markups for GESTAR II, a General Electric
21 standard application for reactor fuel to allow us to
22 update GESTAR with approved modifications once the LTR
23 for CRDA is approved. Those modifications are part of
24 the LTR and will be part of the improvement.

25 That's all I have for the open session.

1 Any questions?

2 CHAIR MARCH-LEUBA: Thank you to the
3 presenters. I have to confess while I was writing the
4 draft letter we issued in the full committee, I had
5 serious problems writing anything that was not
6 proprietary and that's why this presentation -- thank
7 you for having given us this.

8 Now we will proceed with the staff
9 presentation open. We are still in non-proprietary
10 session. You will need to turn on your mic.

11 MR. KREPEL: Good morning. I'm Scott
12 Krepel and you should all be familiar with me by now.
13 Just a quick reminder of my background. I graduated
14 from Purdue about 20 years ago now. I've had the
15 honor of studying under some of the former ACRS
16 members there.

17 Then I moved to TVA and I worked there as
18 a fuel engineer for about 10 years. Then I came to
19 the NRC where I've had experience in research, as well
20 as NRR doing licensing reviews for a lot of different
21 thermal-hydraulic events and accident events.

22 I'm sure that it may make it a little easier on
23 you that both of the presenters here today are named
24 Scott so here I am.

25 With no further ado, I'll go ahead and get

1 started with my presentation doing a review of the
2 CRDA methodology for GNF. First quick background on
3 this. Previously NRC had guidance for the reactivity
4 initiated accidents for CRDA. Also control rod
5 ejection events for PWRs that was developed quite some
6 time ago. I believe several decades ago. That's
7 fairly old and obsolete at this point.

8 More research from facilities like NSRR in
9 Japan and CARI in France, among others, have provided
10 a lot more information and data on fuel failure during
11 this type of accident event which has led to interim
12 criteria and SRP 4.2 Appendix B which eventually we
13 hope Draft Guidance 1327 will replace and become a
14 permanent guidance for the foreseeable future.

15 Currently the GE methodology is based on
16 BPWS, as the other Scott mentioned earlier. Really
17 that is a generic analysis that is designed to look at
18 the limiting notch worth to determine whether a
19 problem is going to occur or not. This methodology,
20 this new methodology, provides an approach that can be
21 used to explicitly analyze different rod withdrawal
22 sequences and confirm whether they match the current
23 guidance.

24 Next slide. As you see, there are four
25 codes listed here that were used by GNF to be able to

1 do the analysis. I am not going to talk about TGBLA
2 again but I just have it there so you know it was a
3 cross section that goes to PANACEA. The other three
4 will be discussed further on as different models that
5 were used for direct CRDA analysis, or to provide a
6 bounding parameter for the input.

7 For the most part, we have already
8 validated a lot of the events of concern, but there
9 were some additional validation that needed to be done
10 that we needed to confirm the application of the cores
11 for the CRDA events and the cold conditions.

12 Next slide. I'm sure that you're familiar
13 with CRP 15.0.2 and that's the framework that we've
14 talked about before, but just a reminder that the last
15 two were not addressed explicitly. They were more
16 implicit as part of our review. If I looked at the
17 documentation and understood it, then I made the
18 finding that the documentation was sufficient. Those
19 are the asterisks for those last two.

20 Next slide. Before I talk about specific
21 areas and summarize that for the benefit of the
22 public, if there are any present, I wanted to go ahead
23 and summarize the regulatory acceptance criteria which
24 is outlined here on the slide. There's different SFR
25 50.34, but basically there's just a summary here of

1 the requirements.

2 First of all, you have to analyze CRDA
3 events and demonstrate that they are bounded by your
4 plant operations and those parameters. Secondly, if
5 a CRDA event happens, you have to look at the dose
6 consequence and it has to be within the design basis
7 limitation. Those are basically the two things that
8 summarize this slide.

9 Next slide, please. In SRP there are
10 specific criteria to demonstrate the regulatory
11 compliance as outlined here. There are interim
12 criteria, but Draft Guide 13.27 has very similar
13 criteria as well. GNF, as already mentioned, their
14 goal with this methodology is no fuel failure.

15 Out of those, it doesn't really matter to
16 GNF for their methodologies since they are going for
17 no fuel failure because then you don't have to worry
18 about the fission gas release and there would be no
19 change in any of the other things as well. We'll be
20 focusing on basically the first two criteria that are
21 listed there which is the high temperature cladding
22 failure.

23 Next slide. There are four areas from SRP
24 15.0.2 that I wanted to talk about. First is that the
25 licensee describes and characterizes the CRDA event

1 and identifies the key parameters, output parameters.
2 We've got NFLP for example.

3 NRC staff, me basically, compared their
4 description of the event to the parameters with other
5 PIRTs. For example, GNF did not include a formal PIRT
6 in their topical report, but they did include enough
7 information for me to be able to compare with other
8 vendors' PIRTs, a PIRT that the NRC even developed,
9 for example.

10 Question?

11 MEMBER REMPE: I do have a question.
12 Thank you for noticing. Again, if this is
13 proprietary, stop me. I know in your SE you did talk
14 about it wasn't quite a typical PIRT. Do you want to
15 elaborate or can you about why it differed?

16 MR. KREPEL: Sure. Typically a PIRT is a
17 more systematic approach where you identify a whole
18 list of specific phenomena that are of interest for
19 the accident. Then you assign them a value of either
20 high, medium, or low importance. That is consistent
21 with the NRC approach.

22 GNF didn't formally officially do that in
23 their topical report, but what they did do is provide
24 a description of the phenomena and how they addressed
25 the most important ones. NRC staff identified that

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1 there were no other phenomena that would be important
2 for this event.

3 MEMBER REMPE: Thank you. That helps.

4 MR. KREPEL: Sure.

5 All right. Next slide. So for the code
6 assessment, as I mentioned earlier on an earlier
7 slide, most of the codes have already been analyzed
8 previously for code fidelity, thermal hydraulic
9 modeling for physics.

10 The only thing is the gap assessment and
11 looking at the cold conditions for reactivity
12 initiated accidents. That was the one little
13 difference. Also looking at the doppler feedback, for
14 example, in previous ones are the turbine trip events.
15 I did an assessment using the SPERT III test.

16 Next slide. For the CRDA evaluation
17 method, there are generally two areas that the NRC
18 staff review; looking at the modeling guidance and the
19 CRDA analysis procedure.

20 Next slide. For the modeling guidance,
21 basically you summarize all of the different
22 recommendations for the input parameters for the
23 modeling and how they model within the code to perform
24 the analysis. They are listed here on the slide and
25 these are generic categories.

1 Next slide. Yes?

2 CHAIR MARCH-LEUBA: This is still non-
3 proprietary but on the fission gas inventory, I assume
4 that information goes from PRIME. Correct?

5 MR. KREPEL: Prime is used to generate
6 some of the information that is used in the analysis.

7 CHAIR MARCH-LEUBA: But the real question
8 is, is it provided how much fission gas is in the
9 cladding in the gap, or the one that is inside the
10 oxide pellet?

11 MR. KREPEL: In the topical report
12 methodology, and I don't know if this is proprietary
13 or not, Scott.

14 MR. PFEFFER: I don't think so.

15 CHAIR MARCH-LEUBA: You need to talk in
16 the microphone. Sorry. Say your name.

17 MR. KREPEL: I'm just trying to avoid
18 proprietary information so just wanted to check in.

19 MR. PFEFFER: This is Scott Pfeffer. I
20 think that question is okay.

21 CHAIR MARCH-LEUBA: Okay.

22 MR. KREPEL: So the methodologies in PRIME
23 to calculate the fission gas that's within the gap,
24 but then it also does more work to then --

25 MR. PFEFFER: One second.

1 CHAIR MARCH-LEUBA: Okay. Why don't we
2 propose this discussion to the proprietary section.

3 MR. KREPEL: Yeah, that's fine. I plan to
4 discuss it later anyway.

5 Okay. The next section really describes
6 how the actual analysis is performed once you've got
7 the model and then what the actual process is that's
8 done. It formulates basically the heart of the
9 method.

10 There are a lot of steps, step-by-step
11 description of what happens and how to specifically do
12 the controlled run withdrawal sequence and different
13 parameters that may affect the applicability of that
14 order. Of course, you evaluate that against the
15 acceptance criteria.

16 Next slide. The uncertainties. Again,
17 GNF did not do a formal PIRT, but they did identify
18 all of the important phenomena and addressed each one
19 of those for the uncertainties in different ways.

20 There are three listed here, the three
21 different approaches; the bounding analysis
22 parameters, the sensitivity studies, and the analysis
23 conservatism so seeing that conservatism in the
24 analysis. I will discuss all of that later in more
25 detail because most of is proprietary.

1 CHAIR MARCH-LEUBA: In 20 seconds or less
2 would you describe the methodology as best estimate,
3 best estimate plus uncertainties, or conservative? A,
4 B, C?

5 MR. KREPEL: I would probably characterize
6 it as conservative.

7 CHAIR MARCH-LEUBA: Okay. In LOCA terms
8 would it be an Appendix K type calculation?

9 MR. KREPEL: Not exactly 100 percent
10 Appendix K but, yeah, it is conservative.

11 CHAIR MARCH-LEUBA: Thank you.

12 MR. KREPEL: I mean, Appendix K is very
13 conservative as you know.

14 Next slide. The final area was a little
15 unique to this topical report because, as you may
16 know, GNF has GESTAR II and they allowed the licensee
17 to adopt new methodology right away. They provided
18 updates to their GESTAR II to allow the licensee to
19 adopt new methodology. There are documentation
20 requirements that clarify how that methodology can be
21 used.

22 Jose, do you have a question?

23 CHAIR MARCH-LEUBA: I didn't turn on my
24 green light and he already could foresee my question.
25 Yes, I would like for our education if you can give us

1 a one-minute primer on the GESTAR methodology.

2 How does it work? Specifically I'm
3 interested in if I am making a minor update to an
4 existing fuel; for example, I'm changing the inlet
5 filter or a major upgrade like GNF 13 by 13, how does
6 it propagate to a licensee? When does the licensee
7 need an LAR?

8 MR. KREPEL: First, with GESTAR II that is
9 the primary methodology that is documented and it
10 describes all of the other methods that can be used to
11 analyze the fuel. GNF does have a process for the new
12 fuel design and they can assess their new fuel design
13 and then document the details of what is called the
14 fuel compliance document which the NRC can audit at
15 any point. We did actually do an audit for GNF2 and
16 GNF1 fuel design if I recall correctly.

17 CHAIR MARCH-LEUBA: So a licensee on the
18 specifications have a reference to the GESTAR
19 document?

20 MR. KREPEL: Yes.

21 CHAIR MARCH-LEUBA: And then --

22 MR. KREPEL: The tech specs reference
23 GESTAR.

24 CHAIR MARCH-LEUBA: And then GE modifies
25 GESTAR only once, gets it approved through you, and it

1 applies to all the licensees. Is that correct?

2 MR. KREPEL: More or less, yes. They do
3 get approval and that includes all of the
4 modifications which is easy, but typically they submit
5 GESTAR amendment topical report that we also review to
6 confirm that everything is A-okay.

7 CHAIR MARCH-LEUBA: Once you issued an SER
8 Amendment 29, then every licensee that references
9 GESTAR can use the fuel. Is that correct?

10 MR. KREPEL: Yes.

11 CHAIR MARCH-LEUBA: Okay. Thank you.

12 MR. KREPEL: One last point here on this
13 final bullet point. As I mentioned, we'll talk about
14 it more later but there were some specific situations
15 where the requesting approval for the use of different
16 ways or methods to do the analysis. Those will be
17 subject to some limitations that we can discuss in
18 more detail later because, again, I don't want to run
19 into proprietary information.

20 Okay, next slide. So overall conclusions.
21 The staff found NEDE-33885P provided good guidance for
22 the use of GNF methodology to do CRDA analyses. We do
23 have four additional limitations and conditions beyond
24 those that already exist for the code that they're
25 using.

1 I'll talk about those more in detail
2 later, but really they are just affirming the key
3 assumptions are met making sure that the method cannot
4 extend beyond the area of applicability that is
5 expected by the NRC staff when approving this method,
6 or when we plan to approve this method, I should say,
7 assuming that the ACRS is fine with it.

8 Yes.

9 MEMBER REMPE: I have a question. In your
10 SE you talked about the sensitivity of the results to
11 the high end of the enrichment spectrum. I assume
12 that was something near 5 percent. Could you confirm
13 that in the open session? Then how do I know that --
14 what would happen if GE came in with a higher enriched
15 fuel?

16 MR. KREPEL: I expect that kind of
17 situation would be addressed through their control rod
18 worth that explicitly says that is part of their
19 methodology for looking at whether they have higher
20 enrichment. Then that would lead to more release,
21 more heat release, and then that would be captured by
22 the control rod worth.

23 MEMBER REMPE: Just so I know what we're
24 approving if we approve this topical report, are we
25 approving its application for higher enrichment than

1 5 percent?

2 MR. KREPEL: I'm not explicitly approving
3 that but I'm not saying that it can't be used for that
4 purpose.

5 MEMBER REMPE: So then, again, I'm not
6 into how this process would work because I just know
7 that -- I'm more into the technical details, but how
8 does that get monitored and checked carefully if that
9 happens because, as you know, it's in discussion right
10 now.

11 MR. KREPEL: Probably the clearest answer
12 is right now PRIME in that methodology has its
13 limitation on burn-up and the applicability for that
14 method.

15 MEMBER REMPE: So for burn-up. What about
16 enrichment? Is it limited to 5 percent?

17 MR. KREPEL: Enrichment I can't recall
18 exactly. I know that with PANACEA there is an
19 assessment database that covers up to 5 percent but I
20 can't recall exactly if there is an explicit
21 limitation in there or not. Maybe GNF has an answer
22 to that.

23 MS. LAMB: This is Shawn Lamb from DNF.
24 We are looking it up right now.

25 CHAIR MARCH-LEUBA: Who was that? Sorry,

1 what's your name?

2 MS. LAMB: This is Shawn Lamb. I'm the
3 Manager of Stability and Radiological Analysis Team.
4 We are looking up if PRIME has an enrichment
5 limitation right now. We'll get back to you very
6 shortly.

7 CHAIR MARCH-LEUBA: Thank you.

8 MEMBER REMPE: I am interested in that.
9 I started asking that question to GE or GNF or whoever
10 we're talking to but also other --

11 MS. LAMB: Okay, thank you.

12 MEMBER REMPE: It sounds like the rules
13 might change and I just want to know if we're missing
14 something if the rules change. Thank you.

15 CHAIR MARCH-LEUBA: You know that ACRS
16 only speaks through letters so what we're hearing here
17 is subcommittee members opinions. I think even though
18 ACRS has not written a letter, we have made our ideas
19 very clear that if the enrichment is increased 5
20 percent, we would expect a very large review for
21 everybody in this building.

22 It wouldn't be -- all the technical
23 reports automatically apply. Even if you didn't say
24 specifically to apply 5 percent, I think it would be
25 a review of everything. That's what I would expect.

1 MEMBER REMPE: Expectations. I'm just
2 curious so it's nice sometimes if someone can say, oh
3 yeah, some other method would limit this. Thank you.

4 MR. KREPEL: Understood. Understood.
5 That's a good statement.

6 CHAIR MARCH-LEUBA: We never made any
7 topical reports that says enrichment has to be granted
8 at 1 percent or 5, but if somebody comes up with a
9 natural reactor with .7 and it doesn't apply, you'll
10 have to review it if it's a big change.

11 MR. KREPEL: I know for the perspective on
12 this topical report, I know that I specifically
13 recognized and took a look that the way they
14 approached the applicability in looking at the
15 existing method that they used to analyze it and
16 whether there were any limitations on the methodology
17 would carry over into the new one for the CRDA
18 analysis.

19 MEMBER REMPE: Thank you.

20 CHAIR MARCH-LEUBA: Okay. So we managed
21 to recover all our technical difficulty time and we
22 are ahead of schedule. I would like to propose to
23 have a 10-minute break so we can switch to the closed
24 session. You are free to sit in your original chairs.
25 We are off the record --

1 MEMBER REMPE: Public comments.

2 CHAIR MARCH-LEUBA: We are not off the
3 record because we need to ask for anybody in the room
4 who wants to provide a comment because this is the
5 opportunity in the public session.

6 Nobody in the room wants to make a
7 comment. How about the phone? If anybody is on the
8 phone line, could you please say hello to know that
9 it's open?

10 MR. HECK: Hello. This is Charles Heck of
11 GNF. We're hearing you. Can you hear me?

12 CHAIR MARCH-LEUBA: Yes, we can hear you.
13 Does anybody on the phone line have a comment? If so,
14 state your name and provide a comment. We waited a
15 full three seconds and nobody said anything. We will
16 assume we can close the public line now because we are
17 going to go into closed session. You're dismissed.
18 We're on a short recess.

19 (Whereupon, the above-entitled matter went off
20 the record at 9:29 a.m. and resumed at 9:40 for the
21 Closed Session.)
22
23
24
25



Global Nuclear Fuel

Control Rod Drop Accident (CRDA) Application Methodology

NEDE-33885P Review

December 3rd, 2019

Contents for Open Portion

Licensing Review

- Licensing Topical Report (LTR) Development Overview
 - Drivers
 - Approach
- Documentation Status
 - Request for Additional Information (RAI)
 - Limitations and Conditions (L&C)
 - Draft Safety Evaluation (SE)

LTR Development

Drivers

- Align with latest reactivity-initiated accident fuel damage guidelines
 - More thoroughly evaluate possible CRDA scenarios
- Improve plant operations
 - Allow for more flexibility during reactor startup
 - Prevent inadvertent subcriticality events
- Dose Improvements
 - Demonstrate zero fuel rod failures result from a CRDA

LTR Development (continued)

Approach

- Utilize previously approved methods
 - PANAC, PRIME, and TRACG
- Implement NRC guidance
 - Hydrogen and Fission Gas Release (FGR) models
 - Pellet Cladding Mechanical Interaction (PCMI) and High Temperature Cladding Failure (HTCF) thresholds
- Sources for NRC guidance
 - NRC Memoranda ML14188C423 (Reactivity-Initiated Accident Acceptance Criteria) and ML15133A306 (Hydrogen Uptake)
 - NUREG-0800, Sections 4.2, including Appendix B, and 15.4.9
 - DG-1327 (Control Rod Ejection and CRDA)

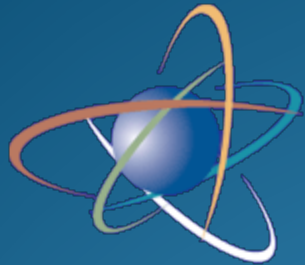
Current Status

Documentation

- CRDA LTR submitted for review February 2018
- NRC audit conducted October 2018
- All RAIs resolved March 2019
- L&C notification October 2019
- Draft SE issued October 2019
- Final SE anticipated January 2020
- Issue approved CRDA LTR expected February 2020
- Update GESTAR-II expected February 2020



Global Nuclear Fuel



U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

NRC Review of GNF Control Rod Drop Accident (CRDA) Application Methodology, NEDE-33885P

Scott Krepel
Office of Nuclear Reactor Regulation, US NRC

Background

- NRC guidance for RIAs has evolved significantly in recent years
 - SRP 4.2 Appendix B
 - DG-1327
- Current GNF/GEH methods are based on BPWS
 - NEDE-33885P provides an approach better tailored to current guidance

Background

NEDE-33885P only covers an analysis procedure; all codes have previously been reviewed and approved by the NRC

- TGBLA (lattice physics)
- PANACEA (3D core physics)
- TRACG (thermal hydraulics)
- PRIME (fuel rod performance)

Additional validation performed to confirm applicability of codes to limiting CRDA events

Licensing Topical Report (LTR) Review Components

SRP 15.0.2 review areas (additional guidance in RG 1.203):

- Accident scenario
- Code assessment
- Evaluation methodology
- Uncertainty evaluation
- Documentation*
- Quality assurance*

*Implicitly addressed via GEH/GNF QA program and staff review of supporting documentation for this LTR

Regulatory Acceptance Criteria

Current regulatory requirements are defined in:

- 10 CFR 50.34 – general safety analysis reporting requirement
- GDC 13 – system parameters must be controlled adequately to bound design basis accidents
- GDC 28 – reactivity accidents must not damage reactor coolant pressure boundary or impede core cooling
- 10 CFR 100.11, 50.67 – radiation dose limits

Regulatory Acceptance Criteria

Current acceptance criteria to demonstrate regulatory compliance defined in SRP 15.4.9.II:

- Reactivity initiated accident criteria (SRP 4.2 App. B)
 - High temperature cladding failure
 - PCMI cladding failure
 - Core coolability
 - Fission product release inventory
- ASME reactor pressure vessel limit

Note: DG-1327 contains updated criteria that are intended to supplant the current criteria; second public comment period ended October 2019

CRDA Accident Scenario

Licensee characterized the CRDA scenario and relevant phenomena.

Critical output parameters are derived from acceptance criteria for CRDA event.

Identification of high importance phenomena is consistent with other available assessments for the CRDA or similar events.

CRDA Code Assessment

Assessments from code LTRs

- Code fidelity
- Thermal hydraulics models
- Global core neutron kinetics response

CRDA specific assessment

- SPERT III tests

CRDA Evaluation Methodology

Different aspects of the CRDA analysis methodology described in the LTR were reviewed.

- Modeling Guidance
- CRDA Analysis Procedure

CRDA Evaluation Methodology: Modeling Guidance

- TRACG Model Nodalization
- Reactivity Insertion
- Fission Gas Inventory
- Initial Parameters
- Doppler Coefficient
- Enthalpy Determination

CRDA Evaluation Methodology: Analysis Procedure

- At-Power & Cold Zero Power
- Analysis Parameters
- Control Rod Withdrawal Order
- Evaluation Against Acceptance Criteria

CRDA Uncertainties

Uncertainties were dispositioned for individual phenomena known to be important for the CRDA event:

- Bounding analysis parameters
- Sensitivity studies
- Analysis conservatism

GESTAR & Method Applicability

- GESTAR II updates to describe relevant documentation requirements (e.g., control rod withdrawal requirements)
- Clarifications regarding how methodology can be used
- New NRC approved models and codes can be used in lieu of those described in the LTR, subject to certain limitations

Conclusions

- The staff found NEDE-33885P to provide adequate guidance for use of PANACEA and TRACG to perform CRDA analyses.
 - Limitations and conditions associated with approved LTRs for individual codes remain applicable
 - Four additional limitations and conditions
 - Confirm key assumption (control rod drop speed)
 - Restrictions on extended applicability of methodology

Nomenclature

ASME – American Society of Mechanical Engineers

BPWS – Banked Position Withdrawal Sequence

CFR – Code of Federal Regulations

CRDA – Control Rod Drop Accident

DG – Draft Guide

FGR – Fission Gas Release

GDC – General Design Criteria

GEH – General Electric - Hitachi

GNF – Global Nuclear Fuel

LTR – Licensing Topical Report

NRC – Nuclear Regulatory Commission

NSRR – Nuclear Safety Research Reactor

PCMI – Pellet-Clad Mechanical Interaction

RIA – Reactivity Initiated Accident

RG – Regulatory Guide

SPERT – Special Power Excursion Reactor Test

SRP – Standard Review Plan

Backup Slides

Transient FGR Database

- Revised NSRR database shifted many data points and exposed a more prominent BU-dependence
- Large spread not unexpected, given spread in steady-state FGR data

