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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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NUSCALE SUBCOMMITTEE

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OPEN SESSION

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TUESDAY

FEBRUARY 7, 2017

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:01 p.m., Michael Corradini, Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL L. CORRADINI, Chairman

RONALD G. BALLINGER, Member

DENNIS C. BLEY, Member

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CHARLES H. BROWN, JR. Member

MARGARET CHU, Member

WALTER L. KIRCHNER, Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

HAROLD B. RAY, Member

JOY REMPE, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

MATTHEW W. SUNSERI, Member

ACRS CONSULTANT:

MYRON HECHT

DESIGNATED FEDERAL OFFICIAL:

CHRISTINA ANTONESCU

ALSO PRESENT:

JOSEPH M. ASHCRAFT, NRO

TOM BERGMAN, NuScale

LUIS BETANCOURT, NRO

GREGORY CLARKSON, NuScale (Rock Creek
Innovations)

GREG CRANSTON, NRO

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DAVID CURTIS, NRO

ROBERT GAMBLE, NuScale

DAWNMATHEW KALATHIVEETTIL, NRO

MARVIN LEWIS, Public Participant*

STEVEN POPE, NuScale

JASON POTTORF, NuScale

OMID TABATABAI, NRO

DINESH TANEJA, NRO

ANDREA D. VEIL, Executive Director, ACRS

*Present via telephone

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P R O C E E D I N G S

1:01 p.m.

1
2
3 CHAIRMAN CORRADINI: This meeting will
4 come to order. This is a meeting of the NuScale
5 Subcommittee. My name is Mike Corradini, chair of
6 the subcommittee. ACRS members in attendance
7 currently are Ron Ballinger, Margaret Chu, Dick
8 Skillman, Harold Ray, Dennis Bley, John Stetkar,
9 Walt Kirchner, Charles Brown, and Joy Rempe. We
10 have a couple other members who will be joining us,
11 such as Matt Sunseri and our consultant, Myron Hecht.

12 Christina Antonescu is the Designated
13 Federal Official for this meeting.

14 The purpose of the meeting is for the
15 subcommittee to review NuScale's Topical Report, TR-
16 1015-18653, Highly Integrated Protection System
17 Platform, Revision 1.

18 We will hear presentations from the NRC
19 staff and representatives from NuScale.

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

24 The rules for participation in today's
25 meeting have been announced as part of the notice of

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1 this meeting previously published in the Federal
2 Register. And as shown in the agenda, some
3 presentations will be closed in order to discuss
4 information that is proprietary to the applicants
5 and its contractors, pursuant to U.S.C. 552(b) (c) (3)
6 and (4).

7 Specifically for the agenda, an overview
8 of the design of highly integrated protection
9 systems platform will be given in open session and
10 then later, if we need to discuss proprietary
11 matters, we will go into closed session to do that.

12 And I will just go off script and ask
13 either NuScale or the staff to identify if we start
14 asking questions that take us where we need a closed
15 session, just hold us off and we will go and discuss
16 that in closed session. Attendance at this portion
17 of the meeting dealing with such information in
18 closed and will be limited to the NRC staff and its
19 consultants of those individuals and organizations
20 who have entered into an appropriate confidentiality
21 agreement with them. Consequently, we will need to
22 confirm this from the eligible observers and
23 participants in the room at the time of the closed
24 session.

25 We have received no written comments or

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1 requests for time to make oral statements from
2 members of the public regarding today's meeting.
3 And as always, we have one bridge line established
4 for interested members of the public to listen in.

5 Also, the bridge line will be opened at
6 the end of the open session to see if anyone has
7 additional comments from the public.

8 In addition, a second line has been
9 arranged for the vendor, as applicable, to be able
10 to participate in the meeting. Again, once we get
11 off here, I want to make sure that line is open and
12 members of NuScale that may be far away can
13 participate. And as I had noted, this line is only
14 for NuScale and NRC support staff who have an active
15 role. And this line can be used during the closed
16 portion of the meeting.

17 A transcript of the meeting is being
18 kept and will be made available, as stated in the
19 Federal Register notice. Therefore, we request that
20 participants in the meeting use the microphones
21 located throughout the meeting room. When
22 addressing the subcommittee, participants should
23 first identify themselves and speak with sufficient
24 clarity and volume so that it may be readily heard.

25 Also, again, please silence all cell

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1 phones, pagers, iPhones, iPads, and other
2 appropriate and sundry appliances.

3 We will now proceed with the meeting and
4 I will call upon Dave Curtis of the Office of New
5 Reactors to start the presentation.

6 Before you start, Mr. Curtis, can I get
7 someone from the second line, which has NuScale
8 staff and NRC staff to just confirm you are on, if
9 questions go your way?

10 Anybody out there?

11 PARTICIPANT: This is Ann from OGC.

12 CHAIRMAN CORRADINI: Okay, fine. All
13 right, so somebody is out there.

14 So, Mr. Curtis, please start us off.

15 MR. CURTIS: Good afternoon. My name is
16 David Curtis. I am the Acting Chief for the
17 Instrumentation, Controls, and Electronics
18 Engineering Branch in the Office of New Reactors.

19 I just wanted to start by thanking
20 NuScale on two fronts. We really appreciate the
21 quality of NuScale's Topical Report because it made
22 it much more straightforward for the staff to be
23 able to identify their safety findings.

24 And I also want to thank NuScale for
25 their participation with us throughout the review

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1 process through each stage of the process and that
2 also made coming to our determinations much more
3 straightforward.

4 The only other point that I wanted to
5 make just sort of starting out is that this Topical
6 Report is platform-specific. We have received
7 NuScale's DC application and it is currently being
8 assessed for acceptance. And when we have moved to
9 the next stage and we have reviewed that DC, then we
10 are going to be coming back to you to talk about our
11 safety findings in regards to that. Staff will go
12 into much more detail about that as they make their
13 presentation.

14 Omid?

15 MR. TABATABAI: Thank you, David. Thank
16 you, Dr. Corradini and ACRS members. Thanks for
17 your time.

18 Just quickly I just wanted to bring to
19 members of the public who are listening to this
20 presentation that we have made a very minor change
21 to the agenda. The latest one also reflects that
22 change that the staff's presentation was supposed to
23 be during the closed meeting but we have moved it up
24 to the open portion of this meeting. So if you are
25 using the old agenda that shows that staff's

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1 presentation starts at 1:30, we have -- I'm sorry
2 3:30 or so, we have moved it up to the open portion.
3 It starts at 1:30. So you don't have to hang up.

4 CHAIRMAN CORRADINI: Yes, I think we
5 have the correct one. And just to reemphasize what
6 you said, since it is open, if we have questions on
7 the open session that dive into proprietary matters,
8 we will postpone them and take them up when we go
9 into closed session.

10 MR. TABATABAI: That's correct. Thanks
11 for that reminder.

12 And also for folks on the bridge line,
13 please, if you are using the private line, if you
14 are not speaking, put your phones on mute so there
15 is no background noise in the room.

16 Other than that, I don't have anything
17 else and I will let NuScale present.

18 CHAIRMAN CORRADINI: So NuScale will
19 come up?

20 MR. TABATABAI: Yes.

21 CHAIRMAN CORRADINI: Okay, we will have
22 a change of place cards.

23 Jason, are you going to start us off?

24 MR. POTTORF: Yes.

25 CHAIRMAN CORRADINI: Okay. Go ahead.

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1 MEMBER BROWN: Before they start, can I
2 make --

3 CHAIRMAN CORRADINI: Charlie, as long as
4 you have a green light, you can talk.

5 MEMBER BROWN: That's why I got
6 permission first.

7 I had taken a quick look at the
8 nonproprietary slides and I have gone through the
9 proprietary slides. There is a good possibility
10 when you listen to the non-proprietary part, it is
11 in words, not necessarily in figures, and some may
12 not be straightforward. The proprietary closed part
13 of this will pretty much, I think, provide a lot of
14 definition and too much back and forth during the
15 nonproprietary session would -- I'm just cautioning,
16 as Harold did in the last meeting, would not be as
17 productive.

18 So I will try to flag those if I think -
19 -

20 CHAIRMAN CORRADINI: So are you telling
21 me you are going to control yourself?

22 MEMBER BROWN: No, that is not a
23 possibility.

24 CHAIRMAN CORRADINI: It was a question.

25 MEMBER BROWN: There are several that

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1 are not controllable in this process and I am just -
2 - all I am trying to do is make you aware that the
3 number of my questions, once I got the slides last
4 night, I was able to come to some slightly different
5 conclusions or at least eliminated some questions.

6 So anyway, I am just trying to give you
7 a heads up, that's all.

8 CHAIRMAN CORRADINI: Okay, that sounds
9 good. Jason, take it off. Go ahead.

10 MR. POTTORF: Thank you and good
11 afternoon, everyone. It is a pleasure to be here.
12 My name is Jason Pottorf. I am a Lead Engineer in
13 Instrumentation and Controls with NuScale Power. I
14 have been with NuScale Power for over eight years
15 now.

16 In about 2010 at NuScale we partnered up
17 with Gregg Clarkson and the Rock Creek Team to
18 develop a new custom protection system architecture.
19 We have been working on that since then.

20 Gregg Clarkson is here with me today.
21 Do you want to go ahead and introduce yourself?

22 MR. CLARKSON: Yes, Gregg Clarkson with
23 Rock Creek Innovations. Like Jason said, I
24 partnered with NuScale in 2010, became a strategic
25 partner in 2012 and also have decided to invest in

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1 NuScale as of 2012 and have had the pleasure of
2 designing a custom protection system for NuScale
3 Power Reactor Design.

4 MR. POTTORF: Okay. We also have Vice
5 President of Engineering at NuScale here, Robert
6 Gamble.

7 MR. GAMBLE: Hello. Good to be here. I
8 am a relatively newcomer to NuScale. I joined
9 within the last year but have crossed paths with
10 many of you in my earlier days with GE on the ESBWR
11 design.

12 CHAIRMAN CORRADINI: That's why you look
13 so familiar. We have seen you before.

14 MR. GAMBLE: That's right.

15 CHAIRMAN CORRADINI: Okay, good.

16 MR. POTTORF: Okay, we will jump into
17 the presentation. The first slide is our standard
18 acknowledgment and disclaimer for the DOE cost
19 sharing for the NuScale work.

20 So the presentation today, the purpose
21 of the presentation is to provide a high-level
22 overview of the design of the highly integrated
23 protection system or HIPS, as we refer to it, the
24 HIPS platform topical report.

25 I will briefly cover the history of the

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1 NRC interactions on the topical report. I will
2 cover the design approach that we took for the HIPS
3 platform, briefly cover the scope of what is in the
4 topical report, and then I will walk through at a
5 high-level kind of a representative architecture to
6 help show the safety data path through the HIPS
7 platform.

8 I have a slide on the prototype effort
9 that we have recently completed and I will wrap up
10 at the end.

11 This is a slide -- slide 4 is all of the
12 acronyms that we have used in the presentation.

13 So slide 5 lists all of the interactions
14 and I will just summarize this slide in the interest
15 of time. We have had a lot of very, very good
16 interactions with the NRC throughout the review of
17 the topical report. To summarize, we submitted in
18 late 2015, Revision 0 of the HIPS platform topical
19 report. We received the first set of RAIs towards
20 the middle of 2016. We responded to those in the
21 fall.

22 And just here recently, in fact last
23 week, the NRC performed their audit of what we refer
24 to as the MPS or module protection system prototype
25 in the U.K. which utilize a lot of the design

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1 concepts of the HIPS platform in that.

2 MEMBER STETKAR: Jason, again, turn me
3 off if it is proprietary. Does that system in the
4 U.K. replicate four divisions, whatever you call
5 them?

6 MR. POTTORF: Yes, quickly, we had --

7 MEMBER STETKAR: Two out of four type, I
8 mean is it that level of --

9 MR. POTTORF: It is two out of four.

10 MEMBER STETKAR: It is not one out of
11 two.

12 MR. POTTORF: And I have a slide and I
13 will cover that, what was covered in the prototype
14 on that slide.

15 MEMBER STETKAR: Okay, sorry.

16 MR. POTTORF: No problem. Okay, so the
17 HIPS Platform is designed to provide a robust
18 platform for safety-related and important safety
19 applications. And the fundamental design objective
20 for the HIPS platform was to take advantage of the
21 benefits of the analog architectures that you will
22 find in existing commercial nuclear power plants, as
23 well as to take advantage of digital technologies,
24 all while incorporating the design I&C principles of
25 independence, redundancy, diversity, and

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1 predictability and repeatability.

2 Now if you are familiar with those
3 existing analog architectures, you will know that
4 the trip determination channels in those systems all
5 function independently of each other within a
6 division of input. And each of those trip
7 determination channels then provides its trip
8 determination to the voting portion of those systems
9 via one-way physical point-to-point connections.
10 And then actuation of safety components in those
11 systems is performed by way of master and slave
12 setup, where a master-slave communicates with
13 multiple slave relays.

14 MEMBER BROWN: Are you talking about
15 analog, your equivalent to the -- you are talking
16 about the analog systems, the classic older systems
17 right now.

18 MR. POTTORF: That's right. That's
19 right.

20 MEMBER BROWN: I just wanted to clarify
21 that. Thank you.

22 MR. POTTORF: And so the final actuated
23 equipment is actually via this master-slave point to
24 multipoint communication where each slave relay
25 would then actuate a final component.

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1 Now, as I am sure you are wondering, why
2 am I describing these analog architectures. I am
3 describing that because the design of the HIPS
4 platform components enables you to implement a
5 protection system very much akin to those analog
6 systems, while taking advantage of the benefits of
7 digital technology by way of the use of field
8 programmable gate arrays or FPGAs.

9 And I guess I would say that if you are
10 only familiar with some of those microprocessor-
11 based digital protection systems that have come
12 before the NRC, I would recommend that you set aside
13 your concepts of how those operate because it will
14 be harder for you to understand how our system
15 operates. You should look at the HIPS platform as
16 really a distributed set of FPGAs. Each of those
17 FPGAs performs a very specific and simple function
18 and there will be many FPGAs in the platform. So,
19 it is quite different but we really tried to take
20 advantage of those benefits of the existing analog
21 and proven protection systems in the current plants.

22 Now as far as the topical report scope,
23 the HIPS platform consists of HIPS chassis, which
24 includes a backplane and a back panel and then also
25 a system of modules that are interchangeable between

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1 chasses.

2 The platform is designed to work with
3 different module types configured to the individual
4 application, where multiple chasses can be connected
5 to create a larger system, if needed. The different
6 HIPS modules and platform inputs and outputs are
7 then connected to each other through the backplane
8 and back panel of the chassis.

9 On Slide 7, I have listed the four
10 module types that part of the HIPS platform. The
11 first of those is a safety function module or SFM
12 for short. The purpose of the safety function
13 module is to provide signal conditioning and
14 actuation determination for safety functions. It
15 also provides scaled value of input process to non-
16 safety controls and other safety displays for
17 monitoring purposes. This module includes an FPGA
18 as well as analog components on it.

19 MEMBER STETKAR: Jason, just for
20 clarity, because people use term safety functions
21 differently. In your construct, a safety function
22 module monitors particular plant parameters and
23 compares them to set points.

24 MR. POTTORF: That's correct.

25 MEMBER STETKAR: So a safety function

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1 module does not initiate the function of auxiliary
2 feedwater or the function of high pressure
3 injection, with a function of blowdown or something
4 like that. It is simply what used to be a bistable.

5 MR. POTTORF: That's correct.

6 MEMBER STETKAR: Okay.

7 MR. POTTORF: Yes.

8 MEMBER STETKAR: It is just a different
9 connotation of safety function than is used
10 elsewhere.

11 MR. POTTORF: Okay, the second module of
12 the HIPS platform is the communications module or CM
13 for short. And the purpose of the Communications
14 module is to control, collect, and transmit
15 information between other HIPS modules or to
16 external components from the platform. This module
17 includes an FPGA, as well as analog components as
18 well.

19 The third module is the equipment
20 interface module or EIM and it provides final
21 equipment actuation output. This module includes
22 analog priority logic circuitry on the board used
23 for automatic and manual actuation inputs. This
24 module include an FPGA as well as analog components,
25 too.

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1 And the final module is the Hardwired
2 module or HWM and this is a relatively simple
3 module. It converts hardwired contact inputs into
4 logic level signals to make that available on the
5 backplane of the chassis and HIPS platform. And it
6 is analog only.

7 I do have a note here on the bottom that
8 the HIPS platform is FPGA-based and, therefore, has
9 no executable software in runtime environment for
10 the platform.

11 CHAIRMAN CORRADINI: So I am probably
12 one of the less knowledgeable on this. So explain -
13 - can you at least remind us what an FPGA is or is
14 this not the right time? Are you going to do it
15 later?

16 MR. POTTORF: I hadn't provided any
17 slides that speak specifically. Actually, I do have
18 --

19 CHAIRMAN CORRADINI: I get smirks from
20 some of my colleagues who probably know what it is.

21 MR. POTTORF: Maybe you can probably
22 explain.

23 MR. CLARKSON: I think a simple
24 explanation would be is imagine you had a surrogate
25 board with a lot of individual components

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1 representing logic gates and they were wired
2 together, all of them were wired together with
3 copper traces and you chose to make a specific
4 sequential logic circuit out of that. You could go
5 in and cut away the logic, the copper wire that you
6 don't want connected, and leave behind what you do
7 want connected. And by doing that, you would result
8 in a specific circuit, that sequential logic
9 circuit.

10 The FPGA does this on a piece of
11 silicone.

12 CHAIRMAN CORRADINI: Okay so it is
13 hardwired but on a very small scale.

14 MR. CLARKSON: Correct. Yes, that is
15 correct.

16 CHAIRMAN CORRADINI: To perform a single
17 function.

18 MR. CLARKSON: To perform a specific
19 function.

20 CHAIRMAN CORRADINI: A specific
21 function.

22 MR. CLARKSON: Just like you would with
23 individual logic gates, yes.

24 CHAIRMAN CORRADINI: Okay.

25 MEMBER BROWN: FPGA means field

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1 programmable gate array, right?

2 MR. CLARKSON: Yes.

3 MEMBER BROWN: It is a bunch of gates.
4 They select which ones you want to use, which ones
5 you don't want to use.

6 CHAIRMAN CORRADINI: Just teeny-tiny.

7 MEMBER BROWN: Tons of logic units.
8 Tons, I would say -- how many are in an FPGA,
9 100,000? More than that?

10 (Simultaneous speaking.)

11 CHAIRMAN CORRADINI: I have got it.
12 Let's go on.

13 MEMBER BROWN: Okay.

14 MR. POTTORF: Okay, on Slide 8 I
15 provided a portion, a block diagram of a portion of
16 a representative architecture. And there is a
17 section in the topical report where we talk about a
18 representative architecture and this is really not
19 part of what we are looking for approval of but we
20 included that in the topical report because it helps
21 demonstrate some of the key or all of the key design
22 concepts of the HIPS Platform components.

23 So on this slide you will see these two
24 major boxes. The one on the upper part of the slide
25 represents a single division of input. We call

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1 those divisions separation groups. So this would be
2 one of four separation groups of input to the
3 representative protection system architecture.

4 The colored blocks in that bigger box
5 there represent HIPS platform modules. The brown
6 and green ones are the safety function modules,
7 where you would bring in process inputs and perform
8 trip determination on those boards. We have colored
9 those green there because this is where triple
10 redundant safety data paths begin in the safety data
11 path.

12 So on the FPGA on the SFM there will be
13 triplicated independent logic on a single FPGA but
14 then, essentially, once you have made a trip
15 determination, that is all that gets passed on down
16 through the system from those SFMs.

17 The lines that you see in the middle of
18 that big box represent the independent communication
19 buses on the backplane of the chassis. You will see
20 that we have a blue, purple, and red. These
21 represent the independent communications for the
22 three safety data paths. So all of the SFMs have
23 independent components on the SFM that communication
24 with each of those three safety data buses on the
25 backplane.

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1 The blue, purple, and red box at the
2 bottom represent what we call a scheduling and
3 bypass modules. These would be the master of the
4 communications on those three safety data buses in
5 that chassis for determination -- for trip
6 determination.

7 CHAIRMAN CORRADINI: So I'm going to
8 slow you down. So you gave us three things before,
9 an SFM, a CM, an EIM, and an HWM. Now you have
10 introduced an SVM. I assume that is a voting -- V
11 for voting. What is the SBM?

12 MR. POTTORF: Yes, so I should clarify.
13 The blue and the purple and the red boxes there are
14 communication modules.

15 CHAIRMAN CORRADINI: Blue, red, and
16 purple?

17 MR. POTTORF: Uh-huh.

18 CHAIRMAN CORRADINI: Okay.

19 MR. POTTORF: So these herein the middle
20 are communications modules. We refer to them as
21 SBMs or scheduling and bypass modules in the
22 representative architecture, whereas down in this
23 voting and actuation chassis shown at the bottom, we
24 refer to those as scheduling and voting modules.
25 This is where the voting would be performed.

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1 All of these in the middle of the system
2 are communications modules. Those lines in-between
3 the communications modules, those are the point-to-
4 point communications for trip determination. And
5 because we are only showing one of the four
6 separation groups, you will see the other three
7 being input to each of the communications modules
8 down at the actuation chassis set of equipment.

9 MEMBER BROWN: Let me provide one
10 hopefully helpful comment. There are four
11 separation groups. They can have lots of SVMs, one,
12 two, three, four, eight, nine. It depends on how
13 many input pieces of data you put in. And then
14 there is three other, a group A, B and -- a B, C and
15 D. Every separation group has three SBMs total.
16 Those are safety bus --

17 MR. POTTORF: They are the master --

18 MEMBER BROWN: -- masters or something
19 like that. I have forgotten exactly what SBM -- but
20 it is fundamentally an organization and sorting and
21 transmission task.

22 MR. POTTORF: Correct.

23 MEMBER BROWN: It doesn't do anything
24 other than that.

25 MEMBER STETKAR: Except for what you

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1 call voting modules.

2 MEMBER BROWN: I haven't gotten there.
3 You are way ahead of me. John, let me finish.

4 Those exist in four separation groups.
5 There will be 12 of those.

6 Once you leave that upper box, you go
7 down to the divisions. There is two divisions of
8 reactor trip and safeguards each. Two divisions of
9 reactor trip. Two divisions of ESFAS. And that is
10 where the SVMs are located. Those are voted -- now
11 they are called scheduling and voting modules. That
12 is where the two of four voting is done.

13 You will also then hear another
14 calibration later, the EIMs take these, they are
15 going to talk about three triple module redundancy
16 at some point. So there is three paths, which
17 become clear in the proprietary section that pass
18 through into the two fundamental divisions.
19 Division 1 has reactor trip and ESFAS Division 2.

20 So I have gone from four separation
21 groups to two divisions of reactor trip and ESFAS.
22 The voting modules then collect the data from the
23 other groups. That is the SGV --

24 MR. CLARKSON: No, that I got.

25 MEMBER BROWN: -- all that type of

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1 stuff.

2 So, there is three SVMs per division and
3 three -- yes, three SVMs per division and they do
4 everything. The EIMs only do take the triple module
5 redundancy and they go to the two out of three so
6 you can have three -- all these trips get processed
7 three times. They are voted on as three times. And
8 then they are processed into the EIMs where you say
9 okay, two out of three of those will cause me to
10 trip. That is the extra redundancy and failsafe if
11 you have a path fail.

12 So, that is the big picture block
13 diagram. There was another figure that was not
14 included in any of these. That is why I went
15 through this dog and pony show.

16 CHAIRMAN CORRADINI: Keep on going.

17 MEMBER MARCH-LEUBA: Hold on. While we
18 have these, these are two analogs. They work on a
19 clock, right?

20 MR. POTTORF: Correct.

21 MEMBER MARCH-LEUBA: Where is the master
22 clock and does it connect to everybody? He will be
23 interested in that.

24 MR. POTTORF: So there is no master
25 clock. And that is kind of why when we refer to

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1 those as scheduling and bypass modules, the SBMs,
2 that is because that SBM is responsible for
3 scheduling the communications within that chassis.

4 MEMBER MARCH-LEUBA: So there is
5 intercommunications between devices --

6 MR. POTTORF: That's right.

7 MEMBER MARCH-LEUBA: -- not the master
8 clock.

9 MR. POTTORF: Yes, that's right. Yes,
10 you will see in the closed portion the details of
11 how that communication scheme works.

12 MEMBER BROWN: And there are some more
13 questions that are useful in the closed session but
14 not here.

15 CHAIRMAN CORRADINI: Green light on.

16 MR. HECHT: On the top part of the
17 diagram, SFM #2 doesn't have any connection. Is
18 that deliberate or did you just leave --

19 MR. POTTORF: Yes, that is an error.

20 MEMBER BROWN: Say that again. I missed
21 it.

22 MR. POTTORF: Yes, there should be
23 similar --

24 MR. HECHT: The question was just making
25 clear that the connectivity of all the functional

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1 SFMs are the same.

2 MR. CLARKSON: Actually, to clarify, if
3 you had an SFM with process inputs that you only
4 needed for monitoring and indication, that is an
5 example of how you would connect it.

6 If it wasn't performing a safety
7 function, if it was just taking the inputs in to
8 bring in for information, that as an example, I
9 don't know if that was the intent, Jason, but that
10 is a good example of that.

11 MR. POTTORF: That's a good point. You
12 could use an SFM to simply bring in -- to monitor
13 non-safety parameters in a plant.

14 MR. HECHT: And then they go out on the
15 MIB?

16 MR. POTTORF: That's right. It only
17 goes out on the MIB. You would only program the
18 FPGA to communicate with the MIB. But the intent
19 for this presentation was to connect all those.

20 So if it was performing a safety
21 function, it would have connections to all of the --

22 MEMBER STETKAR: No, the intent was
23 explicitly to demonstrate that capability.

24 MR. POTTORF: Okay. Okay, we'll move
25 on.

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1 Okay so the prototype effort. So in
2 late 2015, we initiated development of a prototype
3 module protection system and the scope of that
4 prototype includes -- the hardware scope includes
5 two safety function modules and four communications
6 modules. So, the three scheduling bypass modules
7 and monitoring and indication communications module
8 for one separation group of input. The other three
9 separation groups or divisions of input were
10 simulated with LabVIEW in the prototype.

11 As for the actuation portion of the
12 system, the hardware scope included two EIMs an four
13 communications modules, three scheduling and voting
14 modules, as well as a monitoring and communications
15 module for one division of ESFAS.

16 And we just here recently completed the
17 FAT on that system last week at the NRC. We went
18 out to Wimborne Minster and performed an audit of
19 that FAT and testing.

20 MEMBER STETKAR: Jason, because this is
21 on the record, what is a FAT?

22 MR. POTTORF: It is a factory acceptance
23 test.

24 MEMBER STETKAR: Thank you.

25 MR. POTTORF: And the factory

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1 acceptance test went very well. No issues were
2 identified as part of that testing.

3 MR. HECHT: Is there any significance of
4 that FAT, other than just satisfying you as the
5 developer that things work together in an integrated
6 test?

7 MR. POTTORF: That was the main purpose
8 of the FAT was to demonstrate that the concepts of
9 the HIPS platform function and to identify any risks
10 going forward with the platform licensing.

11 MR. HECHT: So it is really an early
12 integration test. It is not really a factory
13 acceptance test, where it is going into a plant.

14 MR. POTTORF: No, that's right. It was
15 acceptance of the prototype equipment. So yes, it
16 will have no input into licensing activities, that
17 is for sure.

18 MR. HECHT: Thank you.

19 MR. POTTORF: To summarize, the HIPS
20 platform is based on the fundamental I&C design
21 principles of independence, redundancy, diversity
22 and defense-in-depth, and predictability and
23 repeatability.

24 The platform was developed to provide a
25 simple and reliable solution for nuclear power plant

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1 I&C applications, which support meeting the
2 guidelines and the requirements of the NRC's
3 regulatory guides and IEEE standards applicable to
4 safety-related and important safety applications.

5 The platform is based on FPGA
6 technology, which has been previously used by the
7 NRC for safety-related -- approved by the NRC for
8 safety-related applications. And the licensing
9 topical report for the HIPS platform demonstrates
10 how the key design concepts for the HIPS platform
11 meet those fundamental I&C design principles. The
12 topical report also describes the testing and
13 diagnostics concepts and how the key design concepts
14 are implemented to achieve overall simplicity in the
15 platform.

16 And that is the end of my opening
17 portion of the presentation.

18 There are some supplemental slides
19 attached to this that we will get into more detail
20 in the closed session.

21 CHAIRMAN CORRADINI: Okay, any questions
22 for the current presentation? Otherwise, we are
23 going to switch to the staff.

24 Okay we will change out and the staff
25 will join us. Thank you.

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1 Who is going to lead us off, Luis?

2 MR. BETANCOURT: I am.

3 CHAIRMAN CORRADINI: Okay.

4 MR. BETANCOURT: So, good afternoon,
5 everybody. My name is Luis Betancourt. I am the
6 I&C lead clinical reviewer for this topical report.
7 Why don't we have everybody here on my side is
8 Dawnmathew Kalathiveetti, who is an electronics
9 engineer in the Office of New Reactors and he is
10 going to be my co-presenter for this presentation.

11 On the right I have Dinesh Taneja, who
12 sit he Senior I&C technical reviewer for the NuScale
13 DC application and we also have Joe Ashcraft, who is
14 an electronics engineer in the Office of New
15 Reactor.

16 So today we are just going to be
17 presenting the staff findings of the design of the
18 highly integrated protection system platform.

19 So for today's agenda, we would like to
20 provide you like a brief background of the major
21 milestones that happened in the review, followed by
22 the scope of the staff review and evaluation and a
23 summary of the staff findings.

24 This slide is a brief summary of the
25 presentation that NuScale provided. So in late

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1 2015, the applicant submitted Revision 0 of the
2 topical report. That was followed by February 2016,
3 when we accepted the topical report of Revision 0.

4 Since then, the staff has expended about
5 1500 hours which has involved the four engineers
6 that you see in front of you. I would like to
7 mention that the actual hours are actually
8 consistent with the estimated hours that was in the
9 acceptance letter. So that is a big win for us at
10 the NRC and the applicant that we were able to meet
11 the schedule within the allowable hours.

12 During this time, we had several public
13 meetings and there were two audits that happened. I
14 would like to mention the last we just completed,
15 the audit of the factory acceptance testing of the
16 prototype. It went really well. We were able to
17 assert the prototype. We were able to have a little
18 feel of the platform acceptabilities and we
19 confirmed that the topical report actually claims
20 conform with the applicable regulations.

21 We had no observations during the audit
22 and there were no ROIs submitted as part of that.

23 Regarding the ROIs, we had the applicant
24 respond to over 18 questions in one round of the
25 ROIs. And then in November 2016, they submitted

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1 Revision 1 of the topical report, which included the
2 -- and they incorporated their responses of the
3 questions.

4 As part of the next steps, we expect to
5 issue the set evaluation, depending on the comments
6 that we get from the subcommittee by late March
7 2017.

8 Any questions on the audit or anything
9 else? No? Okay.

10 So the scope of the staff review was a
11 top-down review approach that was based on the
12 fundamental design principles that are outlined in
13 the NRC design-specific review standard for NuScale.
14 I would like to note this is the first time that we
15 actually used the DSRS to perform a review of a
16 topical report.

17 The design-specific are applicable,
18 regardless of the technology, analog, or digital and
19 they actually work together to ensure that the
20 safety functions will be accomplished when needed.
21 That is, that the design should demonstrate
22 compliance with all of them, rather than one versus
23 another.

24 We also spent a lot of time reviewing
25 the capabilities of the platform regarding the

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1 calibration testing and diagnostics. Some of the
2 items that you see application-specific action items
3 were items that were outside the scope of the staff
4 review. An example of those is the quality
5 assurance and the qualification because design-
6 application specific activities that are dependent
7 on the vendor that it decides to implement the HIPS
8 system. For those aspects, we have established
9 application-specific items for the uses of the
10 platform to demonstrate compliance with Appendix B
11 on the regulatory requirements.

12 MEMBER STETKAR: Luis, are the details -
13 - I don't know which -- when to ask questions of the
14 staff in open session or closed session. Are the
15 ASAIIs considered open information?

16 MR. BETANCOURT: Yes, that is open.

17 MEMBER STETKAR: They are?

18 MR. BETANCOURT: Yes.

19 MEMBER STETKAR: Okay. I had a lot of
20 questions on the ASAIIs so I might as well launch
21 into them. Let me find my notes on them.

22 One of the ASAIIs, and it is number 21,
23 says an applicant or a licensee referencing the SE
24 must provide redundant power sources to separately
25 supply the redundant power conversion features

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1 within the HIPS platform.

2 What does the staff mean by redundant
3 power supplies? Because I can interpret that a
4 variety of different ways. If I have four trains of
5 DC power in my plant, A, B, C, D, I could interpret
6 that as I need power to one division from train A
7 and train D or I could interpret it as I need two
8 separate Division A power supply train A to Division
9 1. What does the staff mean by that? Because it
10 seems contrary to what I understand about the design
11 that I can't talk about in open session.

12 MR. TANEJA: Right.

13 MEMBER STETKAR: So what do you mean by
14 that?

15 MR. TANEJA: So in the topical, their
16 chassis, one box, is like you can use it into a one
17 separation group or one -- let me see.

18 CHAIRMAN CORRADINI: Go ahead.

19 MR. TANEJA: So in the topical report,
20 one chassis design represents an application into a
21 one division or one separation group.

22 MEMBER STETKAR: Now when you talk about
23 separation groups, here we get into semantics
24 because divisions and separation groups are
25 different things.

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1 MR. TANEJA: Right. So if you take a
2 look at just one chassis, let's talk about that one
3 box.

4 MEMBER STETKAR: A chassis.

5 MR. TANEJA: A chassis. So their design
6 is what I want to use the word is it is a single
7 failure-proof design, not in a one point of failure.
8 So you could lose a power supply so the chassis
9 continues to function.

10 So you could have two separate power
11 inputs that provide you with a capability to you
12 know --

13 MEMBER STETKAR: Okay but --

14 MR. TANEJA: -- lose a power supply and
15 allow that failure but continue to function.

16 MEMBER STETKAR: As I understand that,
17 though, both of those inputs could come from the
18 same DC bus.

19 MR. TANEJA: Now that is application-
20 specific. So that is where a person who is applying
21 this thing in their architecture could make a
22 decision how they want to supply those different
23 power sources.

24 MEMBER STETKAR: Okay. I am now going
25 to use this in my application. So I want to make

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1 sure that I really understand what the staff means
2 by this. So I have an application now that has two
3 and only two trains in the whole plant, train A and
4 train B.

5 MR. TANEJA: Right.

6 MEMBER STETKAR: I got two DC buses in
7 my plant. Does that mean that I have to supply each
8 division of my protections system from both DC train
9 A and DC train B because those are my only
10 redundancies?

11 MR. TANEJA: And then you lose your
12 independence between them.

13 MEMBER STETKAR: Yes, you do. So how do
14 I comply with this application-specific action item
15 in that application? I can't, can I?

16 MR. TANEJA: No, see -- I give you one
17 example that --

18 MEMBER STETKAR: I don't want to belabor
19 this because we don't have a lot of time. My
20 biggest questions on these ASAI's as I thought about
21 them, trying to implement them in the real world,
22 they are not specific enough. They don't tell me
23 what your expectation is.

24 It is nice to say you have to have
25 redundant power supplies but you had better darn

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1 tell me what that means because, otherwise, I don't
2 know how to wire up my plant.

3 Because their interpretation, my
4 understanding of redundant power supplies is
5 different from what I think your interpretation
6 might be and if they are different, that is a
7 problem.

8 MR. TANEJA: Yes. Well you know, good
9 comment. We will take that into consideration on
10 clarifying some of these ASAI's.

11 MEMBER STETKAR: Okay, that is on ASAI.
12 I am going to belabor this because I was really
13 disappointed in the ASAI's. I didn't learn much from
14 them.

15 ASAI 40 says an applicant or licensee
16 referencing this SE must describe how the HIPS
17 platform equipment is used for sensitive command
18 features to provide protection against the resulting
19 condition of a nonsafety system action that has been
20 caused by a single credible event, including its
21 directing and direct consequences.

22 Is a single credible event a seismic
23 event, fire, internal flood, external flood? Those
24 are single credible events to me. Or do you mean a
25 single failure in electrical things that you can

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1 think about?

2 MR. TANEJA: I am trying to the SER
3 section.

4 MEMBER STETKAR: It is ASAI 40, forty.
5 I quoted it verbatim.

6 So I want to know when I design this
7 thing, what is a single credible event, especially
8 in its effects on nonsafety system signal inputs in
9 my platform.

10 MR. BETANCOURT: No, this is specific
11 design basis.

12 MR. TANEJA: You know we put in these
13 SER reference sections. So the context of these is
14 really as a whole. When you read that section it
15 will probably get more apparent as to what this
16 thing stands for.

17 MEMBER STETKAR: It wasn't apparent to
18 me and I have read a lot of things. So, what is a
19 single credible event in the staff's interpretation?

20 If these are things that I need to do to
21 make my application-specific platform satisfy NRC
22 staff expectations, those expectations ought to be
23 clear.

24 Don't try to do it real-time. We don't
25 have much time. I have got a bunch of -- I want to

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1 make my comments on the record so that you have them
2 and can go back and think about things because there
3 are several.

4 ASAI 57, five-seven, an applicant or
5 licensee referencing the CSE must configure the
6 slave modules to alarm and assume a failsafe
7 position. I cannot find the term slave module
8 anywhere in the topical report. So I have no idea
9 what a slave module is.

10 MR. BETANCOURT: Well, in the case of
11 the slave module, in this platform are the SFMs and
12 the EIMs.

13 MEMBER STETKAR: Well, you probably
14 ought to refer to those things, since that is what
15 you are writing it on.

16 MR. TANEJA: So I think in the closed
17 portion of the meeting, NuScale has the
18 communication details on how the master and slave
19 interact.

20 MEMBER STETKAR: They don't use the term
21 slave anywhere.

22 MR. BETANCOURT: Well the slave --

23 MEMBER STETKAR: No. I'm trying to say
24 that if the staff is making specifications for
25 things, acceptance criteria, you ought to be precise

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1 and I ought to know what your expectations are.

2 MR. BETANCOURT: Okay.

3 MEMBER BROWN: John, I am just now key
4 wording it and I have found three references.
5 Master-slave protocols --

6 MEMBER STETKAR: Sure.

7 MEMBER BROWN: -- inlays and it is one
8 of the acronyms.

9 MEMBER STETKAR: In their discussion of
10 the analog analogy they use that phrase.

11 MEMBER BROWN: Well no, it's under the
12 communication engine part.

13 MR. BETANCOURT: The protocol that they
14 use is a master-slave configuration. That is what
15 we meant about the slave model.

16 MEMBER STETKAR: Just make sure somebody
17 understands what that is.

18 MEMBER BROWN: We will get it with the
19 request package from the master as a unique
20 identifier of the slave. When it is received, it is
21 only the slave that corresponds, blah, blah, blah.

22 MR. HECHT: Well that is for a bus
23 master.

24 MEMBER BROWN: Well, bus master, all I
25 am saying is it is a bus master but there is a slave

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1 inside. There is one in each end that you have got
2 to communicate between.

3 MR. HECHT: I guess that kind of
4 reinforces John's point because a slave module and
5 master is a slave protocol is different than a slave
6 module whether it is Division A and Division B.

7 MEMBER STETKAR: Other places just to
8 not -- there is going to be a long discussion in the
9 proprietary stuff.

10 I found a lot of duplication in the
11 ASAI's, 62 and 63, 19 and 56, 22 and 52, 32 and 25,
12 33 and 54, 43 and 45. So, it is -- clean it up,
13 please.

14 MR. BETANCOURT: I cannot ask why we
15 have some of them like duplicates. The reason is
16 when we received the topical report the Revision 0
17 and Revision 1, the applicant they proposed to say a
18 size and the way that -- hold on. Let me finish.
19 So the way that they actually set it up was more on
20 the class by class compliance with the 603 7-4.3.2.
21 So that is the reason that you see that some of them
22 are duplicates, even though they mean the same. The
23 whole idea is to show like there will be an ASAI to
24 a specific bus, to the 603 7-4.3.2 and so on.

25 CHAIRMAN CORRADINI: I didn't understand

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1 that. So, it was consciously duplicated why?

2 MR. BETANCOURT: The reason is that the
3 way that the applicant proposed the ASAI's was a
4 class by class on 603 7-4.3.2, I-04 and the SRM.

5 So some of the ASAI may be the same,
6 even though like they are specific to a specific
7 class to the standard requirement. So I can see why
8 he was confused on that.

9 MR. TANEJA: Yes, like IEEE 7-4.3.2 is a
10 daughter standard to IEEE 603. So the 7-4.3.2
11 addresses the digital side of the protection system
12 that is described in 603. So there may be
13 overlapping statements in these two standards. So
14 the application-specific action items are addressing
15 how to meet a certain criteria or clause of 603 or
16 clause of 7-4.3.2, or clause of our ISG on
17 communications. So there may be overlaps but it is
18 like I do this to meet this clause, do this to meet
19 this clause, do this meet this clause.

20 MEMBER STETKAR: So if I am an applicant
21 now, I have to address each one of those and it
22 costs me money to do that, even if I have to say go
23 see this other thing. You say well, that wasn't
24 quite what we intended by that. Why do you make me
25 say the same things two or three times?

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1 MR. TABATABAI: We are trying to take
2 care of that in the BSRS as much as we can.

3 CHAIRMAN CORRADINI: John, do you have
4 other things?

5 MEMBER STETKAR: No, I don't.

6 CHAIRMAN CORRADINI: Okay, let's keep on
7 going.

8 MR. HECHT: I have a question about
9 things which what is in the ASAI's and what is
10 general, and what might fall through the cracks as a
11 result.

12 There are some general questions related
13 particularly to the communications bus and to the
14 application -- and to the specifics of the
15 implementation of general purpose FPGAs and those
16 are primarily related to communications. I can
17 understand an applicant not wanting to get into the
18 details of the implementation of the RS-422
19 protocols or their protocol engine or a number of
20 other things which are common across all modules but
21 you are not asking for that information here. How
22 do you get to those architectural basic level
23 quality assurance issues and all of the things that
24 one might normally expect in Reg Guide 1.152, 1.168,
25 1.17, et cetera?

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1 MR. TANEJA: So the QAs we have the
2 ASAIs specifically for the development life cycle
3 activities, which these reg guides pertain to and we
4 expect the user of this platform to address those in
5 their application for whether it is a design
6 certification or a license amendment to explain how
7 they are going to meet that life cycle development
8 process, whether they are meeting and how they are
9 complying with these.

10 MR. HECHT: But the developer isn't
11 going to be developing the communication bus FPGAs.

12 MR. TANEJA: The FPGAs are going to be
13 developed -- oh the communication protocol is very
14 specific to the architecture.

15 MR. HECHT: Is specific to the what?

16 MR. TANEJA: This prototype or this
17 platform, it is unique to this platform design, how
18 the communication protocol works. The physical area
19 is RS-422 but the communication protocol, which I
20 expect NuScale to cover in the proprietary portion
21 of the meeting, is proprietary to the design, how
22 that works.

23 MR. HECHT: Okay. That was my
24 understanding. So you expect that communication
25 protocol to be used in every NuScale control system.

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1 MR. TANEJA: Well, any application,
2 whether it is NuScale or anybody. Right.

3 MR. HECHT: Well so my question is
4 shouldn't that be part of the evaluation of the
5 platform, as opposed to being an evaluation of the
6 application or why wasn't it?

7 MR. TANEJA: It was part of the platform
8 evaluation.

9 MR. HECHT: Well, is the quality
10 assurance part of the platform?

11 MR. BETANCOURT: No. What we have over
12 here -- well, let me tell you why it was not covered
13 over here.

14 In the past, the platforms that we have
15 received in the NRC, they have already been built.
16 So in the case of NuScale, they are building this
17 platform scratch. It is still on paper. It is
18 still a design. So in the past what we have done is
19 a commercial grade application review and we look
20 upon the QA process, the secure development process
21 and so on.

22 In this case, it hasn't been built so we
23 have an ASAI for any -- right now NuScale may decide
24 to use Ultra (phonetic), may decide to follow a
25 different vendor. So what they have is a set of

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1 requirements and specs that it can give to any
2 single vendor and they can tell them build me this
3 design in accordance with Appendix B. So that is
4 the reason that we have that ASAI.

5 MR. HECHT: So, if Plant A has this
6 communication protocol and Plant B has this
7 communication protocol, you would expect both of
8 them to send you the same information on how the
9 architectural and foundation features of this
10 NuScale design are implemented, even though they are
11 common?

12 MR. TANEJA: Well, see one is a
13 requirement specification and then you know the reg
14 guides that you are referring to, those are really
15 the life cycle activities that you must perform in
16 order to develop an architecture.

17 Even the fabrication of the equipment
18 has to follow a QA process of Appendix B. So if I
19 am looking at a requirement spec, the requirement
20 spec requires the vendor to build a system in
21 accordance with the RQA program or whatever the QA
22 programs that are stipulated in the purchase order.

23 So the ASAI's are asking the user of this
24 topical report to impose the QA requirements on the
25 system that they would be buying to build this

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1 architecture.

2 MR. HECHT: I don't think we are closing
3 on this question but I don't want to take too much
4 time on it.

5 MR. TANEJA: Okay, fair enough.

6 CHAIRMAN CORRADINI: All right.

7 MEMBER STETKAR: I've got one more.

8 MEMBER BROWN: John, before you go, can
9 I amplify Myron's a minute on the QA piece?

10 MEMBER STETKAR: Sure, sorry.

11 MEMBER BROWN: I guess what I was trying
12 to get out of this interchange is right now NuScale,
13 they have got their plant design and they have
14 proposed an architecture for the integrated
15 protection system.

16 MR. TANEJA: Correct.

17 MEMBER BROWN: Well, a part of an
18 architecture. It is a proposed implementation in
19 terms of components, et cetera. It is a platform,
20 as you say.

21 You did not address the ideas, as Myron
22 pointed out, QA, SDOE, all that stuff that you grind
23 through, making sure that you have got a consistent
24 product when you come out, and it makes sense and it
25 is protected. They don't have to go what is it,

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1 Rock Creek, who is building this. This topical
2 report could go to somebody else.

3 MR. TANEJA: That's correct.

4 MEMBER BROWN: And I think that is, in a
5 way, you want to end up with the same consistent
6 quality --

7 MR. TANEJA: Exactly.

8 MEMBER BROWN: -- and product but yet,
9 there was nothing in the SER explicitly talking
10 about how you -- you are expecting that to come with
11 all the other reg guides and rules that we have?

12 MR. BETANCOURT: Well, any use of this
13 platform, they have to come back to us at the NRC.
14 It is a part of our license amendment requirements
15 or a DC application.

16 In the case of NuScale --

17 MEMBER BROWN: You said you have a DC
18 application now.

19 MR. BETANCOURT: Right. In this
20 application, NuScale is already addressing that and
21 they are going to be building the platform in
22 accordance with Appendix B.

23 Any operating power plant or any new
24 reactors they can reference we want to use this
25 platform but they have to address that as a specific

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1 item in the QA program. They have to develop in
2 accordance to the requirements that have already
3 been specified.

4 MEMBER BROWN: Okay so that will
5 springboard into the requirements that you all
6 talked about and imposed on other applicants.

7 MR. BETANCOURT: Right and we will be
8 able to review that when it comes in-house.

9 MEMBER BROWN: Okay, I agree. I have
10 got my answer here. We will move on. Is that okay,
11 Mike?

12 CHAIRMAN CORRADINI: Yes, I'm just
13 listening.

14 MEMBER BROWN: Yes, I want to get on.

15 MR. BETANCOURT: I think you had a
16 question before we move on.

17 MEMBER BROWN: Oh, John, I'm sorry.

18 MEMBER STETKAR: There is this Section
19 3.8.2.4 of the SER. There is a discussion of
20 Section 2 digital I&C Interim Staff Guidance 04, in
21 particular on command prioritization.

22 And in several subsections under there,
23 parts of the discussion, there are statements like
24 the following. This happens to be a quote from one
25 of them: The staff agrees that an evaluation of

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1 point 4 is not applicable because all priority logic
2 capability within the HIPS platform is performed by
3 discrete logic components, i.e., analog technology.
4 Therefore, this SE does not address the evaluation
5 against point 4 of staff position 2. There are, I
6 don't know, three, four, five of those.

7 Okay, where does the staff address those
8 functional requirements for command prioritization
9 in their review of either this platform or some
10 application-specific implementation of this
11 platform? Because this says well, we are not
12 addressing that because it is not software related
13 somehow.

14 MR. TANEJA: Yes, this evaluation was
15 specifically against the ISG-04. The ISG-04 was the
16 set of points in there are dealing digital data
17 communication.

18 MEMBER STETKAR: Software-based?

19 MR. TANEJA: Software-based digital data
20 communication. So in the HIPS platform, the
21 priority logic is discrete. It does not use any
22 software whatsoever.

23 MEMBER STETKAR: I understand that.

24 MR. TANEJA: So that is why it was the
25 evaluation was not relevant to these areas of the

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1 ISG-04.

2 MEMBER STETKAR: Where does the staff
3 review the hardware implemented priority in this
4 platform and have assurance that, indeed, it is
5 implemented fine or specified fine? And the staff
6 does that and when is it done?

7 MR. BETANCOURT: As you just mentioned,
8 this point was specific to software-based system and
9 the -- hear me out. Hear me out.

10 MEMBER STETKAR: Okay.

11 MR. BETANCOURT: At the APL, which is
12 the activation priority logic, the applicant has
13 made a statement about the priority logic that they
14 will use to implement. All of the activation logic
15 it will be having the highest priority, followed by
16 the manual actuation actions. That will also be on
17 ASAI. If I recall very well, we are going to be
18 reviewing that aspect.

19 MEMBER STETKAR: I didn't get the last
20 part of that.

21 MR. BETANCOURT: I think there will be
22 an ASAI on that but I have to --

23 MEMBER STETKAR: I couldn't find one,
24 which is the reason why I kind of asked this because
25 it strikes me that you are saying you are not

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1 reviewing specific aspects of this proposed design
2 because oh, they are not software-implemented
3 aspects. And I couldn't find any places where you
4 were reviewing aspects of the design that are
5 hardware-implemented aspects.

6 MR. BETANCOURT: Okay, we will take it
7 back.

8 MEMBER STETKAR: In particular, under
9 these parts, that ISG-04 priority --

10 MR. BETANCOURT: I understand. We will
11 take it back.

12 MEMBER BLEY: Think about this one in
13 general, not just this specific case. Because when
14 you go through and X things out because they don't
15 fit what you designed it for, the functional concept
16 that was there needs to be picked up somewhere.
17 This should just be an example.

18 MEMBER STETKAR: See, if I read that --
19 for example, if I turn off this notion of software
20 and hardware, in the ISG under Command
21 Prioritization sub-item 2 says priority modules used
22 for diverse actuation signals should be independent
23 of the remainder of the digital system and should
24 function properly, regardless of the state or
25 condition of the digital system. If these

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1 recommendations are not satisfied, the applicant
2 should show how the diverse actuation requirements
3 are met.

4 It doesn't say anything about software
5 there. It just says priority modules. And you say
6 well, you don't have to review that here because
7 that function is not implemented via software, that
8 priority module function.

9 And I think what we are saying is
10 somewhere there ought to be assurance that someone
11 in a staff review, whether it is at the topical
12 report for the platform, which to my mind seems --
13 setting what that priority logic is, what is more
14 important than A or B is clearly an application-
15 specific function. You know what gets higher
16 priority than another.

17 But the way that that logic is
18 implemented seems to be a platform review issue.

19 MR. TANEJA: We did review it and we
20 have a very good understanding of it. We will make
21 sure that we go back and see where we documented it
22 in our safety evaluation.

23 MEMBER STETKAR: Okay.

24 MR. TANEJA: Okay?

25 MEMBER STETKAR: Okay.

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1 MR. TANEJA: So, we will go back and
2 take a look at it.

3 MEMBER STETKAR: Thanks.

4 CHAIRMAN CORRADINI: Any more questions
5 before we move on?

6 MEMBER STETKAR: No, I didn't. That was
7 it.

8 CHAIRMAN CORRADINI: Why don't you guys
9 go ahead, then?

10 MR. BETANCOURT: Okay, let's move on to
11 the next slide.

12 MEMBER BROWN: Luis, would you be a
13 little careful? You are kind of --

14 MR. BETANCOURT: Yes, I know. It is
15 kind of sensitive.

16 MEMBER BROWN: You are going to snap his
17 eardrums out if you are not careful.

18 MR. BETANCOURT: Sorry for that.

19 So let's move on to the topics of
20 independence. We were able to review the design
21 table so the platform that we were able to confirm
22 that the platform independent features that provide
23 the capability to implement the system designs that
24 can satisfy the systems independence requirements.

25 So evaluation was focused in these four

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1 areas that you see on the screen on the physical,
2 electrical, communication, and function
3 independence.

4 Any questions on this topic?

5 CHAIRMAN CORRADINI: This is where I am
6 confused. I am trying to figure out what action
7 that -- so, this is just me who is trying to
8 understand what action the committee is going to
9 take on this, given the number of ASAs that are
10 listed at this point in time.

11 What you are kind of saying is things
12 look okay, assuming they satisfy 65 things. How
13 does one come to a conclusion for a letter back to
14 the staff and informs the applicant that can't say
15 anything more than as long as you satisfy 65
16 additional things, we are kind of okay? I'm
17 struggling.

18 MR. TANEJA: Well you know this is an
19 interesting one. I don't think there has ever been
20 a topical on a digital platform in front of the
21 ACRS. I think this is the first one that we are
22 doing.

23 CHAIRMAN CORRADINI: Because?

24 MR. TANEJA: I don't know.

25 CHAIRMAN CORRADINI: Because they are

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1 already pre-built and you just have to qualify them
2 from a QA standpoint?

3 MR. TANEJA: You know because those are
4 topicals and they are not licensing actions. So
5 since this is really, at this moment, it is not a
6 licensing action unless I have an applicant that
7 refers to this topical in their application, whether
8 it is for design certification or license amendment
9 request.

10 So when we come back with the NuScale
11 review, that is where they are referring to this
12 topical report and they are addressing all of the
13 ASAIIs in there. And that is when we will get into
14 the details of the regulatory compliance and all the
15 safety features and how they are implemented.

16 MR. BETANCOURT: Right because the
17 finding that we are making is only at the platform
18 level but we still need to complete a story on how
19 the platform interacts with the system.

20 CHAIRMAN CORRADINI: Okay. So, I wrote
21 down -- I had a feeling you were going to go this
22 way. So I wrote down the plant protection or the
23 HIPS or whatever this thing is called is a box that
24 you are trying to decide if the box satisfactorily
25 fits into the architecture.

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1 MR. BETANCOURT: Correct.

2 CHAIRMAN CORRADINI: Okay. So if that
3 is the case, other than this as being informational
4 for the members, is that all it is? It strikes me
5 as we are a bit early in the game to write anything
6 with a conclusion if it is strictly they are
7 building a box and the box has got to fit into a
8 bigger box and it looks okay; but until we see how
9 the box fits -- connects to the bigger box, there
10 can be no conclusion.

11 MR. BETANCOURT: Right and that is the
12 reason that we were basically saying like the
13 platform -- if we have an applicant, a licensee that
14 uses this platform, we believe that this that is why
15 we used the wording it first complies with the
16 regulations.

17 CHAIRMAN CORRADINI: Okay, fine.

18 MEMBER STETKAR: Just for the record, at
19 least I haven't tracked down whether it came to the
20 full committee but I know that the US-APWR, the
21 subcommittee -- I am trying to read at the same time
22 I talk and I don't do that well -- did review the
23 topical report on digital I&C and, in fact, the ACRS
24 wrote a letter on June 25, 2009 at least on the
25 Diversity and Defense-in-Depth aspects.

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1 MR. TANEJA: Was it topical or
2 technical?

3 MEMBER STETKAR: It was a topical
4 report. We wouldn't write a letter on a technical
5 report. The June 25, 2009 letter is Safety
6 Evaluation for Mitsubishi Heavy Industry's Topical
7 Report MUAP-07006-P Revision 2, Defense-in-Depth and
8 Diversity Related to US-APWR but we discussed the
9 whole platform.

10 MR. TANEJA: Yes, what happened in that
11 case --

12 MEMBER STETKAR: So just it has come
13 before us in the past.

14 MR. TANEJA: -- so that applicant
15 changed that technical topical report into a
16 technical report for their design.

17 MEMBER BROWN: This really isn't worth
18 our committee time.

19 CHAIRMAN CORRADINI: All right but I
20 just wanted to make sure I was understanding where
21 it would fit in.

22 MEMBER BROWN: Yes, my understanding of
23 what they were trying to show, to do with this, is
24 NuScale has proposed a design and a set of digital
25 components set up in a certain configuration that,

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1 if connected properly, would be capable of
2 demonstrating the fundamentals and the other design
3 aspects, in terms of communications or stuff -- a
4 bunch of stuff we don't need. We have no idea what
5 networks are going to be in this plant, how you are
6 going to connect in and out.

7 We can talk about the memory that they
8 have and if it is not accessible, then we can make
9 sure -- we can say hey, it can be covered. But we
10 don't see it until we have seen it.

11 CHAIRMAN CORRADINI: Okay.

12 MEMBER BROWN: How they connect the
13 other stuff into this platform and everything else
14 is not defined in this. This just shows how you get
15 four separation groups into two divisions of trips
16 and will they trip or not.

17 MEMBER STETKAR: I find it easier to
18 think of this as NuScale has not proposed this
19 topical report. Rock Creek has proposed it and it
20 might be used in the NuScale application.

21 MEMBER BROWN: That is one way of
22 looking at.

23 MEMBER STETKAR: That is one way of
24 thinking about it.

25 MEMBER BROWN: Yes, that is one way of

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1 looking at it.

2 MEMBER STETKAR: Is the proposed design
3 by Joe's Electronics, if you will -- seriously, it
4 is a way of thinking about this disjoint between
5 ASAI's and looking at the platform itself being
6 proposed by a vendor, which could be used in
7 NuScale. It could be used in a Westinghouse plant.

8 CHAIRMAN CORRADINI: Oh, that I
9 understand. I just want to understand the
10 connection to the architecture and I think I have
11 got it. So keep on going.

12 MEMBER BROWN: Oh, and from the time I
13 got here in 2008, I can't remember reviewing a
14 topical report of this nature for any of the -- I
15 understand the point about the diversity, that one
16 aspect that we talked about on the US-APWR but we
17 didn't do that on the other projects that I have
18 looked at. We did the DCD and we used the technical
19 spec or the technical report or a topical report to
20 look at to make sure we could understand how it
21 operated. That is the way I have done it in the
22 past.

23 MR. BETANCOURT: Okay, before I move on
24 on this slide, do you have any questions on
25 independence?

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1 MEMBER BROWN: We will have to take your
2 word for it.

3 MR. BETANCOURT: Okay, let's move on.

4 CHAIRMAN CORRADINI: That's very unlike
5 us but keep on going.

6 MR. BETANCOURT: Okay, in the

7 MEMBER BROWN: Okay in area of
8 redundancy, we were able to confirm that the
9 proposed design exhibits redundancy in the areas of
10 power supply, safety function module, communication
11 redundancy, equipment interface and at the platform
12 level.

13 So all of these redundancies affected to
14 result in a highly reliable system.

15 MEMBER KIRCHNER: Let me ask a question
16 now because I'm following your slides and the
17 NuScale slides. So what you are saying is that all
18 the bullets that are in the NuScale, which is
19 extracted from the topical report, you have checked
20 all those and you agree with all of those.

21 MR. BETANCOURT: Yes. Yes, and there is
22 already areas that we spend our time --

23 MEMBER KIRCHNER: These are the backup
24 slides.

25 MR. BETANCOURT: Okay, yes.

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1 MEMBER KIRCHNER: Okay.

2 MEMBER BROWN: Go on.

3 MR. BETANCOURT: Okay, so I guess I am
4 now going to turn it to Dawnmathew Kalathiveettil on
5 the remainder of the presentation.

6 MEMBER BROWN: Now before he says
7 anything, this is a different picture than you are
8 going to see later. This is just a functional
9 depiction, not box depiction of their proposed
10 system. You don't see an SBM and you don't see an
11 SVM. I can tell you where the SVM is. I can't tell
12 you where the SBM --

13 CHAIRMAN CORRADINI: I don't want to
14 know right now.

15 MEMBER BROWN: You don't want to know.
16 I am just telling you this is a functional depiction
17 of what this system is supposed to look like.

18 You have got the four groups, separation
19 groups, breaking down into two divisions of voting.
20 That's all you are seeing. That is the limits of
21 its intelligence.

22 MR. KALATHIVEETTIL: Okay, good
23 afternoon, everyone. My name is Dawnmathew
24 Kalathiveettil and I will be continuing --

25 CHAIRMAN CORRADINI: You have got to say

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1 that slower. I --

2 MR. KALATHIVEETTIL: Slower?

3 CHAIRMAN CORRADINI: You guys speed up
4 from person to person.

5 MR. KALATHIVEETTIL: It is
6 Kalathiveettil.

7 CHAIRMAN CORRADINI: Okay.

8 MR. BETANCOURT: It is a long name and a
9 long last name.

10 MR. KALATHIVEETTIL: All right, so
11 moving on with diversity of the HIPS platform. So
12 the HIPS platform basically uses two diverse FPGA
13 technologies to achieve equipment diversity.

14 The example in the topical report, the
15 four separation group, protection system is based on
16 using one FPGA technology with two of the separation
17 groups and a number of kind FPGA technology with the
18 other two separation groups. This is shown as
19 yellow and red from the figure.

20 In such an arrangement, additional CCF
21 associated with one FPGA technology would not defeat
22 the safety function, since you still have two
23 separation groups which remain unaffected. And
24 because of the diversity, the unaffected separation
25 groups will be able to accomplish the safety

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1 function.

2 Along with the equivalent diversity,
3 there is also associated shift design diversity
4 because vendors use different development tools to
5 actually make the final configured FPGAs and also
6 the HIPS platform provides functional diversity with
7 the use of different protection logic on the SFMs
8 associated with each safety function or safety
9 function group.

10 All right, so this table here basically
11 tries to explain the built-in diversity of the HIPS
12 platform. The first event you see is a regular
13 transient accident situation with no CCF at all.
14 And in that situation, you have all four separation
15 groups modules, the SFM, CM, and EIMs all being
16 available to do their particular safety function.

17 Case 1 we see that there is --

18 MEMBER SKILLMAN: Excuse me, sir. When
19 you say available, that word connotes the device is
20 powered, it is actuated, it is waiting for a signal
21 and it is going to produce the correct signal at the
22 right point in time. Is that what you were
23 communicating when you say it is ready?

24 MR. KALATHIVEETTIL: Yes, it's
25 available.

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1 MEMBER SKILLMAN: It is going to do what
2 it is supposed to do?

3 MR. KALATHIVEETTIL: Right, that's what
4 it means.

5 MEMBER SKILLMAN: Okay.

6 MR. KALATHIVEETTIL: So Case 2 is where,
7 as you can see, there is additional CCF associated
8 with the FPGA of the SFMs of separation groups A and
9 C. But here we are crediting equipment diversity
10 and module functional diversity because of the CM
11 and EIM of separation groups A and C are still
12 available, just as all the key modules of B and D
13 are available.

14 And the last case scenario in Case 2 is
15 one where we are assuming that a CCF has taken out
16 the FPGA technology associated with A and C. So all
17 three modules are not available for the safety
18 functions. However, you still have separation
19 groups B and D, which can actually accomplish the
20 safety function because the FPGA is not affected by
21 the same CCF.

22 Any questions?

23 MEMBER KIRCHNER: So B and D have the
24 different field programmable beta rays?

25 MR. KALATHIVEETTIL: Yes.

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1 MEMBER KIRCHNER: Okay, just checking.

2 MR. HECHT: What do you mean by
3 functional diversity?

4 MR. TANEJA: Let me elaborate on this
5 one. Typically, when we see a CPU-based digital
6 platform, you have input boards with multiple input
7 capabilities and then you have a CPU board which
8 takes the information and does a processing and then
9 you have the output boards that output the output to
10 an actuated device.

11 In their design, the safety function
12 module is dedicated to a specific function. So each
13 module can only accept four -- it has four input
14 sub-modules on them. So, it can accept four inputs.

15 So, there the design is essentially like
16 if you are familiar with the old Westinghouse 7300
17 cabinets, where they had an input module which was
18 essentially like a driver card that took in an
19 analog input and then you went into a scaling, which
20 kind of scaled that into a different analog circle
21 and went into a bistable module.

22 So their design is, essentially, the
23 application of that scheme. So the functional
24 diversity is that each SFM is only designated to a
25 one given function.

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1 For example, for the NuScale, I think we
2 are dealing with 22 safety functions. So there
3 would be 22 separate safety function modules.

4 So I can lose a safety function module
5 so I will lose that particular parameter. Let's say
6 that is dealing with a pressurizer pressure. But I
7 might be able to achieve a safety function using
8 other plant parameters, which are running on a
9 separate safety function module. So I have not lost
10 the capability other than that specific one.

11 So in comparison to a digital system,
12 where my analog input board goes, I may lose 20
13 inputs or 40 inputs, depending on how they are
14 designed. And then I will lose like a whole
15 division capability.

16 Here, that functional diversity allows
17 me to lose maybe a subset of a function but I have
18 other means within that separation group to achieve
19 the same, I guess -- I don't want to say the same
20 safety function but the intended consequences are
21 dealing with that event.

22 MR. HECHT: Is the platform that we are
23 talking about here, does it require such functional
24 diversity? I used to call it analog -- I mean well
25 some kind of redundancy, functional redundancy. You

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1 are basically saying that you are using different
2 sensors to get the same trip signal. Right?

3 MR. TANEJA: You are getting different
4 plant process parameter to decipher same plant upset
5 or transient condition, let's say. So you are using
6 the level and the pressurizer pressure may be two
7 separate ways of looking at this.

8 MR. HECHT: The term that I was looking
9 for was analytical redundancy.

10 MR. TANEJA: Exactly.

11 MR. HECHT: So, is that required in the
12 design or are you just positing it here for the
13 purposes of this example?

14 MR. TANEJA: The example. This is an
15 example and I think that is going to be an
16 application-specific action item where the user of
17 this platform has to show how they allocated
18 different safety functions to various different
19 inputs to achieve that feature.

20 MEMBER BLEY: Myron, in more general not
21 in terms of just I&C. We have always protected
22 against key accidents in multiple ways. So there is
23 a design principle.

24 MR. HECHT: Yes, I get that. That is
25 D3. But I --

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1 MEMBER BROWN: Before there was a D3.

2 MR. HECHT: Okay.

3 MEMBER STETKAR: Well before we labeled
4 it.

5 MR. HECHT: Okay. So is this an
6 implicit or explicit requirement that there be this
7 functional diversity as part of this platform?

8 MR. TANEJA: Well you know I guess I
9 would say it is additional level of defense-in-depth
10 by having that capability because you do have B and
11 D on a different FPGA platform, which are not
12 susceptible to a common cause failure, which would
13 result in maybe only losing in two out of the four
14 separation groups.

15 So the redundancy, you know you would
16 have these same functions available to you on the
17 redundant set also.

18 So it is just a level of defense-in-
19 depth. I think that is what we are achieving by
20 this purpose. It is not that -- I could, you know
21 like in Case 2, I could lose A and C but I still
22 achieve my functions.

23 MR. HECHT: Right. Well, I guess that
24 case is kind of application-specific as to whether
25 you have that middle case there.

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1 MR. TANEJA: Right, exactly.

2 MR. HECHT: So it is not always there.

3 MR. TANEJA: You know the platform is
4 flexible enough to be able to do that and a good
5 designer should use these capabilities, I would say.

6 MEMBER BROWN: I would suggest that we
7 move on but this will be examined in more detail
8 whenever we get an actual plant architecture
9 presented to us.

10 And I suspect -- you said something
11 about all and just one observation. I know there is
12 four processing plant parameter processings for each
13 safety function module.

14 MR. KALATHIVEETTIL: Right.

15 MEMBER BROWN: I presume they would not
16 put all four pressure signals onto one safety
17 function module. That would defeat your purpose.

18 Well, somebody may not have heard that.
19 I thought I heard that being stated here a minute
20 ago. All right, go on.

21 MR. TANEJA: So the allocation of that
22 has to be design.

23 MEMBER BROWN: I got it. Let's go on.

24 MR. KALATHIVEETTIL: Predictability and
25 repeatability. The staff evaluated how data is

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1 communicated in the HIPS platform and the response
2 time characteristics of the system. The HIPS
3 platform is FPGA-based design and does not use
4 interrupts.

5 The staff reviewed that the HIPS
6 platform operates on fixed cycles, where a
7 deterministic sequence of: 1) acquiring inputs; 2)
8 performing logic operations such as comparing a
9 process variable against a trip set point to
10 determine the partial trip status; and 3) generating
11 output signals as followed without the use of any
12 interrupts.

13 The staff basically finds that the
14 platform conforms to 10 CFR 50.55a(h), specifically
15 IEEE Standard 603-1991, Clause 4, Clause 5.2 and
16 Clause 5.5.

17 MR. BETANCOURT: I would like to make a
18 note that even though this might be single data path
19 flow, NuScale is going to go into a lot of detail in
20 the proprietary information on this topic.

21 This only shows like the scope of our
22 review that we are excluding the fuel sensors and
23 the fuel components. But from the inputs module,
24 all the way to the EIM, that was the scope of our
25 review.

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1 MR. KALATHIVEETTIL: We are showing as
2 the boundary.

3 MEMBER BROWN: Okay.

4 MR. KALATHIVEETTIL: Calculation testing
5 and diagnostic capabilities, Section 8 of the
6 topical report describes the diagnostics and
7 maintenance features provided by the platform and
8 directly addresses IEEE Standard 603-991, Clause
9 5.7.

10 The platform features detect and monitor
11 the system's performance during operation and to
12 initiate alarms if the system fails to perform
13 deterministically and within the required time.

14 The platform uses cycling redundancy
15 check to ensure that for data communication
16 integrity. In addition, the staff also determined
17 that the self-testing features of the modules do not
18 affect the ability of any module to perform its
19 safety function.

20 CHAIRMAN CORRADINI: Any questions?

21 MR. KALATHIVEETTIL: For regulatory
22 conformance, the staff finds that the HIPS platform
23 meets the applicable regulatory requirements
24 associated with the fundamental design principles.
25 As said, earlier, there are 65 ASAs and out of

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1 those, 55 were proposed by the applicant and the
2 staff added an additional 10 to the list.

3 Those 65 ASAI's provided in Table 4-1
4 must be performed when requesting the NRC's approval
5 of the HIPS platform for safety-related applications
6 at nuclear power plants.

7 Any other questions?

8 CHAIRMAN CORRADINI: Any other questions
9 by the committee?

10 Going once --

11 MEMBER BROWN: We're done.

12 MR. BETANCOURT: Okay, thank you.

13 CHAIRMAN CORRADINI: Okay. So we are
14 going to be going into a closed portion.

15 So before we do that, why don't we see
16 if there are members of the public that have
17 comments on this portion.

18 So, can we -- is there anybody in the
19 room that wants to make a comment? Otherwise, can
20 we please turn on the mike for members of the public
21 on the phone line.

22 Okay, anybody in the room? No.

23 Is anybody on the phone line from
24 members of the public want to make a comment?

25 MR. LEWIS: Marvin Lewis, member of the

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1 public.

2 CHAIRMAN CORRADINI: Marvin, Happy New
3 Year.

4 MR. LEWIS: Thank you, same to you.

5 CHAIRMAN CORRADINI: Any comments you
6 make, Marvin?

7 MR. LEWIS: Yes, just a small one. It
8 appears that some very simple things haven't been
9 coordinated just like knowing definitions but I
10 always get in my lane abbreviations are used like a
11 garden. And I find that us that are listening in
12 from the public that you have got to get things
13 hammered down before the meeting or at least
14 introduce those terms for people who are on the
15 line.

16 CHAIRMAN CORRADINI: Marvin, you are
17 fading on us. So you seem to be pulling away from
18 your phone or something.

19 So, get closer to your phone. Don't
20 scream but move closer because you are fading on us.
21 We lose every other word.

22 MR. LEWIS: I am getting some of the
23 same thing on this side.

24 All right, just define your
25 abbreviations, please. Thank you. Bye.

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1 CHAIRMAN CORRADINI: Okay, anybody else
2 on the public line?

3 Okay, not hearing any, could you please
4 close the public line and we will now check the room
5 and go into closed session.

6 (Whereupon, the above-entitled matter
7 went off the record at 2:26 p.m.)

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United States Nuclear Regulatory Commission

Protecting People and the Environment

Design of the Highly Integrated Protection System Platform

**Presentation to the ACRS
Subcommittee**

February 7, 2017

Agenda

- Background
- Safety Evaluation Scope
- Safety Evaluation Topics
 - Fundamental Design Principles
 - Calibration, Testing, and Diagnostics Capabilities
- Regulatory Conformance

Background - Timeline

Date	Activity
December 2015	Topical Report (TR) 1015-18653-P submitted for review
February 2016	NRC Accepted TR for Review
June 2016	NRC Sent RAIs
July 2016	First Audit at NuScale's Rockville Office
August 2016	NuScale Sent Response to RAIs
November 2016	Revision 1 of TR docketed
January 2017	Draft Safety Evaluation Issued
January 2017	Second Audit at Ultra Electronics (Wimborne, UK)
February 2017	ACRS Subcommittee Meeting
March 2017	Issuance of Final Safety Evaluation

SE Review Scope

- The scope of the review was focused on:
 - Fundamental I&C design principles
 - Calibration, testing, and diagnostics capabilities of the HIPS Platform
- Application-Specific Action Items:
 - Quality Assurance
 - Equipment Qualification
 - Secure Development Process
 - MWS and PS Gateway
 - Human-Machine Interface
 - Displays

Independence

- Physical Independence
- Electrical Independence
- Communications Independence
- Functional Independence

The staff finds that the TR provides information sufficient to support conformance with the independence requirements in RG 1.75, RG 1.152, RG 1.53, and DI&C-ISG-04, or establishes ASAs as necessary to fully comply with the regulatory requirements for an applicant or licensee referencing this SE.

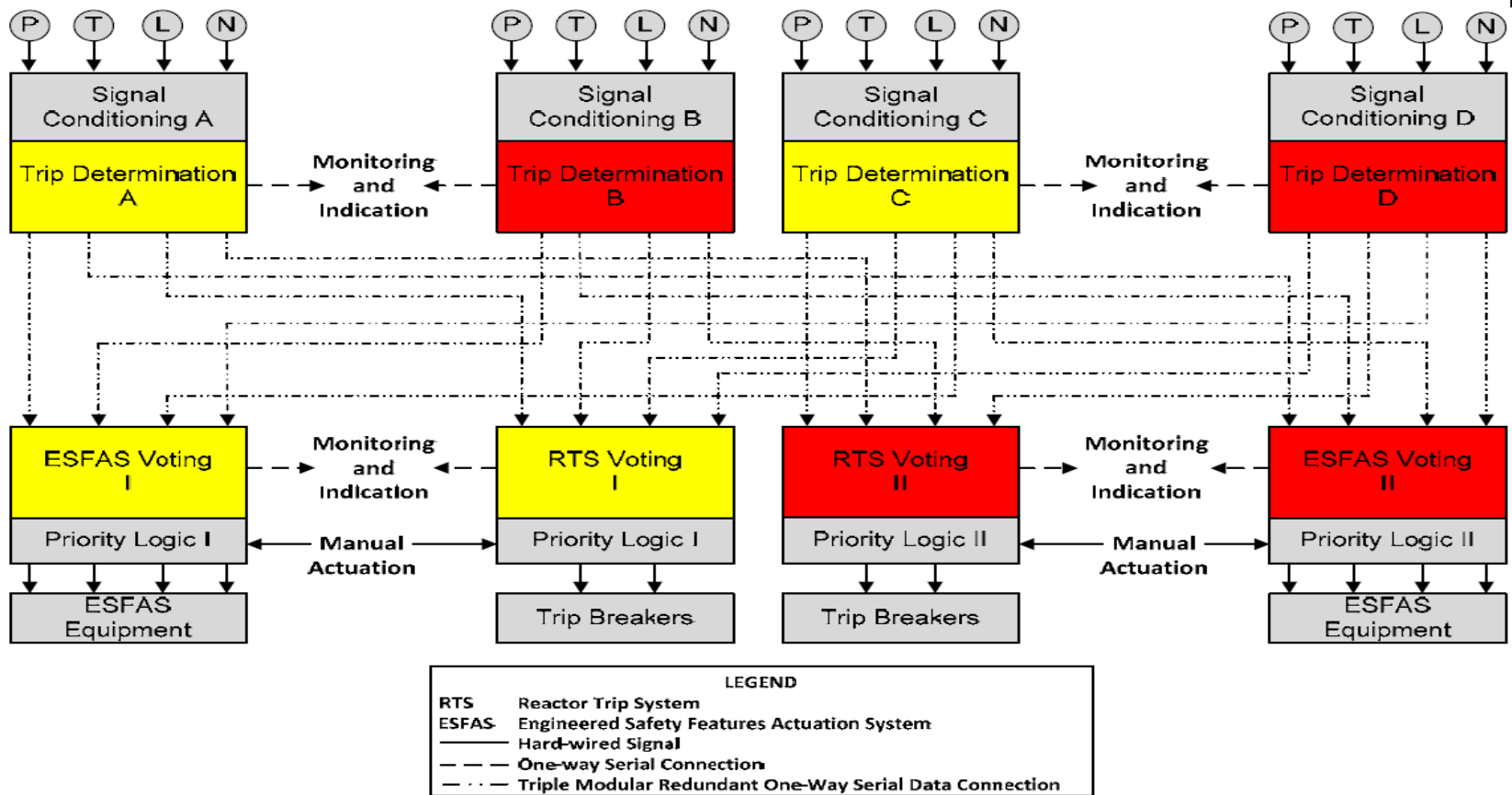
Redundancy

- Power Supply Redundancy
- Safety Module Redundancy
- Communication Redundancy
- Equipment Interface Redundancy
- Platform Redundancy

The staff finds that the TR provides information sufficient to support conformance with the regulatory requirements on the single failure criterion in RG 1.53, or establishes ASAs as necessary to fully comply with the regulatory requirements for an applicant or licensee referencing this SE.

Diversity

FPGA Equipment Diversity Allocation in a Representative Architecture



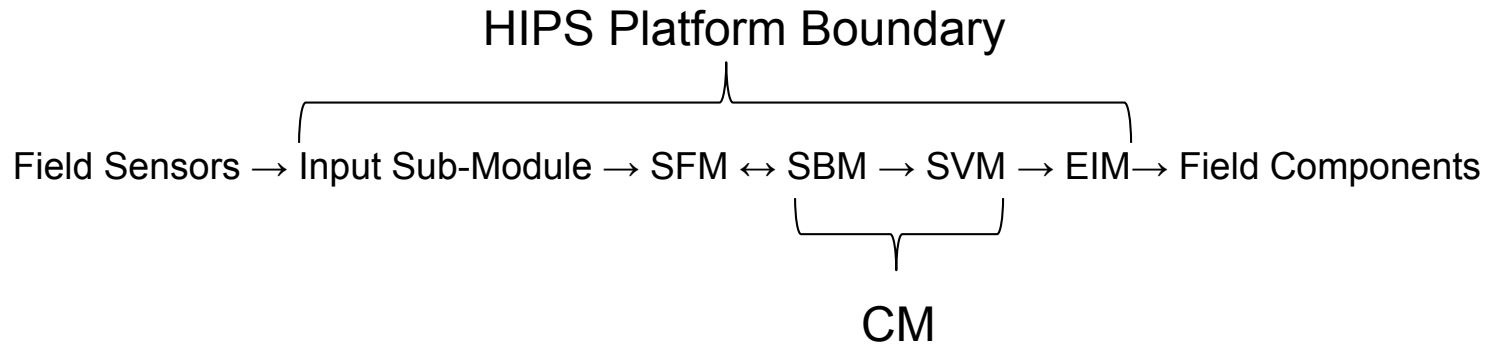
Diversity

Effects of Digital CCF for HIPS Diversity Strategy

Event	Module	A	C	B	D
Transient or accident (no CCF)	SFM	✓	✓	✓	✓
	CM	✓	✓	✓	✓
	EIM	✓	✓	✓	✓
Transient or accident with CCF (Case 1 – equipment (FPGA) and module functional diversity)	SFM	✗	✗	✓	✓
	CM	✓	✓	✓	✓
	EIM	✓	✓	✓	✓
Transient or accident with CCF (Case 2 - equipment (FPGA) diversity)	SFM	✗	✗	✓	✓
	CM	✗	✗	✓	✓
	EIM	✗	✗	✓	✓

Predictability and Repeatability

Typical plant signal data flow path in HIPS platform



Calibration, Testing, and Diagnostics Capabilities

- Section 8, “Calibration, Testing, and Diagnostics,” of the TR describes the diagnostics and maintenance features provided by HIPS platform and directly addresses IEEE Std 603-1991 Clause 5.7.
- These features include the use of BIST, CRC checks, periodic surveillance testing, and other tests in each type of module as appropriate to verify normal operation.



Regulatory Conformance

- The HIPS platform design supports meeting the applicable regulatory requirements associated with the fundamental I&C design principles.
- 65 ASAs have been established to identify criteria that should be addressed by applicants or licensees referencing this SE.

Questions



Acronyms

- ACRS: Advisory Committee on Reactor Safeguards
- ASAI: application-specific action item
- BIST: built-in self-testing
- CCF: common-cause failure
- CM: Communication Module
- CRC: cyclic redundancy checksum
- DC: direct current
- EIM: equipment interface module
- ESFAS: engineering safety features actuation system
- FPGA: field programmable gate array
- HIPS: highly integrated protection system
- I&C: instrumentation and control
- IEEE: Institute of Electrical and Electronics Engineers
- ISM: input sub-module
- MWS: maintenance workstation
- NRC: U.S. Nuclear Regulatory Commission
- PS: protection system
- RAI: request for additional information
- RG: regulatory guide
- RTS: reactor trip system
- SBM: scheduling and bypass module
- SFM: safety function module
- SE: safety evaluation
- SVM: scheduling and voting module
- TR: topical report