

Official Transcript of Proceedings
NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
 Accident Analysis Thermal Hydraulics
 Open Session

Docket Number: (n/a)

Location: teleconference

Date: Tuesday, June 6, 2023

Work Order No.: NRC-2426

Pages 1-26

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1716 14th Street, N.W.
Washington, D.C. 20009
(202) 234-4433

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

DISCLAIMER

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

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, as reported herein, is a record of the discussions recorded at the meeting.

This transcript has not been reviewed, corrected, and edited, and it may contain inaccuracies.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

www.nealrgross.com

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

THERMAL-HYDRAULICS ACCIDENT ANALYSIS SUBCOMMITTEE

+ + + + +

OPEN SESSION

+ + + + +

TUESDAY,

JUNE 6, 2023

+ + + + +

The Subcommittee met via hybrid in-person and video-teleconference, at 1:00 p.m. EDT, Jose March-Leuba, Chairman, presiding.

COMMITTEE MEMBERS:

JOSE MARCH-LEUBA, Chair

RONALD G. BALLINGER, Member

VICKI BIER, Member

CHARLES H. BROWN, JR., Member

VESNA DIMITRIJEVIC, Member

GREGORY HALNON, Member

WALT KIRCHNER, Member

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

DAVID PETTI, Member

JOY L. REMPE, Member

MATTHEW SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

MIKE SNODDERLY

ALSO PRESENT:

KENT HALAC, GE

JOHN HANNAH, GNF

SCOTT KREPEL, NRR

MATHEW PANICKER, NRR

1		3
2	Opening Remarks, Jose March-Leuba, Chair	4
3	Discussion of GNF Topical Reports on	
4	LANCR02 Computer Programs for	
5	Evaluating Fuel Lattices, John	
6	Hannah, GNF	7
7	Staff's Evaluation of GNF Topical Reports,	
8	Matthew Panicker, NRR	20
9	Opportunity for Public Comment	
10	(No public comment)	
11	Adjourn	26
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		

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

1:00 P.M.

CHAIR MARCH-LEUBA: The meeting will now come to order. This is a meeting of the Accident Analysis Thermal Hydraulics Subcommittee. I am Jose March-Leuba, the SC chair.

In addition to in-person attendance at NRC headquarters, the meeting is broadcasted via MS Teams. Members in attendance are Ronald Ballinger, Vicki Bier, Charles Brown, Vesna Dimitrijevic, Greg Halnon, Walter Kirchner, David Petti, Joy Rempe, and Matthew Sunseri.

Today, we are reviewing topical report NEDE-33935P, Revision 0, by Global Nuclear Fuel Americas entitled LANCR02/PANAC11 application methodology, and two associated methodology qualification reports.

These reports support a combined use of the LANCR02 and PANAC11 codes for modeling neutronics and thermal hydraulic BWR core physics.

Portions of our meeting will be closed to the public to protect GNF priority information. We have not received requests to provide comments, but we have an opportunity for public comments before the beginning of the closed session of the meeting.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

(202) 234-4433

www.nealrgross.com

1 The ACRS was established by a statute and
2 is open by the Federal Advisory Committee Act, FACA.
3 As such, the committee only speaks to its published
4 letter reports.

5 The rules for participation in all ACRS
6 meetings were announced in the Federal Register on
7 June 13, 2019. The ACRS section of the U.S. NRC
8 public work site provides our charter, bylaws,
9 agendas, letter reports, and full transcripts for the
10 open portions of all full and subcommittee meetings,
11 including the slides presented there.

12 The Designated Federal Official today is
13 Michael Snodderly.

14 A transcript of the meeting is being kept.
15 Therefore, speak into the microphones clearly and
16 state your name for the benefit of the court reporter.
17 And if you are in a conference room with multiple
18 people on the line, just remember to identify yourself
19 regularly for the accuracy of the transcript.

20 Please keep all your electronics and the
21 microphone on mute when not being used.

22 We are now ready for the GNF presentation.
23 Kent Halac of General Electric Hitachi will present
24 some opening remarks and introduce the GNF presenters.

25 Remember, this is the open session of the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 meeting. Questions that may need proprietary
2 information should be discussed in the closed session.

3 Kent?

4 MR. HALAC: Thank you. This is Kent
5 Halac, General Electric. We're representing Global
6 Nuclear Fuels. I brought with me John Hannah,
7 principal engineer in our Advanced Methods Group.
8 Thank you for having us today. We have some
9 interesting material that pushes our technology
10 forward and enables increased enrichment which is one
11 of the objectives of these updates.

12 We're here to answer any questions you may
13 have about the technology. And just note that LANCR
14 and PANAC are both approved technologies, and this is
15 the combination of LANCR with PANACEA for the
16 application method and we're going to be talking about
17 LANCR02 updates to enable increased enrichment.

18 With that, I'll move to John.

19 MR. HANNAH: Thanks, Kent. This is John
20 Hannah as Kent introduced --

21 CHAIR MARCH-LEUBA: Sorry, there is a very
22 narrow field of view for the mic. If you cannot hear
23 yourself on --

24 MR. HANNAH: Then you can't hear. Okay

25 CHAIR MARCH-LEUBA: -- you're not talking

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 --

2 MR. HANNAH: I'm going to try again.
3 Okay, now I can hear me.

4 This is John Hannah from Global Nuclear
5 Fuels as Kent suggested. So I am here representing
6 the team that worked on this material. There was a
7 good number of us to advance this forward, so I'm
8 looking forward to talking about it today.

9 Slide, Kent.

10 So just a few introductory remarks in this
11 part of the session. We'll go a little deeper in the
12 closed session, talk about backgrounds, the drivers
13 and approach associated with these licensing topical
14 reports which you'll hear me refer to as LTRs
15 sometimes. Kind of why we developed them and what we
16 were trying to do when we did. And then what the
17 current status of them is.

18 Okay, so from a high level perspective and
19 background, right now, TGBLA06 and PANAC11 is GNF's
20 approved core simulator that's in use today across the
21 BWR fleets, boiling water reactor fleet. TGBLA06, all
22 lattice business codes, application range is limited
23 with respect to a next phase of fuel development, so
24 where we're trying to head to support ATF objectives,
25 be those higher enrichments, different clad types.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 It's not something that right now TGBLA has approved
2 to evaluate.

3 We do have LANCR02 which is approved from
4 a model and qualification perspective which is our
5 more advanced lattice physics code and does have the
6 approval to evaluate some of these features. And so
7 the main purpose of putting together the revisions to
8 the LANCR topical report and the combined LANCR/PANAC
9 topical report was to enable their use together as an
10 approved core simulator to evaluate these new spaces.

11 To that end, the driver really is to
12 expand the core simulator application range when we're
13 using LANCR as a new lattice physics solver as opposed
14 to TGBLA, so LEU+ is one of the main drivers for that,
15 looking to be able to evaluate fuel enriched between
16 5 and 10 percent in U235.

17 In addition, there is currently in
18 operation fuel designs that are 11 by 11 in nature and
19 TGBLA has in some limitations associated with that and
20 LANCR does not. And so it's another driver for moving
21 in that direction.

22 CHAIR MARCH-LEUBA: Remember that we are
23 in open session and you probably can answer better in
24 a closed session, but anything you can say for the
25 public it helps on the transcript.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 Can you tell us anything about GE plans to
2 use LEU+, anything above 5 percent, anything in the
3 near future, 20 years from now?

4 MR. HALAC: This is Kent speaking. I can
5 speak to that. We have already put in an application
6 1097 related to the fuel fabrication facility to
7 increase the plant to eight percent weight enrichment.
8 And we -- you know, the first step is getting our
9 methods in line and our plant ready to fabricate. The
10 next step after that would be lead test assemblies.
11 So this work here would enable us to analyze and
12 deliver lead test at some reactors.

13 CHAIR MARCH-LEUBA: And I know this may be
14 sensitive, you were talking 6 months or 20 years?
15 Neither, right?

16 MR. HALAC: Yes, neither is correct. But
17 I would say it's most near term for us in the ATF
18 programs. We use ATF as an umbrella for coated
19 claddings; iron, aluminum, chromium claddings. And
20 we've also married the benefits side which would be
21 increased enrichment with high burnup. And of all
22 those things for us the most near term would be LEU+.

23 CHAIR MARCH-LEUBA: Okay, thank you.

24 MR. HALAC: Sure. So going forward, the
25 purpose as I said for moving to LANCR is to kind of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 enable these new areas to be evaluated. In addition,
2 we're taking the opportunity to update the core
3 simulator approval basis. That's one of the big
4 drivers that's made our group very interested.

5 The approval basis for TG1PANAC expands
6 across several decades and a lot of different topic
7 reports. And there's an opportunity to clarify some
8 of that and make it easier to incrementally improve
9 going forward and so we've made a big effort to kind
10 of do that in this -- to enable that in this
11 submittal, trying to make minimal changes to what's
12 approved in the simulator space right now, but
13 clarifying how things work today, how uncertainties
14 are quantified, and basically putting together one
15 report that we can launch from going forward to
16 improve the way that we have evaluated the core.

17 CHAIR MARCH-LEUBA: I have seen -- again,
18 we are in open session. There are some processes to
19 modify the approval if you have small changes with
20 respect to the probe. Can you address some of these?
21 I'm trying to place these ideas in the public
22 transcript before we address them properly in the
23 closed session.

24 MR. HANNAH: Yes, there are some --

25 CHAIR MARCH-LEUBA: Keep it high level,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 non-proprietary.

2 MR. HANNAH: Understand, right, yes. In
3 LANCR, there is some -- there's a section that's
4 dedicated to describing updates that are allowable
5 that we modeled similarly in the LANCR-PANAC topical
6 report to try to lay out basically a foundation that
7 explains when you make or change kind of what the
8 definition of what that change is, what it requires
9 you to do and then how you're going to communicate
10 that with the regulatory body so that there's
11 agreement in the fronts what different changes mean
12 and what approval bases are required in an attempt to
13 make the approved -- make approval paths more certain
14 for everyone.

15 CHAIR MARCH-LEUBA: I try to think at the
16 lower level, so this is something equivalent to 10 CFR
17 50.59, in a sense that you will have to document your
18 changes. You will make a decision that this does not
19 require staff review. And then the staff can comment
20 on the methodology. Is that more or less what the
21 process will be?

22 MR. HANNAH: I would say that's one of the
23 outcomes of some of the update processes we define,
24 but some of the update processes I'm comfortable
25 saying, explicitly say if you do this, you have to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 resubmit. And so it's trying to say for the different
2 levels of changes what's going to be required so that
3 there's less ambiguity.

4 CHAIR MARCH-LEUBA: You're always allowed
5 to submit. The question is specifying what you don't
6 have to. Unfortunately, we all know you are in the
7 receiving end and it take 18 months, 2 years for any
8 approvals, so if you can avoid that by having an
9 agreement, a good bounder, a good box to stay inside
10 of that, we can save 2 years of review on 900 hours of
11 cost is a positive direction.

12 MR. HANNAH: We agree.

13 MEMBER KIRCHNER: To follow on Jose's --
14 this Walt Kirchner -- Jose's point. I'm just guessing
15 your methodologies previously were limited to five
16 percent or less enrichment.

17 MR. HANNAH: Correct.

18 MEMBER KIRCHNER: And then the specific
19 cladding as well?

20 MR. HANNAH: Yes, the intent will be for
21 more exotic cladding materials, then LANCR would be
22 the solution. That's right.

23 MEMBER KIRCHNER: Right.

24 MR. HALAC: This is Kent. I just wanted
25 to add one more piece of information. We do a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 technology update every year between the staff and GNF
2 and during that update, we will talk about any and all
3 methodology changes so that there is an open line of
4 communication and that our standing of what is
5 happening, so that there is no misunderstandings about
6 changes being done without people understanding what
7 to do.

8 CHAIR MARCH-LEUBA: I may be using the
9 wrong term. Is this part of the GSTAR program?

10 Your mic --

11 MR. HALAC: Yes, we have hooks in GSTAR
12 for say, like, use programs that require us to provide
13 updates at the GNF technology updates, so yes, GSTAR
14 is part of the equation.

15 CHAIR MARCH-LEUBA: Thank you.

16 MR. HANNAH: So the approach which we at
17 hinted at bit, for some of what's on here, but first
18 for LANCR, it's important to note that there already
19 is an approval basis for revision 3 of the model and
20 qualification topical reports. And so what we're
21 doing here is relatively limited in scope for those
22 documents. We're looking to expand the core critical
23 benchmarking enrichment range to support the increase
24 enrichment from five to ten percent.

25 Updating the qualification basis, back

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 when we originally submitted this, the benchmarking
2 was based against MCNP5. We're moving to MCNP6.2 and
3 then an improved version of that based on some
4 improvements that Los Alamos has basically recommended
5 that isn't yet in 6.2.

6 And then we're also implementing some
7 targeted model improvements that were informed based
8 on extensive benchmarking. So we basically pushed the
9 LANCR cross sections all the way through into the core
10 simulator, did our performance demonstrations and our
11 uncertainty quantifications, and used those results to
12 inform to ourselves where differences were being
13 exhibited compared to our current versions of codes.
14 And that helped us determine where we wanted to go and
15 try to implement some improvements in LANCR.

16 CHAIR MARCH-LEUBA: And once more for the
17 public transcript in case somebody has to read it,
18 this is part of the proprietary, but the benchmark set
19 that you guys used to validate this is very extensive.
20 I don't want to say the numbers. You may want to say
21 the numbers. I don't know if it's proprietary. But
22 it's very extensive.

23 MR. HANNAH: Yes, it's a large set of
24 cases. So going forward then so after the LANCR
25 updates, we went to create the LANCR and PANAC

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 application LTR. There were four elements of that
2 that are important to --

3 MEMBER BROWN: Can I interrupt?

4 MR. HANNAH: Of course, yes.

5 MEMBER BROWN: I'm not a thermal-
6 hydraulics guy. I used to have to deal with this all
7 the time in my old job, 20 years ago in the Navy, we
8 had the analysis and we used to use Monte Carlo as
9 well, and I remember how we used to update the Monte
10 Carlo standards as we went. They were based on
11 experimental data. Is that -- when you go from 5 to
12 6.2 what benchmarks does the Monte Carlo use?
13 Hopefully, it's experimental data that you do that
14 with?

15 MR. HANNAH: That's right, yes. So I'm
16 comfortable saying in the public session even too,
17 right? So the concept of benchmarking LANCR, you
18 can't just go code to code against Monte Carlo basis.

19 MEMBER BROWN: I was hoping you would say
20 that.

21 MR. HANNAH: Yes, that gets connected to
22 the Monte Carlo code and the underlying cross sections
23 that are basically used in Monte Carlo and LANCR, get
24 benchmarked against cold critical benchmarks from a
25 criticality perspective and gamma scans for a pen

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 power distribution.

2 MEMBER BROWN: Okay, so you've got actual
3 data that you can then validate Monte Carlo against
4 within some uncertainty bands?

5 MR. HANNAH: That's right. It's the
6 connected piece in between the actual LANCR and the
7 experiments because you can't do the experiments
8 directly into 2D lattice physics.

9 MEMBER BROWN: The second question was in
10 some of your documents, I didn't see it in these
11 slides and presume this is probably not proprietary,
12 but wasn't one of the purposes of this in order to
13 achieve higher burnups for your fuel as well? It was
14 in one of the topical reports.

15 MR. HANNAH: In fact, for LANCR and PANAC,
16 an increase in the burnup range isn't something that
17 we were pursuing. LANCR was already approved up to a
18 burnup that is bounding of what we need.

19 MEMBER BROWN: Okay, so the purpose of
20 this then is not to go another step forward. That
21 would be another process that you would do later then.

22 MR. HANNAH: Right, the nuclear methods in
23 the core simulator are not perceived to be an obstacle
24 to higher burnups. There are other areas where that
25 will be necessary.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 MEMBER BROWN: Thank you.

2 MR. HANNAH: So for LANCR and PANAC
3 application LTR, to enable it to be a foundation for
4 future change, we wanted to kind of document four
5 elements: defining the applicable methodologies
6 explicitly, kind of state what it is that these codes
7 are doing and how they do it; clarifying,
8 consolidating the uncertainty quantification
9 approaches which had been scattered across a number of
10 different topical reports in the past, so the intents
11 here was to make that more streamlined for users and
12 for changing the future; demonstrating performance of
13 the codes, against a broad set of actual operational
14 data; and then establishing update metrics which we
15 just kind of hinted at a moment before, update
16 mechanics to say precisely.

17 So the last thing just to point out the
18 current status just to give you an idea of where we've
19 been and where we're going, we started work on this
20 back in early 2020 as far as the latest iteration of
21 LANCR and PANAC. The actual work on LANCR goes back
22 much farther, way back into the -- before 2010. And
23 the approval of Revision 3 was in the 2015-16 time
24 frames. We're picking this back up now as driven by
25 the desire to move to fuel features that ATF enables

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 like LU+. So we picked that back up early 2020.
2 Created the licensing topical reports. Issued them
3 for review in late 2021. We've been going through
4 review cycles since that time. There was an audit with
5 RAIs and RAI responses in the middle of 2022, which
6 led us to the ACRS meeting which we're at today. And
7 we're moving forward from there.

8 We believe we're on track for issuance of
9 an approved version of these LTRs by the end of 2023.
10 It's noted here because it's relevant that the final
11 approval of a supplement for this, Supplement 1, which
12 is the implementation of LANCR and PANAC and the
13 downstream methods is also happening in parallel
14 because you approved the core simulator and LANCR as
15 the underlying cross section, but then you need to
16 actually push that into your system codes and do
17 safety analyses and you need to understand the
18 qualification basis remains adequate or the
19 uncertainties that you're using are still applicable.
20 So that effort is ongoing. And we expect to try to
21 complete that around mid-2024 and that's what would
22 enable this in productions.

23 CHAIR MARCH-LEUBA: Completed the review
24 or complete the topical report?

25 MR. HANNAH: Complete the review. So the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 topical report has been submitted and we're through
2 some review phases of it, so that's an end state for
3 approval ideally.

4 CHAIR MARCH-LEUBA: Thank you.

5 MR. HANNAH: That's all I have.

6 CHAIR MARCH-LEUBA: Mike, do we have the
7 staff on line? So is Scott Krepel on line? I believe
8 Scott was going to produce some introductory remarks.

9 MR. KREPEL: (Speaking through an
10 interpreter) Can everyone hear me?

11 CHAIR MARCH-LEUBA: Yes, we can. We can
12 see you.

13 MR. KREPEL: Okay, great. I'm Scott
14 Krepel. I'm speaking through a sign language
15 interpreter. I'm the Branch Chief for the Nuclear
16 Methods and Fuel Analysis Branch with which is the
17 branch within the technical reviewers like Matthew who
18 did the review.

19 I am happy to have my staff present the
20 results of the review of these three topical reports
21 for LANCR. As you, I'm sure, are already aware, this
22 supports ATF-related activities since LANCR would be
23 approved for higher than five percent -- five weight
24 percent U235.

25 And I think that GEH and the staff worked

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 well together to address all of the issues and get
2 them resolved satisfactorily including some last-
3 minute things that came up that will be discussed at
4 a later point during the presentation.

5 So I just wanted to give those remarks and
6 thank you for your time.

7 CHAIR MARCH-LEUBA: Thank you, Scott. So
8 I guess we move to Matthew Panicker to make the open
9 session interaction by the staff.

10 MR. PANICKER: I am Matthew Panicker. I am
11 a member of the Nuclear Materials and Fuel Analysis
12 Group in the Division of Safety System of NRI. And
13 this is a short presentation open to the public to the
14 ACRS today.

15 Next slide. Short list of topics covered
16 in the open session in relation to the background.
17 Review based on regulatory evaluation and review of
18 the guidance. It mainly is about NEDC-33935 topical
19 report which is LANCR02, PANAC11 application
20 methodology and early on I have a slide on short
21 summary and conclusions by the staff.

22 Next slide. The Global Nuclear Fuels
23 Americas updates its nuclear methods to enable lessons
24 and limits. The three TRs are the main, NEDC-33935
25 Revision 0, application methodology and the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 supporting topical reports are NEDC-33376P LANCR2
2 physics model and NEDC-33377P, Revision 4, lattice
3 physics model qualification reports.

4 The qualification reports consist of
5 figures to verify the cross sections and also some
6 test cases.

7 Next slide, please. The regulatory
8 evaluation is then based on GDC10 and Section 50.34.
9 (Unintelligible) requires licensees to perform safety
10 analysis.

11 And most of the new guidance is coming out
12 of Section 4.3 Nuclear Design of NUREG-0800 Standard
13 Review Plan for review of safety analysis report for
14 nuclear power plants. The list of areas of guidance
15 are listed in the closed session.

16 Next slide, please. NEDC-33935
17 Application methodologies applied to various fuel
18 designs approved for evaluation with LANCR02. LANCR02
19 is a lattice physics code that is used to process
20 nuclear data for use in the downstream analysis
21 methods. PANAC11 is the static evaluation couple
22 nuclear thermal hydraulic review program.
23 (Unintelligible) boiling water reactor code exclusive
24 of the external flow loop.

25 Next slide, please. A summary of the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 (unintelligible) and test cases (unintelligible) 6.2
2 qualification. There is also a section on performance
3 evaluation through compression qualifications and the
4 TR establishes guidelines for future updates for
5 normal and uncertainty ranges.

6 Next slide, please. The staff reviewed
7 all the TRs submitted for review. Staff reviewed the
8 methodology for efficacy demonstration and uncertainty
9 quantification. They reviewed the model distribution,
10 topical report and quantification topical report and
11 models were included in the code to predict the level
12 of physical processes for lattice physics analysis.

13 The results of this quantification or
14 qualification analysis just confirmed the
15 applicability of the latest ENDF/B-VII.0 cross
16 sections to analyze BWR.

17 Staff reviewed the LANCR02 model, the
18 LANCR02 model qualification, and LANCR02 application
19 methodology TR against acceptance criteria specified
20 in SRV 4.3, of the SRV which is titled nuclear design.

21 That is my last slide for this.

22 CHAIR MARCH-LEUBA: Thank you, Matthew.
23 It's not on the slide, but again for the open
24 transcript for the record, it is the intention of the
25 staff to issue a safety evaluation report approving

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 this methodology for use in future applications. I
2 guess that's the conclusion. And you say yes?

3 MR. PANICKER: Yes. That is one of my
4 slides in the closed session.

5 CHAIR MARCH-LEUBA: I guess it's a good
6 conclusion for the transcript.

7 MR. PANICKER: Okay.

8 CHAIR MARCH-LEUBA: Any questions from the
9 members. Yes?

10 MEMBER KIRCHNER: Just to elaborate on --
11 this is Walt Kirchner. Good afternoon, Matthew.

12 MR. PANICKER: Good afternoon.

13 MEMBER KIRCHNER: From the staff's
14 perspective, the physics methods that they already
15 have are already demonstrated to predict accurately
16 the benchmarks that are used for BWR simulations. So
17 the physics models don't change. The cross sections,
18 okay, you're using ENDF/B-VII.0, right?

19 What were the big issues or areas that the
20 staff focused on because on the surface, these models
21 should -- seven or eight percent is not a big stretch
22 over five percent. So what were you looking at when
23 you did your review? What were your focus areas to
24 come to a conclusion that you would issue an SE
25 approving these methodologies? I'm trying to draw you

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 out for the public record. What's the big deal here?

2 MR. PANICKER: What I was saying was how
3 did the quantification of all the uncertainties when
4 you analyzed the BWR and then since they're asking
5 about (unintelligible), they are looking for
6 (unintelligible) test cases where some of the test
7 cases are concentrated on higher end of the spectrum
8 and whether there is a comparison between what makes
9 it nicer with the NCV because the two codes are
10 slightly different configuration. One of them is
11 analytical and one is statistical. So these are some
12 of the main. And also the (unintelligible) updates
13 which we will describe in the closed session.

14 MEMBER KIRCHNER: And then with regard to
15 an 11 by 11 lattice configuration, what were you
16 looking for there to draw your conclusion that these
17 methods are applicable?

18 MR. PANICKER: What we are looking for was
19 if the -- can the core be applicable to an 11 by 11
20 configuration. And also whether when they're going to
21 an 11 by 11 configuration, the uncertainty is provided
22 in the application methodology TR. They are all
23 method, they should describe that they should be
24 within those ranges of applicability. These are the
25 two main things we look for.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 CHAIR MARCH-LEUBA: Thank you, Walt. I
2 wanted to place also in the open session, I like very
3 much the approach used on the SER, on the limitations
4 and conditions section. I'm used to seeing SERs that
5 have 25 limitations. Here, you took the approach of
6 dividing that into range of applicability and real
7 limitations. So what sort of limitations and
8 conditions on SERs are not real limitations? They're
9 redefining what's already in topical report. This is
10 only good up to 11 by 11 with this type of cladding
11 within this pressure range. So I want to give
12 positive reinforcement to the staff that I like two
13 sections on the limitation and condition. One is not
14 even a limitation which is the range of applicability.
15 Another one is real limitations where there was a
16 deficiency on the benchmarking above certain range. So
17 I think you guys did a good job, staff, on that.

18 Any more comments, questions from members?
19 So at this point, we're going to open the microphone
20 to members of the public. If somebody wants to make
21 a comment, please open your microphone and say it.
22 We'll give you five seconds to comment.

23 Seeing none, we are going to close this
24 session, but before we go off the transcript, I wanted
25 to ask the members, inform the members, that I have

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1716 14th STREET, N.W., SUITE 200
WASHINGTON, D.C. 20009-4309

1 reviewed the SER and the topical reports and I haven't
2 found any serious deficiency that would merit a letter
3 from us to the staff pointing out something.
4 Basically, our letter would say the standard, both GE
5 and staff did a great job publishing the SER. Because
6 of that, I am proposing that we use our methodology
7 that we will write a short paragraph describing the
8 methodology and describing the recommendation of the
9 subcommittee chair and we will review it and approve
10 it, hopefully, during the P&P session of the full
11 committee which is the only one that has authority to
12 make the decision.

13 So if during the closed session we are
14 going to be looking at the actual details, you find
15 something that merits a comment, please keep in mind
16 that we can always backtrack.

17 With that, we are in recess and this
18 meeting link is going to disappear. We will not come
19 back to this room. So we are in recess.

20 (Whereupon, the above-entitled matter went
21 off the record at 1:34 p.m.)
22
23
24
25

ENCLOSURE 1

M230070

ACRS Subcommittee Open Session Presentation Slides for Revision 0
of LANCR02/PANAC11 and Revision 4 of LANCR02 Licensing
Topical Reports

Non-Proprietary Information



Global Nuclear Fuel

LANCR02/PANAC11 Application Methodology Review

NEDE-33776P Revision 4 – LANCR02 Lattice Physics Model Description

NEDE-33777P Revision 4 – LANCR02 Lattice Physics Model Qualification Report

NEDE-33935P Revision 0 – LANCR02/PANAC11 Application Methodology

June 6th, 2023

Contents for Open Portion

Licensing Review

- Background
- Licensing Topical Report (LTR) Development Overview
 - Drivers
 - Approach
- Current Status

LTR Development

Background

- TGBLA06/PANAC11 is GNF's approved core simulator in use today
- TGBLA06 application range limited with respect to the next phase of fuel development
- LANCR02 approved from a model and qualification perspective, but no current approval basis coupled with a nodal solver for core simulation support
- Three (3) Licensing Topical Reports (LTRs) submitted to support use of LANCR02/PANAC11 as approved core simulator:
 - NEDE-33776P Revision 4 – LANCR02 Lattice Physics Model Description
 - NEDE-33777P Revision 4 – LANCR02 Lattice Physics Model Qualification Report
 - NEDE-33935P Revision 0 – LANCR02/PANAC11 Application Methodology

LTR Development

Drivers

- Expand core simulator application range by enabling use of LANCR02 as lattice physics solver
 - LEU+ : Fuel Enriched $>5\%$ and $\leq 10\%$ in U235
 - 11x11 : Support evaluation of plants with 11x11 fuel products
- Update GNF core simulator approval basis
 - Establish a new foundation upon which an incremental improvement approach can be established
 - Make minimal changes in Revision 0 to enable simplified review

LTR Development (continued)

Approach

- Update LANCR02 LTRs
 - Expand cold critical benchmarking enrichment range
 - Update qualification basis (MCNP5 -> Improved MCNP6.2)
 - Implement targeted model improvement based on extensive benchmarking
- Create LANCR02/PANAC11 Application LTR
 - Define applicable methodologies
 - Clarify and consolidate uncertainty quantification approach
 - Demonstrate performance
 - Establish update mechanics

Current Status

Milestones/Schedule

ID	Task Name	2020			2021				2022				2023				2024			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Create L02/P11 LTRs	[Redacted]																		
2	NRC Review LTRs/ Create Draft SE	[Redacted]																		
3	NRC Audit, RAIs, and RAI Responses	[Redacted]																		
4	ACRS Meeting	[Redacted]																		
5	NRC Final SE + "-A" Version of LTR	[Redacted]																		

- On track for issuance of approved (i.e, “-A”) version of LTRs by end of 2023
- Final approval of NEDO-33935 Supplement 1, “Implementation of LANCR02/PANAC11 in Downstream Methods” (parallel effort, not in scope of this review) expected mid-2024.

Non-Proprietary Information

The logo consists of the letters 'GNF' in a bold, white, sans-serif font. The 'G' is a simple, rounded shape. The 'N' is formed by two vertical bars connected at the top. The 'F' is formed by a vertical bar on the left and two horizontal bars on the right.

Global Nuclear Fuel

**U. S. NUCLEAR REGULATORY COMMISSION STAFF'S EVALUATION OF
GLOBAL NUCLEAR FUELS - AMERICAS TOPICAL REPORTS
NEDC-33935P, REVISION 0, "LANCR02/PANAC11 APPLICATION
METHODOLOGY," NEDC-33377P, REVISION 4, "LANCR02 LATTICE
PHYSICS MODEL QUALIFICATION REPORT," AND NEDC-33376P,
REVISION 4, "LANCR02 LATTICE PHYSICS MODEL DESCRIPTION"**

**Mathew Panicker, Nuclear Methods and Fuel Analysis
Division of Safety Systems**

**Advisory Committee on Reactor Safeguards
Subcommittee Meeting Open Session
June 6, 2023**

TOPICS COVERED

- Introduction and Background
- Regulatory Evaluation, Review Guidance
- NEDC-33935P, Revision 0, Topical Report (TR) Application Methodology
- NRC Staff's Summary and Conclusions

INTRODUCTION AND BACKGROUND

- Global Nuclear Fuels - Americas (GNF-A) is updating its Nuclear Methods to enable fuel enrichments above the current licensing limits.
- Three TRs submitted for review:
 - NEDC-33935P, Revision 0, “LANCR02/PANAC11 Application Methodology”
 - NEDC-33376P, Revision 4, “LANCR02 Lattice Physics Model”
 - NEDC-33377P, Revision 4, “LANCR02 Lattice Physics Model Qualification Report”

REGULATORY EVALUATION REVIEW GUIDANCE

- General Design Criterion (GDC) 10 of Appendix A to Part 50, GDC for Nuclear Power Plants
- Section 50.34 of the Title 10 to the *Code of Federal Regulations* (10 CFR) requires licensees to perform safety analyses of their facilities
- Section 4.3, “Nuclear Design,” of the NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants” (SRP)

NEDC-33935P, REVISION 0, APPLICATION METHODOLOGY

- Applied to various fuel designs approved for evaluation with LANCR02.
- LANCR02 is a 2-Dimensional lattice physics code that is used to process nuclear data for use in the downstream analysis methods.
- PANAC11 is a static 3-Dimensional coupled nuclear-thermal-hydraulic computer program representing the boiling water reactor (BWR) core exclusive of the external flow loop.

SUMMARY OF TR DEVELOPMENT

- Cold criticals and test cases for benchmarking LANCR02 validation with Monte-Carlo N-Particle (MCNP) code include higher enrichment.
- Updated MCNP5 to MCNP6.2 for qualification.
- LANCR02/PANAC11 Application TR defines methodologies.
- LANCR02/PANAC11 provides uncertainty quantification.
- Assessment of LANCR02/PANAC11 performance through operational qualifications.
- TR establishes guidelines for future updates for model and uncertainty ranges.

THE NRC STAFF'S SUMMARY AND CONCLUSIONS

- The NRC staff reviewed the LANCR02/PANAC11 methodology for efficacy demonstration and uncertainty quantification.
- The NRC staff reviewed the model description TR and the qualification TR and concludes that adequate models were included in the code to predict the relevant physical processes important for lattice physics analyses.
- The results of these qualification analyses justified the applicability of the ENDF/B-VII.0 cross sections to analyze BWRs.
- The NRC staff reviewed the LANCR02 Model, LANCR02 Model qualification, and LANCR02/PANAC11 Application Methodology TRs against the acceptance criteria specified in SRP Section 4.3, "Nuclear Design."

Attendance List

Name	Timestamp
Michael Snodderly	6/6/2023, 12:31:52 PM
Thomas Dashiell	6/6/2023, 12:31:52 PM
Gerond George	6/6/2023, 12:34:16 PM
Kate Lenning	6/6/2023, 12:31:52 PM
John Hannan (GNF-A)	6/6/2023, 12:34:16 PM
Halac, Kent E (GE Vernova)	6/6/2023, 12:34:16 PM
Larry Burkhart	6/6/2023, 12:34:43 PM
Mathew Panicker	6/6/2023, 12:36:51 PM
Ron Ballinger	6/6/2023, 12:42:57 PM
Gregory Halnon	6/6/2023, 12:43:49 PM
Court Reporter1	6/6/2023, 12:46:58 PM
Tammy Skov	6/6/2023, 12:49:10 PM
Vesna B Dimitrijevic (Guest)	6/6/2023, 12:49:30 PM
Vicki Bier	6/6/2023, 12:49:46 PM
Robert Williams	6/6/2023, 12:59:15 PM
Roberts, Thomas E	6/6/2023, 12:59:40 PM
Zena Abdullahi	6/6/2023, 1:01:29 PM
Richard Fu	6/6/2023, 1:02:27 PM
Benjamin Parks (He/Him/His)	6/6/2023, 1:03:12 PM
Gregory Suber	6/6/2023, 1:07:17 PM
Sandra Walker	6/6/2023, 1:09:05 PM
Kevin Heller	6/6/2023, 1:11:15 PM
Sign Language Interpreter	6/6/2023, 1:12:03 PM
Jennifer - ASL interpreter (Guest)	6/6/2023, 1:12:04 PM
Scott Krepel	6/6/2023, 1:13:24 PM